

**PROPOSED RESIDENTIAL DEVELOPMENT
at STATION ROAD, LONG SUTTON
LINCOLNSHIRE**

DRAINAGE STATEMENT

**FOR NENE TRANSPORT (LINCS) LTD c/o
Robert Doughty Consultancy Ltd**



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Drainage Statement for Proposed Housing Development at Station Road, Long Sutton, Lincolnshire.

Hall Infrastructure Design Ltd have been engaged by Nene Transport (Lincs) Ltd c/o Robert Doughty Consultancy Ltd to prepare a drainage statement for a proposed residential development at the above site. A proposed site layout drawing, reference 1185-01-SP01 rev A, produced by Robert Doughty Consultancy Ltd has been provided to Hall Infrastructure Design Ltd from which to produce this statement. A topographical survey drawing, reference AS2084/1, produced by Axis Surveys Ltd has also been provided and for the purposes of this report it has been confirmed by the client that they have approval to discharge surface water from the development at agreed values to the existing Anglian Water Services Ltd surface water sewer currently serving the existing transport depot.

This application is for outline planning permission.

This statement details the existing site conditions pre development and the discharges post development.

1. Topography and Site Layout.

The site is situated at land, formerly Nene Transport (Lincs) Ltd depot, to the north west of Station Road as shown on the topographical survey drawing (**doc 1**). The site, which is an existing transport depot and roughly rectangular in shape, has an approximate 73m width and an approximate 150m length totalling 1.033 Hectares. The site is generally level with a few localised undulations. Levels at the north west boundary are in the region of 3.20m ODN and levels at the south east boundary are also in the region of 3.20m ODN with on-site variations between 3.10m ODN and 3.70m ODN. The site is mainly covered in buildings, yard and hardstandings and as such has an existing impermeable area of 0.814 Hectares which equates to 79% as shown on the topographical survey drawing (**doc 1**).

The proposal includes for the construction of an adoptable access road (total area 0.103 Ha) serving a converted block of flats together with 35 new build detached, semi-detached and terraced dwellings (average roof area 55m², total roof area 0.211 Ha which includes a 6% allowance for “development creep”) together with individual domestic curtilage permeable paved driveways (0.195 Ha) all as shown on the schematic concept drainage plan 1602/01 (**doc 2**). The total impermeable area is calculated at 0.509 Ha which equates to 49%.

2. Existing green field conditions.

Existing green field runoff values, calculated in accordance with the H R Wallingford greenfield runoff estimation for sites (**doc 3**) in accordance with DEFRA / Environment Agency Report SC030219 rev E and Interim National Procedure Principle 17, confirm that the existing impermeable area (0.814 Ha) of the site generates a 1 year run off value of 5.0 l/s, 30 year of 5.0 l/s and 100 year of 5.0 l/s. These are all classified as default values.

As the impermeable area of the development site is being removed to enable construction the proposed development therefore represents a **reduction** in impermeable area of 0.305 Ha (37.5%).

3. Infiltration Testing.

Soil Testing has been undertaken for the site by Ground Engineering Ltd in December 2015 and their report reference C13684 (**doc 5**) confirms that the ground has limited infiltration potential (1.12x10⁻⁵ms – 1.55x10⁻⁶ms) and a water table between 2.90m and 4.00m deep.

4. The Design – Surface Water.

In accordance with the House of Commons Written Statement (HCWS161 – 18th December 2014) there is an expectation for SuDS to be incorporated in all residential developments of 10 houses or more (major developments) unless demonstrated to be inappropriate.

Furthermore in accordance with recognised guidance, Part H of the Building Regulations 2010 and National Planning Policy Framework 2012, there is an hierarchy of where surface water should discharge. This hierarchy should be followed where practicable, and is as follows:

- 1) Infiltration
- 2) Watercourse
- 3) Public sewer

Any proposed surface water drainage system will need to be designed to account for the effects of climate change over the lifetime of the development. Based on the recommendations in Paragraph 13 - Table 5 of the Technical Guide to National Planning Policy Framework 2012 (NPPF-TG) the proposed drainage systems should be sized to allow for a 30% increase in rainfall intensity.

The 2014 DEFRA Draft National Standards and Specified Criteria for Sustainable Drainage states that:

‘The drainage system must be designed and constructed so surface water discharged does not adversely impact the water quality of receiving water bodies, both during construction and when operational.’

Based on best practice and EA guidelines it is desirable to incorporate 1 no. water treatment stage within the drainage design for roof water runoff and 2 no. water treatment stages within the drainage design for vehicular surfaces where practicable and subject to the requirements of approving/adopting authorities. Therefore the design of the drainage system should seek to ensure that all runoff complies with these requirements and SUDS features are incorporated into the drainage design to provide pollution reduction.

Addressing each method in turn:

Infiltration

Grass areas and soft landscaping areas incorporating the required SuDS balancing features are proposed in the development totalling 0.524 Ha (51%), as shown on the schematic concept drainage plan 1601/01 (**doc 2**). There are no proposals for any other surface water to discharge by infiltration due to the findings of the Ground Engineering Ltd soil testing report (**doc 5**). It may be possible for some infiltration to be incorporated into the design but this would be minimal and given the low percolation results would mean that infiltration structures would take longer than the permitted 24 hours to drain down to 50% capacity. Whilst this has been taken into account in the Microdrainage calculations (**doc 4**) using the lowest recorded soil percolation test result, 1.55x10⁻⁶ms, the infiltration proposed is to assist the positive drainage system and not as a standalone infiltration system. A standalone system would not comply with the relevant design standards.

Watercourse

The site is situated on the boundary of two SHIDB sub-areas as shown on the SHIDB asset map (**doc 6**).

There are no proposals for any surface water to discharge to watercourse as there are no watercourses in the practical vicinity of the site. The nearest IDB watercourse is approximately 300m south west of the

site outside no. 35 Station Road being the head of the South Holland IDB (area H) drain ref DRN199G0402 as shown on the SHIDB asset map (**doc 6**). It is not considered practicable to achieve a gravity solution to this point.

Public Sewer

Given the site currently discharges to a 525mm diameter Anglian Water surface water sewer immediately outside the site in Station Road public sewer can be used as the primary method of disposal of surface water from the development.

Anglian Water Services Ltd in their pre-planning assessment report ref 00009366 (**doc 7**) have confirmed that subject to receipt of evidence to confirm that infiltration or watercourse options are not practicable then a discharge rate of 5.0 l/s to the existing 525mm diameter surface water sewer will be permitted. The permitted discharge rate of 5.0 l/s is comparable to the green field runoff from the existing site impermeable area (where it a green field). Given the existing site is brownfield and hard paved with an existing impermeable area of 0.814 Ha connected in to the 525mm diameter surface water sewer it would actually be generating flows in the region of 113 l/s based on 50mm/hr rainfall and so a permitted discharge rate of 5.0 l/s represents a significant betterment to the existing surface water sewer network.

Anglian Water Services Ltd's October 2013 requirements with regard to surface water storage are that the preferred method should be an adoptable on-line system with an adopted or Management Company Ltd maintained off-line storage pond being acceptable. Conflicting with this preference – the SUDS Lead Local Flood Authority (LLFA) which, at the time of the development's anticipated construction date, is Lincolnshire County Council, have confirmed at the Lincolnshire LLFA Consultants & Developers Seminar (April 2015) that their preference is for under-drained swales to be used for conveyance of surface water to an on-line storage pond. A possible site for such a facility is shown on the schematic concept drainage plan 1602/01 (**doc 2**). This together with the use of permeable materials within domestic curtilage provides source control (quality) and storage volume (quantity) together with amenity and biodiversity SUDS.

Surface water from the adoptable road (0.103 Ha) (which will comprise one footway to the high side and a single cross-fall carriageway) will shed directly into a 300mm deep adjacent under-drained swale to the low side, providing highway water with an initial treatment stage, with domestic curtilage roof areas (0.211 Ha) and individual permeable paved driveways (0.195 Ha) being collected along the way, connected in to the perforated under-drain pipework. Typical construction details for the source control outlets from domestic roof water to permeable paved individual driveway and under-drained conveyance swale are shown on the schematic concept drainage plan 1602/01 (**doc 2**).

Roof water will be collected in underground pipes, where required, within domestic curtilage with silt traps incorporated prior to connecting to adjacent permeable paved individual driveways wherever practicable by way of proprietary diffusers which in turn are connected to the under-drained swale. Where roof water downpipes are located either over or immediately adjacent to permeable paved individual driveways these will surface discharge to the permeable paving with proprietary rainwater shoes with no underground pipework being required. This provides an "on-plot" source control treatment stage for all domestic curtilage runoff prior to entering the adoptable system. An on-line surface water detention and attenuation balancing pond provides additional storage and a second treatment stage at the flow control location. The pond will be wet (maximum 600mm depth) under normal conditions (unless infiltration results in the water level further reducing) with a normal water area of 112m², normal water level of 1.850m ODN and 1:3 side slope batters, as shown on the schematic concept drainage plan 1602/01 (**doc 2**). A Hydrobrake Optimum flow control device attenuates flows down to the permitted discharge rates for 1 year, 30 year and up to the 1:100 year plus 30% climate change standard to permitted discharge rates.

Flows in excess of these figures are stored in the on-line detention and attenuation balancing pond where they are stored for a period of time before draining back down again to normal water level.

The final outfall from the development is proposed at invert level (1.787m ODN) which is the soffit to soffit invert level of a 225mm diameter pipe connecting to the existing 525mm diameter surface water sewer in Station Road at manhole 8851 as shown on the schematic concept drainage plan 1602/01 (**doc 2**). The invert level of the development discharge at the balancing pond is proposed at 1.850m ODN.

The normal water level in the balancing pond being set at 1.850m ODN is at least 1.350m below the footway level at Station Road (3.200m ODN) thereby enabling a maximum 1.050m of storage depth and 0.300m freeboard.

Microdrainage calculations, using FEH rainfall data, have been prepared to demonstrate that the surface water design operates satisfactorily for the given return periods whilst keeping discharges lower than or equal to existing green field values. (**doc 4**) confirms the Microdrainage calculations with 1 year outflow restricted to 4.9 l/s with the water level in the balancing pond raising by 274mm to a level of 2.124m ODN, 30 year outflow restricted to 4.9 l/s with the water level in the balancing pond raising by 693mm to a level of 2.543m ODN and 100 year plus 30% climate change outflow restricted to 5.0 l/s with the water level in the balancing pond raising by 1052mm to a level of 2.902m ODN. Top of bank of the surface water balancing pond will be set at 3.200m ODN therefore providing an additional 298mm freeboard above the 100 year plus 30% climate change level.

In order to comply with Planning Practise Guidance which refers to NPPF-TG (paragraph 9) and to demonstrate how the surface water sewer system can be monitored and maintained to ensure it will continue to function correctly for the lifetime of the development and prevent any increase in flood risk on or off site it is anticipated that the surface water system including the under-drain to the swales to its point of attenuated discharge to the outfall to existing will be included in a section 104 adoption agreement with Anglian Water Services Ltd. It is anticipated that the grassed surface part of the swales will be included in a section 38 adoption agreement with Lincolnshire County Council. It is anticipated that the balancing ponds will be included in the Public Open Space area and will be adopted by a Management Company Ltd.

5. Flood Risk.

Flood risk does not form any part of this drainage statement as this is being dealt with by others.

6. Finished Floor Levels.

Finished floor levels do not form any part of this drainage statement as this is being dealt with by others.

7. The Design – Foul Water.

Foul water drainage does not form part of this drainage statement as this is being dealt with by others. As the client has provided details of the existing foul sewer crossing the site and its diversion through the site this has been included on the schematic concept drainage plan 1601/01 (**doc 2**) for completeness.

8. Conclusion.

With the information provided to date it has been demonstrated that the proposed development site can easily comply with the set discharge requirements. Sustainable Urban Drainage Systems can be incorporated within the design (permeable pavements, conveyance swale, filter drain etc) with final attenuation being primarily in an under-drained swale piped network and open balancing pond. The use

of water butts and other rainwater harvesting techniques could be considered at the detailed design stage and these would provide additional storage over and above that demonstrated in this statement.

All elements of the surface water drainage system can be demonstrated to comply with paragraph 9 of NPPF-TG.

This statement contains schematic concept drainage proposals. The detailed road and sewer design for the entire development would proceed, following outline planning approval and drawings would be submitted to Anglian Water Services Ltd for inclusion in a section 104 adoption agreement and Lincolnshire County Council for inclusion in a section 38 adoption agreement.

Given the development site is a brownfield development, represents a significant reduction in impermeable area and discharge rate, is underlain with strata not conducive for the use of soakaways and is not practicable to achieve a gravity solution to watercourse it could be argued that the site is not suitable for SuDS. The House of Commons statement only sets out an expectation that SuDS be provided wherever appropriate. Whilst this statement has been prepared to demonstrate that a SuDS scheme is achievable the final decision on whether a SuDS scheme be actually implemented is one to be discussed between the developer and LPA / LLFA at the appropriate stage. Should the LPA / LLFA agree that a SuDS scheme is not required and a traditional piped system with oversized pipes for attenuation storage be implemented then the pond currently shown on plot 1 can be removed and plot 1 reinstated.

Detailed design does not form any part of the current design remit.

G.W.Hall 12.02.16

Document 1



Existing Site Area = 1.033 Ha.



Existing Impermeable Area = 0.814 Ha (79%).

KEY:	
	BUILDING
	FENCE
	HEDGE
	CHANNEL
	WALL
	BANK EDGE
	STORM DRAINAGE
	FOUL DRAINAGE
	CHANGE OF SURFACE
	OVERHEAD ELECTRIC
	OVERHEAD TELEPHONE
	TREE
	BOREHOLE
	MANHOLE
	CONTROL STATION
	BOLLARD
	BIN
	BRITISH TELECOM
	PIPE CROWN
	CABLE TELEVISION
	EARTH
	ELECTRIC BOX
	ELECTRIC POLE
	EAVES
	FIRE HYDRANT
	GULLY
	GAS VALVE
	INSPECTION CHAMBER
	INVERT LEVEL
	KERB OFFSET
	LAMP HOLE
	LAMP POST
	MARKER POST
	POST BOX
	ROD EYE
	RIDGE
	SIGN POST
	STAY
	STOP VALVE
	THRESHOLD
	TRAFFIC LIGHT
	TELEGRAPH POLE
	TRAFFIC SIGNAL
	VENT COLUMN
	VENT PIPE
	WATER LEVEL
	WATER METER
	WALL TOP

NOTES:

- Survey plotted to OS National Grid.
- All levels related to OS Datum.
- GPS/GLONASS ETR89 observations transformed to OSGB36 using OSTN02 Transformation.
- ETRS89 ellipsoid heights converted to heights above mean sea level using National Geoid Model OSGM02.

Initial Survey Date: 2 SEP 2015

CONTROL STATIONS			
Stn:	Eastings:	Northings:	Height:
9000	542799.045	322921.961	3.591
9001	542764.845	322959.395	3.411
9002	542739.259	322987.056	3.352
9003	542784.420	323005.250	3.277
9004	542872.080	322913.770	3.027
9005	542868.952	322910.801	3.172
9006	542855.550	322888.108	3.032
9007	542843.989	322890.856	3.167
9008	542831.285	322866.315	3.264
9009	542812.698	322864.975	3.264
9010	542805.181	322890.178	3.605

Rev:	Amendments:	Date:
A	AWS Sewer info added from records.	12.02.16

Client:
NENE TRANSPORT

Project Title:
**NENE TRANSPORT
LONG SUTTON
LINCOLNSHIRE**

Drawing Title:
OGL SURVEY

Scale:	1:500	Date:	5 SEP 2015
Drawing No:	AS2084/1	Rev:	A A1
C.A.D. Title:	RDCLONGSUTTON020915		
Drawn By:	D.J.SMITH	Added To By:	G.W.HALL

AXIS SURVEYS LTD.
CHARTERED LAND SURVEYORS

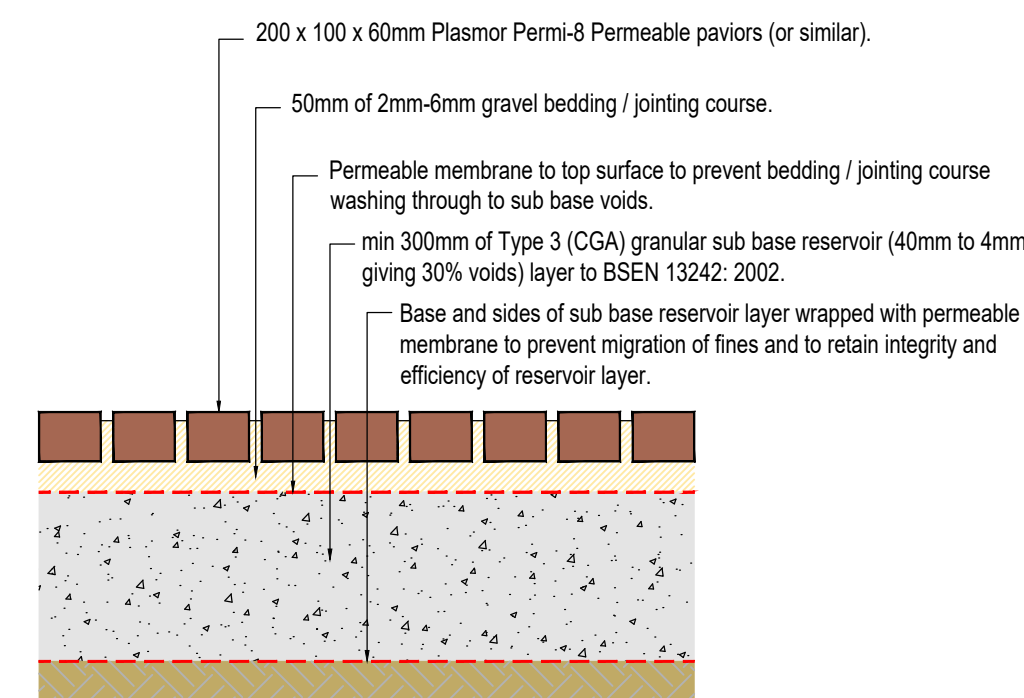
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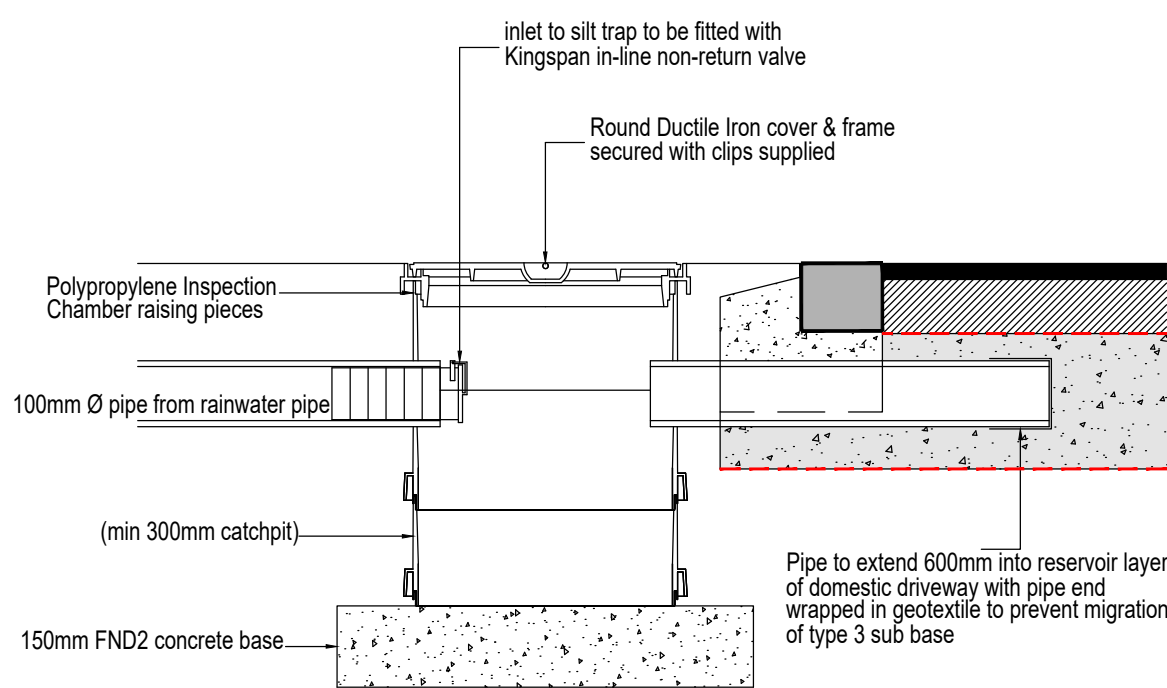
Document 2

NOTES:

- Development Site.
Area = 1.033 Ha
Existing Ai = 0.514 Ha (49%)
Proposed Ai = 0.509 Ha (49%).
- Domestic Curtilage Roof Areas (36 dwellings including converted flats)
Ai = 0.199 Ha (19%) plus 6% development creep Ai = 0.211 Ha (20%).
To be connected to adjacent domestic curtilage permeable paved individual driveways sub base reservoir layers.
- Domestic Curtilage Permeable Paved Individual Driveways.
Ai = 0.195 Ha (19%).
To be paved with permeable materials with levels set to shed towards diffuse outlet positions, connected into swale under-drain.
- Adopted Tarmac Access Roads / Footpaths.
To be paved in traditional impermeable materials, sheet flow to adjacent under-drained swale.
Ai = 0.103 Ha (10%).
- 3.00m wide, 0.30m deep under-drained swale with 1:4 side slopes and 0.00m central channel, 300mmØ perforated pipe as under-drain.



Typical Domestic Driveway (Permeable Paved) Detail



Typical Source Control Outlet (sco) from Domestic Roofwater

DO NOT SCALE. USE FIGURED DIMENSIONS ONLY. CHECK ON SITE AND ALL DISCREPANCIES TO BE REPORTED TO HALL infrastructure DESIGN Ltd.

AMENDMENTS:

REF.	DESCRIPTION.	DATE.	BY.

CLIENT:
Nene Transport (Lincs) Ltd

PROJECT:
Station Road
Long Sutton, Lincolnshire

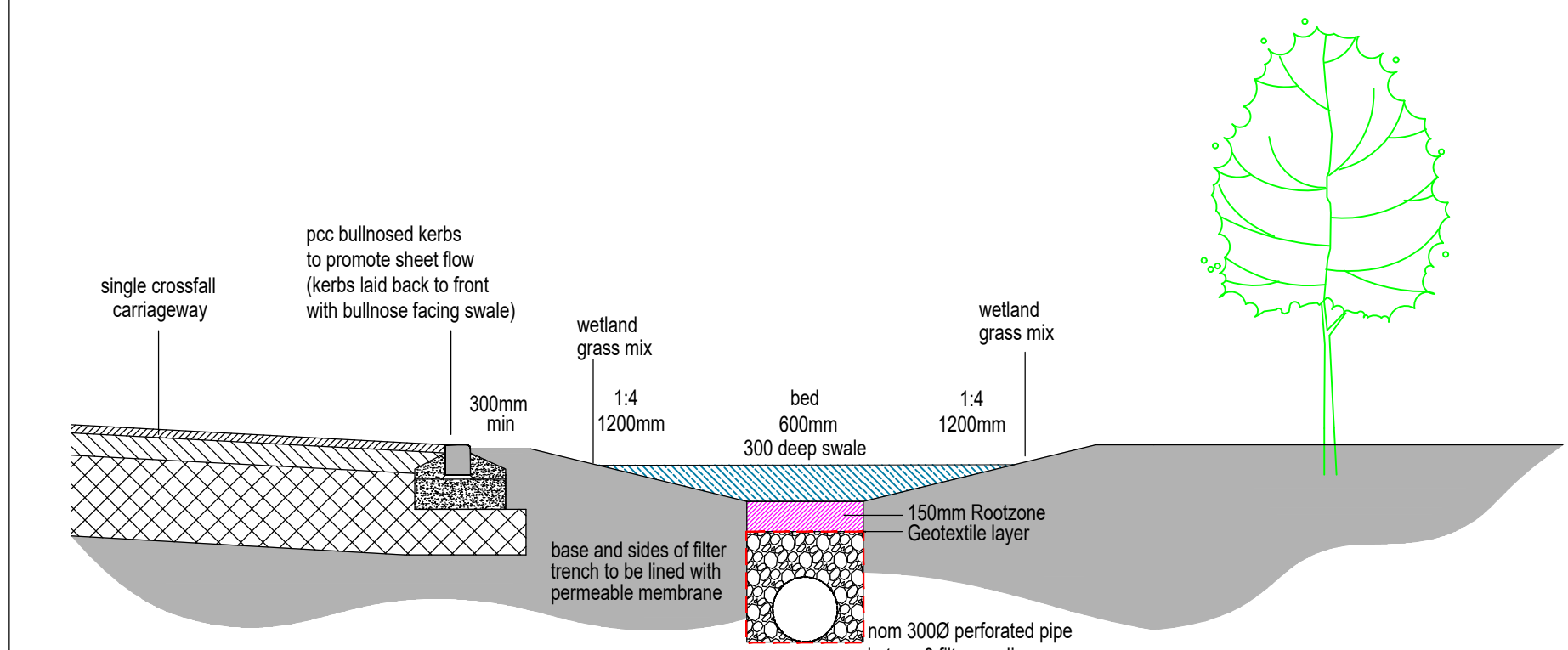
TITLE:
Schematic Concept Drainage Plan

SCALE: 1:500 **DATE:** February 2016 **SIZE:** A1

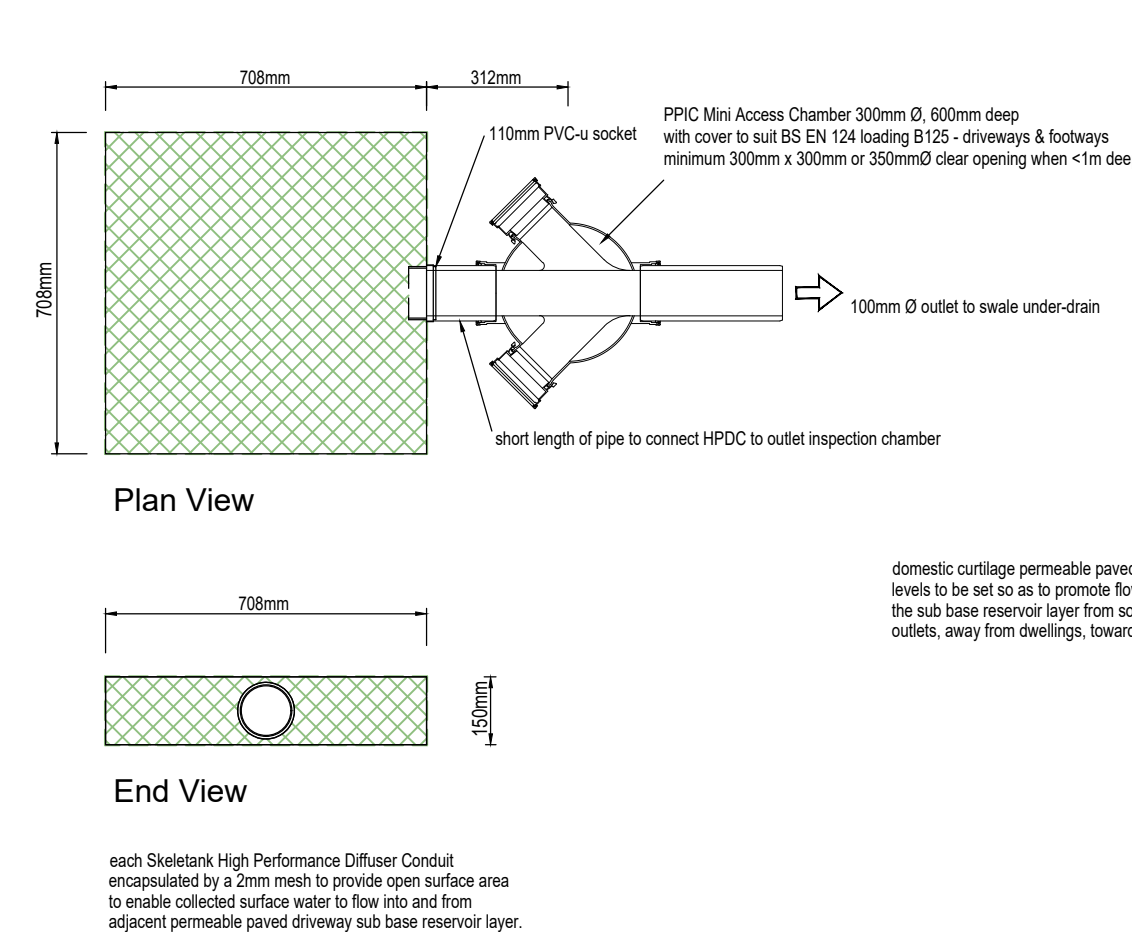
DRAWING No: 1602/01 **DRAWN BY:** *[Signature]* **CHECKED BY:** *[Signature]*

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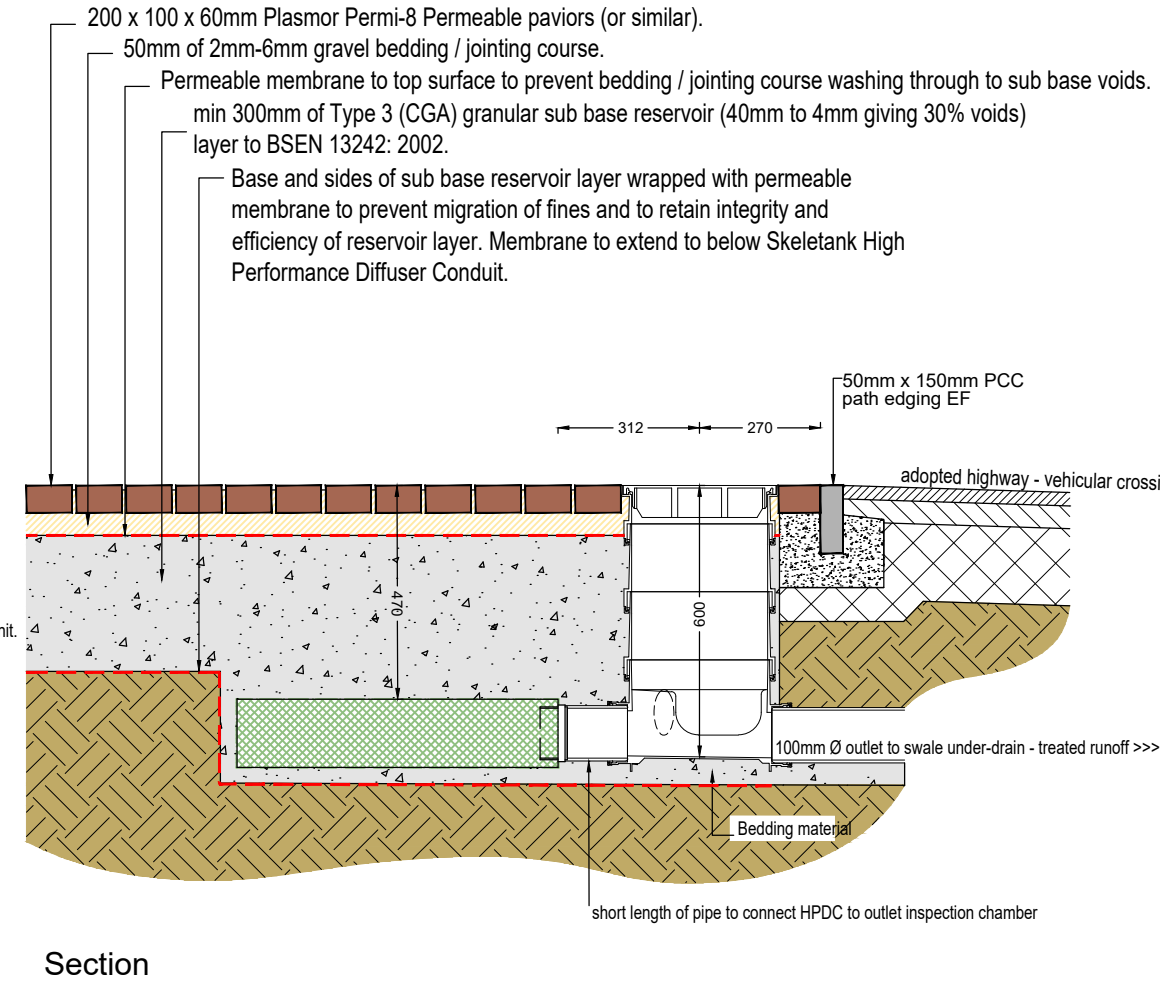
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Typical Under-Drained Swale Detail



Typical Diffuser Outlet (do) from Domestic Driveway



Section

Document 3

Site name: Nene Transport
Site location: Long Sutton

Site coordinates

Latitude: 52.78467° N
Longitude: 0.11658° E

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Reference: u12h69huux8m / 1.03

Date: 12 Feb 2016

Site characteristics

Total site area	1.03	ha
Significant public open space	0.22	ha
Area positively drained	0.81	ha

Methodology

Greenfield runoff method	IH124
Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type
SOIL type	2
HOST class	N/A
SPR	0.30

Hydrological characteristics

	Default	Edited	
SAAR	581	581	mm
M5-60 Rainfall Depth	20	20	mm
'r' Ratio M5-60/M5-2 day	0.4	0.4	
FEH/FSR conversion factor	0.76	0.76	
Hydrological region	5	5	
Growth curve factor: 1 year	0.87	0.87	
Growth curve factor: 10 year	1.65	1.65	
Growth curve factor: 30 year	2.45	2.45	
Growth curve factor: 100 year	3.56	3.56	

Greenfield runoff rates

	Default	Edited	
Qbar	1.19	1.19	l/s
1 in 1 year	5.00	5.00	l/s
1 in 30 years	5.00	5.00	l/s
1 in 100 years	5.00	5.00	l/s

Please note that a minimum flow of 5 l/s applies to any site

Document 4

Hall Infrastructure Design Ltd		Page 1
9 St Mary's Park Louth Lincolnshire LN11 0EF	Nene Transport (Lincs) Ltd Station Road Long Sutton	
Date 12.02.16 File scheme 120216.MDX	Designed by GWH Checked by GWH	
Causeway	Network 2015.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model	
Return Period (years)	1
Site Location GB 542750 322350 TF 42750 22350	
C (1km)	-0.021
D1 (1km)	0.343
D2 (1km)	0.266
D3 (1km)	0.196
E (1km)	0.310
F (1km)	2.502
Maximum Rainfall (mm/hr)	0
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.306	4-8	0.166	8-12	0.037

Total Area Contributing (ha) = 0.509

Total Pipe Volume (m³) = 7.023

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	31.000	0.129	240.3	0.170	8.00	0.0	0.600	o	300	
1.001	31.000	0.129	240.0	0.170	0.00	0.0	0.600	o	300	
1.002	31.000	0.129	240.0	0.169	0.00	0.0	0.600	o	300	
1.003	11.300	0.063	179.4	0.000	0.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul Flow (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	0.00	8.51	2.237	0.170	0.0	0.0	0.0	1.01	71.4	0.0
1.001	0.00	9.02	2.108	0.340	0.0	0.0	0.0	1.01	71.4	0.0
1.002	0.00	9.53	1.979	0.509	0.0	0.0	0.0	1.01	71.4	0.0
1.003	0.00	9.73	1.850	0.509	0.0	0.0	0.0	0.97	38.7	0.0

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9 St Mary's Park Louth Lincolnshire LN11 0EF	Nene Transport (Lincs) Ltd Station Road Long Sutton	
Date 12.02.16 File scheme 120216.MDX	Designed by GWH Checked by GWH	
Causeway	Network 2015.1	

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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1.003	MH8851	3.087	1.787	1.487	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	1.000
Hot Start (mins)	0	Inlet Coefficient	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 Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	3	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	E (1km)	0.310
Return Period (years)	1	F (1km)	2.502
Site Location	GB 542750 322350 TF 42750 22350	Summer Storms	Yes
C (1km)	-0.021	Winter Storms	No
D1 (1km)	0.343	Cv (Summer)	0.750
D2 (1km)	0.266	Cv (Winter)	0.840
D3 (1km)	0.196	Storm Duration (mins)	30

Hall Infrastructure Design Ltd		Page 3
9 St Mary's Park Louth Lincolnshire LN11 0EF	Nene Transport (Lincs) Ltd Station Road Long Sutton	
Date 12.02.16	Designed by GWH	
File scheme 120216.MDX	Checked by GWH	
Causeway	Network 2015.1	

Online Controls for Storm

Hydro-Brake Optimum® Manhole: 4, DS/PN: 1.003, Volume (m³): 3.3

Unit Reference MD-SHE-0104-4900-1000-4900
Design Head (m) 1.000
Design Flow (l/s) 4.9
Flush-Flo™ Calculated
Objective Minimise upstream storage
Diameter (mm) 104
Invert Level (m) 1.850
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.9	Kick-Flo®	0.633	3.9
Flush-Flo™	0.292	4.9	Mean Flow over Head Range	-	4.2

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)	Depth (m)	Flow (l/s)
0.100	3.5	0.800	4.4	2.000	6.7	4.000	9.3	7.000	12.2
0.200	4.7	1.000	4.9	2.200	7.0	4.500	9.9	7.500	12.6
0.300	4.9	1.200	5.3	2.400	7.3	5.000	10.4	8.000	13.0
0.400	4.8	1.400	5.7	2.600	7.6	5.500	10.9	8.500	13.4
0.500	4.6	1.600	6.1	3.000	8.2	6.000	11.3	9.000	13.7
0.600	4.2	1.800	6.4	3.500	8.8	6.500	11.8	9.500	14.1

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Storage Structures for Storm

Complex Manhole: 2, DS/PN: 1.001

Dry Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00558	Trench Length (m)	29.0
Infiltration Coefficient Side (m/hr)	0.00558	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	150.0
Porosity	0.30	Cap Volume Depth (m)	0.912
Invert Level (m)	2.408	Cap Infiltration Depth (m)	0.612
Trench Height (m)	0.612	Include Swale Volume	Yes
Trench Width (m)	0.6		

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00558	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	65.0
Max Percolation (l/s)	180.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.910	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: 3, DS/PN: 1.002

Infiltration Coefficient Base (m/hr)	0.00558	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	65.0
Max Percolation (l/s)	180.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.700	Cap Volume Depth (m)	0.300

Complex Manhole: 4, DS/PN: 1.003

Infiltration Basin

Invert Level (m)	1.850	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00558	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00558		

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	112.0	0.600	200.0	1.200	0.0	1.800	0.0	2.400	0.0
0.100	125.0	0.700	218.0	1.300	0.0	1.900	0.0	2.500	0.0
0.200	139.0	0.800	234.0	1.400	0.0	2.000	0.0		
0.300	153.0	0.900	252.0	1.500	0.0	2.100	0.0		
0.400	168.0	1.000	270.0	1.600	0.0	2.200	0.0		
0.500	184.0	1.100	288.0	1.700	0.0	2.300	0.0		

Dry Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

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Dry Swale

Infiltration Coefficient Base (m/hr)	0.00558	Trench Length (m)	17.0
Infiltration Coefficient Side (m/hr)	0.00558	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	150.0
Porosity	0.30	Cap Volume Depth (m)	0.750
Invert Level (m)	2.150	Cap Infiltration Depth (m)	0.450
Trench Height (m)	0.450	Include Swale Volume	Yes
Trench Width (m)	0.6		

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00558	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	65.0
Max Percolation (l/s)	180.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.490	Cap Volume Depth (m)	0.300

Nene Transport (Lincs) Ltd
Station Road
Long Sutton



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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m ³ /ha Storage	1.000
Hot Start Level (mm)	0	Inlet Coefficient	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 Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	3	Number of Real Time Controls	0

Synthetic Rainfall Details

Synthetic Rainfall Details						
Rainfall Model					FEH	D3 (1km) 0.196
Site Location	GB	542750	322350	TF	42750 22350	E (1km) 0.310
C (1km)					-0.021	F (1km) 2.502
D1 (1km)					0.343	Cv (Summer) 0.750
D2 (1km)					0.266	Cv (Winter) 0.840

```
Margin for Flood Risk Warning (mm) 450.0      DVD Status OFF
      Analysis Timestep   Fine Inertia Status OFF
      DTS Status          ON
```

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

										Water	Surcharged
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth
PN	Name	Storm	Period	Change		Surcharge	Flood	Overflow	Act.	(m)	(m)
1.000	1	60 Summer		1	+0%	30/60 Summer				2.329	-0.208
1.001	2	60 Summer		1	+0%	30/60 Summer				2.241	-0.167
1.002	3	60 Summer		1	+0%	30/60 Summer				2.147	-0.131
1.003	4	360 Winter		1	+0%	1/60 Winter	100/360 Winter			2.124	0.050

PN	US/MH Name	Flooded		Pipe	Status	Level Exceeded
		Volume (m³)	Flow / Cap.	Overflow (l/s)		
1.000	1	0.000	0.20			OK
1.001	2	0.000	0.40			OK
1.002	3	0.000	0.59			OK
1.003	4	0.000	0.15		4.9	SURCHARGED 2

Nene Transport (Lincs) Ltd
Station Road
Long Sutton



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Simulation Criteria

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	3	Number of Real Time Controls	0

Rainfall Model					FEH	D3 (1km)	0.196
Site Location	GB	542750	322350	TF	42750	22350	E (1km) 0.310
C (1km)					-0.021		F (1km) 2.502
D1 (1km)					0.343	Cv	(Summer) 0.750
D2 (1km)					0.266	Cv	(Winter) 0.840

Profile(s)	Summer and Winter
Duration(s) (mins)	60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
n Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

										Water	Surcharged
PN	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth
	Name	Storm		Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)
1.000	1	60	Summer	30	+0%	30/60 Summer				2.748	0.211
1.001	2	60	Summer	30	+0%	30/60 Summer				2.703	0.295
1.002	3	60	Summer	30	+0%	30/60 Summer				2.560	0.282
1.003	4	360	Summer	30	+0%	1/60 Winter	100/360 Winter			2.543	0.468

PN	US/MH Name	Flooded		Pipe Flow (l/s)	Status	Level Exceeded
		Volume (m³)	Flow / Cap. (l/s)			
1.000	1	0.000	0.56	36.6	SURCHARGED	
1.001	2	0.000	1.04	67.6	SURCHARGED	
1.002	3	0.000	1.58	103.1	SURCHARGED	
1.003	4	0.000	0.15	4.9	FLOOD RISK	2

Nene Transport (Lincs) Ltd
Station Road
Long Sutton



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Network 2015.1

Document 5

GROUND ENGINEERING

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SITE INVESTIGATION REPORT

**NENE TRANSPORT (LINCS) DEPOT
STATION ROAD
LONG SUTTON
LINCOLNSHIRE**

Report Reference C13684

On behalf of:-

**Nene Transport (Lincs) Limited
18 Station Road
Long Sutton
Lincolnshire
PE12 9BP**

December 2015

NENE TRANSPORT (LINCS) LIMITED

ROBERT DOUGHTY CONSULTANCY LIMITED

CONSULTING ENGINEERS

SITE INVESTIGATION REPORT

FOR

PROPOSED RESIDENTIAL DEVELOPMENT

AT

NENE TRANSPORT (LINCS) LIMITED

STATION ROAD

LONG SUTTON

LINCOLNSHIRE

Report Reference No. C13684

December 2015

INTRODUCTION

The client, Nene Transport (Lincs) Limited, proposes to build a new residential development, replacing the existing depot to the north of Station Road, Long Sutton, Lincolnshire. The proposed building loads were not known at the time of report writing.

Ground Engineering Limited was commissioned by the client, under the direction of Robert Doughty Consultancy Limited, to carry out a site investigation to determine the nature and geotechnical properties of the underlying soils, and provide information for the design and construction of the foundations. A desk study checking past uses and a contamination assessment were also included within the scope of this report.

LOCATION, TOPOGRAPHY AND GEOLOGY OF THE SITE

The site is located at the former Nene Transport haulage depot, to the north of Station Road (B1390), in Long Sutton, Lincolnshire. The National Grid Reference for the centre of the site is TF 4277 2295 and its location is shown on a plan following this report text.

At the time of the investigation in September and November 2015, the approximately 75m wide by 160m deep rectangular shaped investigation area contained the disused Nene Transport haulage depot, and was accessed from Station Road to the south. The site boundaries were defined by Station Road to the south; the rear gardens of properties off Garnsgate Road to the west; the rear gardens of properties off Saddlers Way to the north; a grassed park to the north-east; and Long Sutton Medical Centre to the east. A gas governor was present in the south-western corner of the site adjacent Station Road. A two-storey brick building formerly used as offices, and a single-storey brick building were also present in the southern part of the site fronting Station Road. A 30m wide by 70m long Depot building was present in the eastern part of the site, and a warehouse building was in the rear part of the site. A former above ground tank had been removed from the northern side of the depot building prior to this investigation. A grassed border was present adjacent the pavement of Station Road; the central part of the site was concrete surfaced; and the rear part of the site was soft landscaping which appeared to have been recently cleared of vegetation. A 'Google Streetview' pictures between 2009 and 2011 showed both Cypress and some deciduous trees including Ash, Silver Birch and Wild Cherry in the south-eastern corner of the site fronting Station Road, these had been removed by the client prior to this investigation. An 8m high Silver Birch tree was present in front of the offices in the southern part of the site. On the adjacent plots to the west, north and east of the site were recently pruned coniferous trees, which had been cut back to make room for new fencing along the boundaries.

The site stands at an elevation of approximately 3mOD on level ground within the Lincolnshire Fens. The site is approximately 6km west of the River Nene.

The 1978 geological map for the area at 1:50,000 scale, Sheet 145 'King's Lynn and The Wash', shows the site to be underlain by superficial Terrington Beds (more recently named Tidal Flat Deposits), covering the solid geology of the Ampthill Clay Formation at depth. Previous investigations by Ground Engineering Limited in this area found Marine Sand below the anticipated near surface Terrington Beds. The River Nene is a major watercourse 6km to the east, flowing north to The Wash. Long Sutton is in the South Holland IDB, and is split between Catchment H to the south and Catchment K to the north. The closest drains are the southward flowing Cowpers Gate Drain 270m south-west of the site, and the south-western flowing Lutton Eau 285m north-west of the site. The hydraulic gradient is anticipated to flow towards the east and north-east and the River Nene. The site is within land reclaimed by the time of the Domesday survey (1086).

SUMMARY OF ENVIRONMENTAL DATA

Appendix 2 contains information derived from Environmental Databases for a radius of up to 2,000m from the site. The information covers datasets held by Groundsure with contributors including the local authority, the Environment Agency (EA), British Geological Survey, Ordnance Survey and the Coal Authority and the results, within a radius of 250m, are summarised below:

1. Historical Industrial Sites	On-Site	0 - 250m
Potentially Contaminative Uses (1:10,000 mapping)	22	10
Historical Tank Database	0	0
Historical Energy Features Database	6	18
Historical Petrol & Fuel Site Database	0	0
Historical Garage & Motor Vehicle Repair Database	0	18
Potentially Infilled Land	0	5
2. Environmental Permits, Incidents and Registers	On-Site	0 - 250m
Sites Holding Environmental Permits/Authorisations	0	2
Records of COMAH and NIHHS Sites	0	0
Environment Agency Recorded Pollution Incidents	0	0
Sites Determined as Contaminated Land under Part IIA EPA 1990	0	0
3. Landfill and Other Waste Sites	On-Site	0 - 250m
Landfill Sites	0	0
Landfill and Other Waste Sites	0	0
4. Current Land Use	On-Site	0 - 250m
Current Industrial Sites Data	2	14
Records of Petrol and Fuel Sites	0	0
Underground High Pressure Oil and Gas Pipelines	0	0
5. Geology	Description	
Artificial Ground or Made Ground records	No	
Superficial Ground and Drift Geology records	Yes	
6. Hydrogeology and Hydrology	On-Site	0 - 250m
Productive strata within superficial geology	No	
Productive strata within solid geology	No	
Groundwater Abstraction Licences	0	0
Surface Water Abstraction Licences	0	0
Potable Water Abstraction Licences	0	0
Source Protection Zones	0	0
River Quality Data	No	No
Detailed River Network Entries	0	0
Surface Water Features	No	No

7. Flooding					
Environment Agency indicative Zone 2 floodplains within 250m of site				Yes	
Environment Agency indicative Zone 3 floodplains within 250m of site				Yes	
Risk of flooding from rivers & the sea (RoFRaS) rating				Low	
Flood defences within 250m of site				No	
Any areas benefitting from flood defences within 250m of site				No	
Flood storage areas within 250m of site				No	
Maximum BGS groundwater flooding susceptibility within 50m of site				Not prone	
BGS confidence rating for groundwater susceptibility areas				Not applicable	
8. Designated Environmentally Sensitive Sites				On Site	0 - 250m
Environmentally sensitive sites (Nitrate Vulnerable Zones)				0	1
9. Natural Hazards (on site)					
Hazard	Negligible	Very Low	Low	Moderate	High
Shrinking or Swelling Clay	-	-	On-site	-	-
Landslides	-	On-site	-	-	-
Soluble rocks	On-site	-	-	-	-
Compressible Ground	-	-	-	On-site	-
Collapsible Rocks	On-site	-	-	-	-
Running Sand	-	-	-	On-site	-
9.2. Radon					
The property is not in a Radon Affected Area, as less than 1% of properties are above the action level. No Radon Protective Measures are required for new properties or extensions.					
10. Mining					
Coal mining areas within 75m of site				No	
Non coal-mining areas within 50m of site				No	
Brine affected areas within 75m of study site				No	

Database Summary

The potentially contaminative uses identified from 1:10,000 mapping are for a Depot, railway station, railway building and sidings on-site, and a fire station 18m south-east of the site. There are no tanks recorded on, or within 250m of the site, the above ground tank to the rear of the depot on-site has not been recognised. There is a gas governor in the south-western corner of the site, and three electricity sub-stations 9m south-east, 110m north-west and 208m south-west of the site. There are five garages and an agricultural engineering works within 250m of the site, the closest garage is 132m east of the site. One area of potentially infilled land relates to a pond 73m south-west of the site. There are no environmental permits on the site, and two within 250m of the site, related to unspecified discharge consents 48m south-west and 151m east, both revoked. There are no pollution incidents recorded on, or within 250m of the site. There

are no registered or historic landfills registered on, or within 250m of the site. There are two current industrial uses recorded on the site, related to the depot and gas governor. There are fourteen current industrial sites within 250m of the site, including the fire station, 31m south-east; electricity sub-stations to the south-east, north-west and south-west; car dealer to the south-east; distribution & haulage firms; and unspecified works and factories. There are no petrol or fuel sites within 250m of the site.

Superficial Tidal Flat Deposits are indicated to cover the site, which are designated by the EA as an 'Unproductive' stratum. The site is underlain by the solid geology of the Ampthill Clay Formation, which is also designated by the EA as an 'Unproductive' stratum. There are no groundwater abstractions, nor surface water abstraction licences on site, or within 250m of the site. There are no river network entries, nor surface water features, on or within 250m of the site, however there is a pond 73m to south-west of the site (not recorded by Groundsure). The site is within a Zone 2 and Zone 3 floodplain, and is not within an area benefiting from flood defences. The site has a 'low' risk of flooding for rivers and the sea (RoFRaS) rating.

The site is assessed as having a 'moderate' hazard from compressible ground and running sand. The site is assessed as having a 'low' hazard from shrinking or swelling clay. The site is assessed as having a 'very low' hazard from landslides. The site is assessed as having a 'negligible' hazard from soluble rocks and collapsible rocks. A Local Nature Reserve is located 203m north-west of the site, a designated environmentally sensitive area. The site is not within an identified mining area, or brine affected area. No radon protection measures are required for new residential properties or extensions.

PRELIMINARY RISK ASSESSMENT

Potential sources of contamination present on or beneath the site would relate primarily to; the historical use of the site; the presence of contaminated soil; and the potential presence of hazardous or ground gas beneath the site.

In order to assess the risks associated with the presence of ground contamination the linkages between the sources and potential receptors to contamination need to be established and evaluated. This is in accordance with the Environmental Protection Act 1990, which provides a statutory definition of Contaminated Land. To fall within this definition it is necessary that, as a result of the condition of the land, substances may be present on or under the land such that;

- *Significant harm is being caused or there is a significant possibility of such harm being caused; or*
- *Pollution of controlled waters is being, or is likely to be, caused.*

There are three principal factors that are assessed whilst undertaking a qualitative risk assessment for any site. These are the presence of a contamination source, the existence of migration pathways and the presence of a sensitive target(s). It should be noted that it is necessary for each element of source, pathway and target to be present in order for exposure of a human or environmental receptor to occur.

UK Government guidance on the assessment of contaminated land, requires risk to human health and the environment to be reviewed using source – pathway – target relationships. If each of these elements is present, the linkage provides a potential risk to the identified targets.

Contaminants or **potential pollutants** identified as **sources** in relation to the identified previous uses are listed overleaf in Table 1.

Table 1: Identified Potential Contaminant Sources

<i>Contaminant Source</i>	<i>Comments</i>
Drainage	Effluent from leaking drains would provide a contaminant source.
Buildings	Asbestos containing materials could be present within the construction of the buildings on the site.
Above Ground Tank	Spillages from the former tank could provide a contaminant source.
Soil Beneath Site	Contamination may be present within any made ground materials on the site, such as associated with the former railway use of the site, and the infilled pond.
Soil Gas	Potential soil gas generated from made ground soil, or the infilled pond in the north-east of the site.
Ground Contamination Outside Site Boundary	Ground contamination migrating from adjoining sites such as the adjoining former railway land and coal depot.

A **Pathway** is defined as one or more routes through which a receptor is being, or could be, exposed to, or affected by, a given contaminant.

Potential **Target or Receptors** fall within the categories of Human Health, Water Environment, Flora and Fauna, and Building Materials.

There are a number of possible pathways for the contaminants identified on the site to impact human and/or environmental receptors and these are summarised in Tables 2 and 3.

Table 2: Human Receptors and Pathways

<i>Human Receptor-Mechanism</i>	<i>Typical Exposure Pathway</i>
Human Inhalation	Breathing Dust and Fumes Breathing Gas emissions
Human Ingestion	Eating -contaminated soil, for example by small children -produce grown on contaminated soil Ingesting dust or soil on vegetables Drinking contaminated water
Human Contact	Direct skin contact with contamination Direct skin contact with contaminated liquids

Table 3: Water Receptors and Pathways

<i>Receptor-Water Environment</i>	<i>Typical Exposure Pathway</i>
Groundwater The superficial Tidal Flat Deposits are indicated to be an 'Unproductive' stratum. The solid geology Ampthill Clay also is indicated by the EA to be an 'Unproductive' stratum. The site is not within any Source Protection Zones.	Surface infiltration of atmospheric waters into the soils beneath the site could wash or dissolve potential contaminants and migrate to underlying groundwater. Contamination leads to restriction/prevention of use as a resource, for example, drinking water, and can have secondary impacts on other resources, which depend on it.
Surface Water The nearest surface water feature is a pond 73m south-west of the site.	Surface infiltration of atmospheric waters into the soils beneath the site could wash or dissolve potential contaminants and laterally migrate. Contamination leads to a restriction/prevention of use: -as drinking water resource -for amenity use Effects on aquatic life.

Preliminary Conceptual Model

Assessment of the potential linkage between ground contamination sources, human and environmental receptors have been assessed based on the desk study research documented in the preceding sections of this report.

A generalised preliminary conceptual model is presented below in Table 4.

Table 4: Preliminary Conceptual Model Relative to Proposed Residential Development

Receptors	Pathway	Estimated Potential for Linkage with Contaminant Sources					
		Drainage	Buildings	Above Ground Tank	Soil Beneath Site	Soil Gas	Ground Contamination Outside Site Boundary
Human Health – ground or construction workers	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	Low likelihood	Likely	Likely	Likely	Low likelihood	Low likelihood
Human Health – end users	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	Unlikely	N/A	Likely	Likely	Low likelihood	Low likelihood
Water Environment	Migration through ground into surface water or surrounding groundwater	Low likelihood	N/A	Low likelihood	Low likelihood	Unlikely	Unlikely
Flora	Vegetation on site growing on contaminated soil	Low likelihood	N/A	Low likelihood	Low likelihood	Low likelihood	Unlikely
Building Materials	Contact with contaminated soil	Low likelihood	N/A	Low likelihood	Low likelihood	Low likelihood	Low likelihood

Key to Table 4 Estimated Potential for Linkage with Contaminant Source	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such an event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.
N/A	Not Applicable.

SITE WORK

The site work conducted on 28th and 29th September, and 30th November 2015 comprised nine window sampled boreholes (WS1 to WS9), and two machine excavated soakaway trial pits (TP1 and TP2). The positions are shown on the exploratory hole location plan following this report text.

Public utility service drawings were sourced and consulted prior to determining the exploratory hole positions. The service drawings sourced by Ground Engineering Limited are available on request. Prior to excavation, a service scan was made at each position using a CAT (Cable Avoidance Tool) to check for the absence of detectable buried services that may otherwise have been damaged by the investigation.

The exploratory hole records, presented following the exploratory hole location plan, give the descriptions and depths of the various strata encountered, details of all samples taken, in-situ tests and the groundwater conditions observed during and on completion of boring and excavation.

Window Sample Boreholes

The window sampled boreholes WS1 to WS9 were sunk to depths of between 4.00m and 4.45m where they were completed. The surface concrete at boreholes WS4 and WS5 was cored at 200mm diameter. Prior to the start of boring, an inspection pit was dug to 1.20m below ground level using hand tools to ensure the absence of buried services.

Representative small disturbed samples of soil were taken from the starter pits at regular intervals throughout their depth. Samples of made ground were taken within polycarbonate pots and amber glass jars pending possible contamination testing.

The boreholes were formed by a small track mounted window sampling and super heavy dynamic probing rig. The window sampling equipment consisted of drive-in sample tubes of specially constructed and strengthened steel, lined with a plastic core-liner. The barrels were initially of 87mm or 77mm internal diameter and were reduced in diameter with successive

barrels with increasing depth. Upon extraction, a continuous 'undisturbed' profile of the soil was obtained within the plastic liners. The plastic liners were subsequently split by a geotechnical engineer who sub-sampled them, with the remaining samples re-sealed within the plastic liners.

The standard penetration test (SPT) was carried out at regular intervals in order to allow the assessment of the relative in-situ density or stiffness of the ground. The test was made by driving a split-barrel sampler (SPT(S)), into the soils at the base of the borehole by means of an automatic trip hammer weighing 63.50kg falling freely through 750mm. The penetration resistance was determined as the number of blows required to drive the tool the final 300mm of a total penetration of 450mm into the soil ahead of the boreholes. The SPT results have been plotted against depth in Figure 1.

An immediate assessment of the apparent shear strength of clay was made within the liners using a hand shear vane, the average of three readings for each test depth have been recorded and presented on the borehole records in kilopascals (kPa). The apparent cohesion results have been plotted against depth in Figure 2.

On completion the exploratory holes were backfilled with arisings.

Machine Excavated Trial Pits

Trial pits TP1 and TP2 were excavated using a JCB 802 mini-digger to depths of 1.50m and 1.75m respectively. The exposed strata were sampled and recorded by a Geoenvironmental Engineer. Representative small disturbed samples of soil were taken at regular intervals throughout the depth of each trial pit.

Soakaway tests were carried out within trial pits TP1 and TP2, in broad accordance with BRE Digest 365 in order to allow the assessment of the soil infiltration rate. The general method of the test was to excavate the trial pits with vertical sides trimmed square to the base. The dimensions were accurately measured and recorded, and the pits were then filled with clean water. The rate of water dissipation from the pits was measured by recording the depth of water relative to a datum at frequent time intervals. As the water in trial pit TP1 was very slow to drain away only one test could be undertaken at this position. In trial pit TP2, the

water drained away sufficiently after 32 minutes for the water to be topped up and the test repeated a second time. The results are presented and follow the trial pit records.

The trial pits were emptied of any remaining water and were backfilled with compacted arisings upon completion.

LABORATORY WORK

The samples were inspected in the laboratory and assessments of the soil characteristics have been taken into account during preparation of the borehole and trial pit records. The soil descriptions have been made in accordance with BS5930:2015. The geotechnical test results, undertaken in accordance with BS1377:1990, are presented following the exploratory hole records. The chemical test results follow the geotechnical test results.

The moisture contents of selected soil samples were determined. The moisture content results have been plotted against depth in Figure 3.

The index properties of selected soil samples were determined as a guide to soil classification and behaviour. The liquid limit was determined by a cone penetrometer.

An immediate assessment of the apparent shear strength of clay was made within clay soils using a hand shear vane, the average of three readings for each test depth have been recorded and presented on the borehole records in kilopascals (kPa). The apparent cohesion results have been plotted against depth in Figure 2.

The particle size distributions of selected samples were obtained by sieve analysis. The results of these tests are given as particle size distribution curves at the end of this report.

Test specimens were prepared at full diameter from selected undisturbed samples. Immediate undrained triaxial compression tests were performed under either single or multi-stage confining cell pressures. The apparent cohesion results have been plotted against depth with the hand shear vane results in Figure 2. The moisture content and bulk density of each specimen was also determined. The moisture content results have been plotted against depth in Figure 3.

Selected samples of soil were analysed to determine the concentration of soluble sulphates. The pH values were also determined.

Chemical analysis of nine soil samples recovered from the exploratory holes was undertaken, by an independent laboratory, primarily for characterisation purposes. The samples were tested for a suite encompassing a wide range of potential contaminants outlined by the Environment Agency (EA) and National House Building Council (NHBC) document R&D 66;

2008 'Guidance for the Safe Development of Housing on Land Affected by Contamination'.
Three samples were also tested for total petroleum hydrocarbons (TPH).

A sample of made ground from WS7 at 0.60m depth was scheduled for a full
Waste Acceptance Criteria (WAC) CEN Leachate Suite test at 2l/kg and 10l/kg.

GROUND CONDITIONS

The ground conditions beneath the site of the proposed development have been plotted as a soil profile in Figure 4. The ground conditions comprised a surface layer of made ground, underlain by the expected Tidal Flat Deposit, in turn underlain by Marine Sand which was proved to at least the base of the boreholes and trial pits, and to a maximum depth of 4.45m. Groundwater was found as seepages below 2.90m depth during boring.

Made Ground

Made ground was encountered to depths of between 0.40m and 1.80m. In boreholes WS4 and WS5, in the central part of the site, a 0.33m and 0.35m thick layer of concrete and asphalt was encountered. Beneath the hardstanding in WS4, brown, slightly sandy, gravel fill was encountered to 0.50m depth, covering slightly gravelly, silty sand fill to 0.75m depth. In WS5 below the hardstanding, slightly gravelly, clayey sand fill was encountered to 0.40m depth. The gravel fraction comprised angular to rounded, flint and brick fragments (WS5).

Beneath the hardstanding and sub-base in WS4 and WS5 at 0.75m and 0.40m depth, and from surface in the other investigation locations, the made ground generally comprised a brown, dark brown and orange brown, slightly clayey to clayey, silty, slightly gravelly to gravelly sand fill, with occasional cobbles of concrete (TP1). The made ground varied to soft, locally desiccated to stiff (WS1), slightly gravelly, sandy, silty clay fill. The gravel component consisted of flint, limestone, coal, ash, slag, asphalt, shells, mortar, concrete, slate, glass, plastic, plastic strap and brick fragments.

Tidal Flat Deposits

Tidal Flat Deposits were found beneath the made ground from between 0.40m and 1.60m depth to between 1.30m and 3.40m below ground level, a thickness of between 0.50m and 2.20m. The Tidal Flat Deposits consisted of soft or firm, locally desiccated to stiff (WS1),

becoming very soft below approximately 1.80m depth, brown, orange brown and light grey mottled, sandy, silty clay, varying to slightly gravelly (WS2 & TP1), slightly clayey, sandy silt. The gravel fraction comprised fine and medium, angular to sub-rounded flint. Trial pits TP1 and TP2 were completed within Tidal Flat Deposits.

Marine Sand

Marine Sand was encountered beneath the made ground and Tidal Flat Deposits, at depths of between 1.30m and 3.40m below ground level, to at least the base of the exploratory holes at between 4.00m and 4.45m depth. The Marine Sand consisted of a loose, brown and orange brown, silty to very silty sand with occasional black specks. The sand fraction was fine grained.

Groundwater

Groundwater was encountered as seepages at between 2.90m and 4.00m depth in all the boreholes WS1 to WS9, within the Marine Sand. The shallow trial pits TP1 (1.50m) and TP2 (1.75m) were dry during excavation and on completion.

Observations

Live roots were observed in boreholes and trial pits close to the boundaries and in areas of cleared trees, and to a maximum depth of 1.95m in WS1, which was positioned in the area of the recently cleared Cypress trees adjacent Station Road in the southern part of the site.

Evidence of Contamination

The made ground encountered during this investigation was not noted to have olfactory or visual evidence of fuel contamination. The made ground contained fragments of coal, ash, slag, asphalt, shells, mortar, concrete, slate, glass, plastic, plastic strap and brick fragments. No asbestos containing materials were noted in the soils during this investigation.

COMMENTS ON THE GROUND CONDITIONS IN RELATION TO FOUNDATION DESIGN AND CONSTRUCTION

The proposed development is understood to comprise demolishing the existing depot and building a new residential development. The investigation confirmed the site to be underlain by made ground resting on the expected superficial Tidal Flat Deposit and underlying Marine Sand. The made ground soils had variable bearing properties and were found to a maximum depth of 1.80m. The made ground should be avoided as a bearing stratum. The proposed building loads were not known at the time of report writing, although the anticipated houses are expected to be 'lightly' loaded. The underlying superficial deposits (clay, silt and sand) could offer support for lightly loaded traditional foundations for new buildings, locally deepened in clay soils due to the presence of trees, however deepened foundations may be unsuitable due to soft and very soft soils. The Marine Sand could provide a suitable bearing stratum for piled foundations. Shallow foundation excavations should be dry, although water could infiltrate from surface layers. Ground bearing floor slabs could be adopted, but would need to be suspended in clay soils affected by tree roots.

Traditional Foundations

Foundations should be extended through any made ground, which was found to a maximum 1.80m depth.

The naturally deposited 'firm' Tidal Flat Deposit, and underlying Marine Sand, could provide suitable founding strata where encountered at shallow depth for traditional foundations. Deepened foundations into soft and very soft Tidal Flat Deposits may be unsuitable due to poor bearing capacity and likely excessive settlement.

Samples of the Tidal Flat Deposits (clay and silt) had modified plasticity indices of between 7% and 17%. The results indicate the clay/silts range from 'non-shrinkable' to having a low volume change potential, based on NHBC Standards Chapter 4.2 'Building near trees' (2014). On an open site, away from the influence of trees, a minimum foundation depth of

0.75m below current or proposed ground level, whichever is deeper, would be required within the naturally deposited clays in order to be below the zone of seasonal volume change in accordance with the NHBC Standards.

The non-shrinkable, loose, brown, sandy silt or silty sand of the Tidal Flat Deposits and Marine Sand could provide a suitable founding stratum for proposed buildings, where present from a minimum foundation depth of 0.60m.

It is likely that some of the proposed dwellings will be within influencing distance of high water demand trees where clay soils are present at shallow depth. Trees were present along the western, northern and eastern boundaries, and within the southern edge of the site, which included Cypress and Silver Birch.

Based on a high water demand Cypress tree adjacent the site boundaries and recently cleared from the southern edge of the site, and a moderate water demand Ash and low water demand Silver Birch tree in the south, a minimum foundation depth of between 1.15m, and 2.30m would be required in such clay soils based on NHBC Standards at 1m distance. Foundations would need to be at least 18m from the position of a mature Ash tree, 12m from a mature Cypress tree and 7m from a mature Silver Birch tree, for the adoption of the minimum foundation depth of 0.75m on this site. Within these distances foundation depths will depend on the proximity of trees to new foundations and depths should be determined using the NHBC Standards where clay forms the base of foundation excavations. Tree species along the site boundaries and distances to the proposed dwellings should be verified before final design of foundation depths based on NHBC Standards.

Foundations should be taken at least 0.50m below the last vestiges of live roots in clay soils. Live roots were encountered to a maximum depth of 1.95m within WS1 in clay soils. The depth of roots is likely to vary across the site, and is likely to be deeper closer to the trees and former trees adjacent the site boundaries. Some desiccation of the clay soils was noted, to approximately 2.00m depth in WS1 and WS2 (Figure 3). Strip footings could be 'stepped' up along the length of wall runs where foundation depths vary due to the influence of trees. Steps

should not exceed 0.50m and further guidance is provided in the aforementioned NHBC document.

Recommendations for foundation depths related to proposed tree planting are also provided in the NHBC Standards and the volume change potential should be considered for any proposed landscaping within the proposed scheme on the site.

In summary, foundations for the new building will need to be a minimum of 0.60m deep and may need locally to be taken to below 2.30m below ground level, in order to penetrate the depth of potential root-induced desiccation within this site.

Bearing Capacity

The firm clay soils found at the minimum foundation depth of 0.75m offer a maximum safe bearing capacity of 40kN/m^2 with a factor of 3.0 incorporated for a 0.60m wide strip foundation, which is limited by the strength of the underlying soft clays. Similarly the Tidal Flat Deposits beneath a nominal 12m by 6m raft foundation would have a maximum safe bearing capacity of 20kN/m^2 with the same factor of safety of 3.0 incorporated.

These bearing capacities should also ensure that settlement beneath such foundations would be within 25mm. Settlement within the underlying sand should occur as the loads are applied. However, some minor differential movements are likely to occur where differences in the thickness of the clay occurs, since any consolidation settlement within the clay will occur over a longer period of time. Differential consolidation settlement beneath a 0.60m wide strip foundation applying 40kN/m^2 would be expected to be in the order of 15mm, based on the encountered variation in clay thickness beneath the site. For this reason it may be prudent to adopt raft foundations for the proposed development, which would be best suited to resist differential movements and minimise variations in foundation pressures, such as may occur along strip foundations.

The non-shrinkable, loose, sandy silt to silty sand of the Tidal Flat Deposits and Marine Sand could provide a suitable founding stratum for proposed building foundations, cast at a minimum foundation depth of 0.60m even close to neighbouring trees. The naturally deposited

sandy silt or silty sand, where present from depths of 0.60m below existing ground level, has an allowable bearing pressure of 50kN/m² for foundations up to 1.20m wide. This bearing pressure should limit immediate settlement to within 25mm.

Piled Foundations

Alternatively piled foundations may be used to support the proposed buildings, particularly if buildings are proposed close to the existing line of the deep sewer crossing the site. The underlying Marine Sand would provide a suitable pile bearing stratum. The advice of a specialist piling contractor should be sought with regard to suitable methods of pile installation. Bored or Continuous Flight Augered (CFA) piles are likely to be best suited to these ground conditions. Vibrations from driven piles could be potentially damaging to neighbouring structures, particularly where they are supported by shallow footings.

Preliminary working loads for a single bored pile may be estimated for preliminary cost and design purposes using the pile bearing coefficients given over page, which are based on the following assumptions;

1. The ultimate load on a pile would be the sum of the adhesion in clay, and friction in sand, acting on the shaft of the pile together with the end bearing load.
2. The friction acting on the shaft of the pile is a function of the SPT 'N' values presented on the borehole records and in Figure 1, and the effective overburden pressure along the length of the pile shaft. The adhesion acting on the shaft of a pile is a function of the values of apparent cohesion within the clay.
3. The end bearing load would be a function of the SPT 'N' values in sand (Figure 1).
4. A factor of safety of at least 2.0 would be used to assess the working load and if test loading of selected piles were not practical, the factor of safety (F) would be increased to at least 2.5.

Item	Ultimate Pile Bearing
	Value (kN/m ²)
Friction/adhesion in made ground	Ignored
Adhesion in superficial deposits (clay), 1.00m to 2.00m	20
Adhesion in superficial deposits (clay), 2.00m to 3.40m	10
Friction in superficial deposits (sand), 1.00m to 4.50m	5
End bearing in superficial deposits (sand), 4.00m to 4.50m	2,000

Based on these coefficients it is estimated that a single 300mm diameter bored pile installed to 4.5m depth within the Marine Sand, would have a working load of 65kN (F=2.5).

Larger diameter piles would have increased working loads. For example, the same 4.5m length pile at 450mm diameter would have a working load of 140kN (F=2.5).

The final design of piles should be undertaken by a piling specialist.

Excavations

The made ground together with the underlying soils should be easily removed within excavations for the proposed building, although the existing surface concrete and buried foundations and obstructions may be more difficult to remove and require a breaker. The sides of excavations within the made ground are likely to be unstable and excavations should not be relied upon to stand unsupported. Groundwater seepages are likely to be encountered below depths of about 2.90m.

Shallow excavations could be expected to remain dry based on the findings of this investigation. Care should be taken to keep the excavations dry. However, any deep excavations extending below 2.90m are likely to encounter groundwater under sub-artesian pressure within the Marine Sand with resulting 'running sand' conditions and ensuing side instability, side collapse and flooding of excavations resulting.

Whilst pumping from screened sumps may achieve sufficient draw-down of the groundwater locally, it is likely that it would be more effective to control the groundwater, particularly within deep excavations such as for sewers, by a dewatering scheme using well-points. Care should be taken not to allow removal of the clay or silt fraction from the sand in

order to avoid loosening of this stratum. A specialist dewatering contractor should be consulted, but the latter well-pointing technique is likely to enable supported excavations to be completed dry. Consideration should be given to the possibility of settlement of neighbouring existing foundations which may be induced by dewatering.

The base of foundation excavations should be inspected on completion to ensure that the condition of the soil complies with that assumed in design. Should pockets of inferior material or made ground be present, they should be removed and replaced with well graded, well compacted hardcore or lean mix concrete. This should include inspection in the area of the existing north-south aligned sewer with an inert of approximately 4.50m within the western edge of the site. The excavated surfaces should be protected from deterioration and a blinding layer of concrete used where foundations are not completed without delay. The excavated surfaces should be protected from deterioration using a blinding layer of concrete, since the sandy clay and silt soils as well as the silty, fine sands, are all prone to rapid deterioration if exposed to water, with resulting loss of their modest bearing properties. Care should therefore be exercised to ensure that neither surface water nor groundwater is allowed to collect in the base of excavations.

Attention should be given where personnel are to enter deep excavations, when sides should either be safely battered back, or close side support provided, in order to comply with statutory safety requirements and prevent sidewall collapse.

Floor Slabs

In open areas, well away from any trees, the proposed buildings could have a ground bearing floor slab, providing the sub-grade soils are well prepared. The proposed houses may be in areas close to trees in clay soils, where the floor slab should be suspended on the foundations in order to avoid any differential movements between them. A suspended floor slab would avoid any volume change movements within any root affected clays, providing that the sub-floor gaps recommended in NHBC Standards Chapter 4.2, Tables 9 and 10, are adopted.

Sulphate Conditions

Sulphate analysis of selected samples of soil yielded soluble sulphate concentrations within Design Sulphate Classes DS-1 and DS-2 of the BRE Special Digest 1, Table C2 (2005), presented in Appendix 3. The pH results of samples ranged between 7.4 and 10.1 indicating alkaline conditions.

These results indicate an Aggressive Chemical Environment for Concrete (ACEC) Class of AC-2 for buried concrete. This ACEC Class should be considered when specifying a Design Chemical Class (DC Class) for buried concrete on this site, as detailed in the above cited BRE document.

Drainage

The soakaway tests (TP1 and TP2) gave soil infiltration rates (f) of between 1.12×10^{-5} m/s and 1.55×10^{-6} m/s, for Tidal Flat Deposit soils. These results rate the Tidal Flat Deposit as having a 'good' to 'poor' drainage potential according to BS8004:1986, and reflect the variable properties of the Tidal Flat Deposit clays and silts.

Groundwater was met as seepages between 2.90m and 4.00m depth in WS1 to WS9, within the superficial Marine Sand deposits. Soakaway drainage on this site may deteriorate over time as the chambers could become blocked with silt. Provision should be made for regular cleaning.

Hardstanding

Made ground soils comprising soft or firm, slightly sandy, slightly gravelly, clay fill, and silty, gravelly sand fill, or naturally deposited soft or firm, slightly sandy clay/silt, was encountered at sub-grade level across this site.

Based on Interim Advice Note (IAN) 73/06 (2009) 'Design Guidance for Road Pavement Foundations (Draft HD25)', Table 5.1 recommends a design CBR value of 3.0% for a clay with a plasticity index of 10% and thin pavement construction, and a design CBR value of 1% for silt with a thin or thick pavement construction. A conservative design CBR value of 3.0%

for firm clay/sand fill or naturally deposited sandy clay soils, or 1.0% for silt, could be adopted for hardstanding design on this site. This assumes that any inferior soils at sub-grade level will be removed and replaced.

The sub-grade should be suitably compacted and inspected with any soft spots being removed and replaced with more suitable well-graded coarse-grained fill. Care should be taken not to allow the exposed soil at sub-grade level to become exposed to inclement weather conditions, as the condition of the very silty soils will rapidly deteriorate in the presence of water.

COMMENTS ON THE SOIL CHEMICAL TEST RESULTS

The results of the laboratory chemical testing on near surface soil samples have been compared to CLEA Soil Screening Values (SSVs) and Category 4 Screening Levels (C4SLs), which have been used as screening tools for use in the assessment of land affected by contamination.

Atkins Limited has derived ATRISKsoil SSVs based on the default assumptions provided in SR3, which have been used in the development of the Soil Guideline Values (SGVs) published by the Environment Agency in 2009. Atkins SSVs have been derived in line with the Environment Agency 2009 guidance (SR2, SR3, SR4, SR7) using the CLEA v1.04 and CLEA v1.06 software. These are provided under licence to Ground Engineering Limited, and respective toxicology reports and technical details on the derivation of the SSVs can be provided on request.

Following revised statutory guidance to support Part 2A of the Environment Protection Act (2012), Final Category 4 Screening Levels have been published (for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead) by the Department for Environment Food and Rural Affairs in their document SP1010:2014. With the exception of lead the C4SLs are higher than the SSVs.

The following standard land uses form the basis of the assessment in relation to soils:

- Residential usage with home grown produce
- Residential usage without home grown produce
- Commercial and industrial usage

The intended purpose of the SSVs are as “intervention values” in the regulatory framework for assessment of human health risks in relation to land use. These values are not binding standards, but are intended to inform judgements about the need for action to ensure that a new use of land does not pose any unacceptable risks to the health of the intended users.

Table 5 compares the test results for the made ground with the SSVs, and C4SLs for lead and chromium (VI), in relation to the specified uses. The number of test results, which exceed these values, is also provided.

Table 5: Comparison of Chemical Test Results with SSVs and C4SLs for Made Ground

Determinand	Number of Samples	Min Value mg/kg	Max Value mg/kg	Number of Samples Exceeding SSV/C4SL for			Measured 95 th Percentile mg/kg	Assessment Method	Soil Screening Criteria 1% SOM [#]		
				Residential with home grown produce	Residential without home grown produce	Commercial/Industrial			Residential with home grown produce mg/kg	Residential without home grown produce mg/kg	Commercial/Industrial mg/kg
Organic Matter	9	0.71%	13%	-	-	-	-	-	-	-	-
Arsenic	9	12	30	0	0	0	26.17	SSV	32	35	640
Cadmium	9	<0.10	4.2	0	0	0	1.17	SSV	10	83	230
Chromium (III)*	9	17	46	0	0	0	36.22	SSV	12,800	15,500	21,300
Chromium (VI)	9	<0.50	<0.50	0	0	0	<0.50	C4SL	21 [#]	21 [#]	49 [#]
Lead	9	17	210	1	0	0	95.03	C4SL	200 [#]	310 [#]	2330 [#]
Mercury	9	<0.10	0.37	0	0	0	0.27	SSV	6	7	66
Selenium	9	<0.20	<0.20	0	0	0	<0.20	SSV	350	595	13,000
Nickel	9	19	35	0	0	0	27.70	SSV	130	130	1800
Phenols	9	<0.30	0.77	0	0	0	0.45	SSV	162	262	686
Benzolalpyrene	9	0.87	87	9	8	2	32.71	SSV	0.8	0.9	14
Copper	9	14	190	0	0	0	84.12	SSV	3970	8370	109,000
Zinc	9	46	630	0	0	0	265.15	SSV	16,900	46,800	917,000
Free Cyanide	9	<0.50	<0.50	0	0	0	<0.50	SSV	34	34	34

Notes * The concentration of Trivalent Chromium is assumed to be equivalent to the Total Chromium concentration. This is because most naturally occurring chromium is in the trivalent (chromic) state.

Category 4 Screening Levels for lead and chromium VI are based on 6% SOM.

Discussion of Soil Results

The results of the laboratory analysis indicate that the made ground contains elevated concentrations of benzo[a]pyrene and lead, which exceeded the residential with home grown produce soil screening values/C4SLs. The highest concentrations of benzo[a]pyrene also exceeded the associated soil screening values for a residential without home grown produce and commercial/industrial end use.

Levels of all remaining elements and compounds were within the associated soil screening values for both residential and commercial/industrial end uses.

The US95 value for benzo[a]pyrene exceeded the screening value for a residential with home grown produce end use; and also exceeded the screening values for a residential without home grown produce end use and a commercial or industrial usage. None of the US95 values for the other elements and compounds tested exceeded the corresponding screening values for either of the residential end uses or for a commercial or industrial usage.

The maximum value test was carried out on the benzo[a]pyrene and lead results. The results show that the T-Calc Values for benzo[a]pyrene (1.86) and lead (1.60) are less than the T-Critical Value (2.11), thus the highest values of benzo[a]pyrene (87mg/kg, WS6 at 0.90m) and lead (210mg/kg, WS1 at 0.90m), may be regarded as part of the same sample populations and are not 'outliers'.

Other Contaminants

The made ground encountered during this investigation was not noted to have olfactory or visual evidence of fuel contamination. Total petroleum hydrocarbon concentrations of between <10mg/kg (below laboratory detection limit) and 12,000mg/kg (WS6 at 0.90m depth) were recorded in the samples tested. The highest result from WS6 probably reflects the significant presence of ash and coal in the sample, and is not considered significant.

No asbestos containing materials were observed in any of the samples.

UPDATED CONCEPTUAL MODEL

Assessment of the potential linkage between ground contamination sources, human and environmental receptors have been assessed based on the desk study research and the intrusive ground investigation documented in the preceding sections of this report.

A generalised conceptual model relative to the existing site and proposed new residential development use of the site is presented in Table 6 below.

Table 6: General Conceptual Model Relative to Future Residential Development

Receptors	Pathway	Estimated Potential for Linkage with Contaminant Sources					
		Drainage	Buildings	Above Ground Tank	Soil	Soil Gas	Off-Site Sources
Human Health – ground workers	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	Moderate	Moderate	N/A	Moderate	Very Low	Very Low
Human Health – users of completed development	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	N/A	N/A	N/A	Moderate	Very Low	Very Low
Water Environment	Migration through ground into surface water or groundwater	Low	N/A	N/A	Very Low	Very Low	Very Low
Flora	Vegetation on site growing on contaminated soil	Very Low	N/A	N/A	Very Low	Very Low	Very Low
Building Materials	Contact with contaminated soil	Very Low	N/A	N/A	Very Low	Very Low	Very Low

<u>Key to Table 6 Risk</u>	Definition
Very High	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, or, there is evidence that severe harm to a designated receptor is currently happening. The risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) and remedial works may be necessary in the short term and likely over the long term.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild.
Low	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.
N/A	Not Applicable because the proposed development will remove the source.

COMMENTS ON GROUND CONTAMINATION IN RELATION TO PROPOSED DEVELOPMENT

Anticipated exposure scenarios relating to the existing depot site, the site history and proposed residential use of the site, in the context of the conceptual model, are discussed as follows.

The proposed development is understood to comprise demolishing the existing depot buildings and replacing them with a new residential development, including gardens, landscaping and areas of hardstanding. A proposed site layout was not available at the time of report writing.

This investigation may not have revealed the full extent of contamination on the site and appropriate professional advice should be sought if subsequent site work reveals materials that may appear to be contaminated.

Contaminated Soil

On the basis of the ground investigation, the site is underlain by between 0.40m and 1.80m of made ground. The presence of benzo[a]pyrene, lead and hydrocarbons (TPH) in the made ground indicates that there is a moderate risk of contaminants affecting groundworkers during any construction works and a moderate risk of affecting future end users of the site if the made ground is exposed in any garden or landscaped areas within a residential setting.

Two of the concentrations of benzo[a]pyrene (WS6 and WS9, both at 0.90m depth) exceeded the screening value for a commercial or industrial end use, representative of areas to be covered by buildings and hardstanding, and these concentrations are considered to reflect the significant presence of ash and asphalt in these made ground samples. Generally there is a low risk of affecting future site users in areas to be covered by buildings or hard surfaced areas, which would effectively provide a barrier from end users to the made ground.

Existing Drainage

Redundant drain runs, where encountered, should be removed from beneath the site and precautions should ensure that any remaining effluent is directly disposed off-site. The integrity of existing drainage should be checked, and if they are to be retained any damaged sections replaced prior to development. The latter measures should minimise any future risk to human health and the water environment.

Existing Buildings

The existing buildings may have asbestos containing materials within them. It would be recommended that an asbestos survey is conducted within the buildings prior to any demolition or building works. No asbestos was found in the soils during this investigation. Suitable precautions, in line with current best practice, such as vigilance and examination of near surface made ground soils, should be put in place to protect workers from the effects of any asbestos material, during the excavation phase.

Soil Gas

According to the environmental database there are no landfills within 250m of the site. The site is underlain by a layer of made ground, covering superficial Tidal Flat Deposits and Marine Sand.

There is a very low risk that hazardous gas would affect groundworkers during the construction phase and a very low risk of hazardous gas affecting future users of the site.

The site lies within an area where less than 1% of homes are above the BRE action level for radon and that no radon protection measures are required.

Human Health - Construction Workers

The presence of contaminants in the made ground (benzo[a]pyrene) indicates that there is a moderate risk to groundworkers during the construction phase of development.

No special precautions would be required during the development of the site by workers who may come into contact with the soil during groundworks, providing standard precautions are adopted which should generally include the procedures given by the Health and Safety Executive (The Blue Book) HS(G)66.

For the protection of workers during groundworks the following is recommended:

a) Limit repeated or prolonged skin contact with soils by wearing gloves with sleeves rolled down.

b) Washing facilities should be made available to groundworkers, so as to minimise the potential for inadvertent ingestion of soil.

c) If any soils are revealed which are different to those encountered by this ground investigation, the advice of a specialist should be sought in view of classifying the material and ascertaining its risk to groundworkers.

d) Consideration should be given to gas monitoring within deep or confined spaces, particularly where made ground thickens, to ensure safety of personnel entering them, since carbon dioxide could accumulate within any excavations, service chambers or sub-structures.

Human Health - Users of Completed Development

The results of the chemical analysis undertaken indicate that the made ground should be considered unsuitable for re-use at the surface in any new garden or landscaped areas within a residential setting, due to the statistically elevated concentrations of benzo[a]pyrene, lead and TPH. For garden and patio areas it is recommended that the made ground should either be completely removed, or removed to a minimum depth of 0.90m below finished ground level, and replaced with an equivalent thickness of clean inert topsoil or clean granular fill.

Other than the removal of the TPH (ash, coal and asphalt) contaminated soils, no scheme of remediation would be considered necessary for areas to be covered by buildings or hard surfaced areas, which would effectively provide a barrier between end users and the made

ground, and the risk to end users would therefore be considered to be very low. This is because it would be unlikely that the site users or workers would normally be able to penetrate building floors or surface hardstanding layers necessary in order to uncover any soils beneath the site.

Any soil imported to site must be certified as "suitable for use".

Water Environment

The site is underlain by 'Unproductive' superficial strata, covering an 'Unproductive' solid geology stratum, and there are no surface water features on the site. The nearest surface water feature is a pond 73m south-west of the site. The site does not lie within a source protection zone.

The risk to the water environment is considered as very low as it is unlikely that the proposed development would impact the quality of the water environment.

Effects on Building Materials

The sulphate requirements for buried concrete have been discussed in the previous section of this report.

Off-Site Disposal of Soil Arisings

The results of chemical analysis provided to the rear of this report should be used within the information necessary for basic characterisation of the soil destined for landfill. The Environment Agency publication Hazardous Waste, Technical Guidance WM2 outlines the methodology for classifying wastes and should be referenced for guidance. The test results (total metals, hydrocarbons and cyanide) should be compared to the relevant thresholds to determine whether they fall into the primary categories of non-hazardous or hazardous waste and will help indicate the likely European Waste Catalogue (EWC) code which is determined by the waste type. The results of Waste Acceptance Criteria (WAC) leachate testing, on a sample of made ground (WS7, 0.60m) should be used to check whether, if categorised as non-hazardous waste it

could be disposed of at an inert waste landfill; or if categorised as hazardous waste whether it could qualify as stable non-reactive hazardous waste for disposal in non-hazardous landfill.

Excavated material and excess spoil should always be classified prior to removal from site as required by 'Duty of Care' (Environmental Protection Act, 1990) legislation. This means that material has to be given a proper description and waste classification prior to removal. Basic characterisation is the responsibility of the waste producer, whilst compliance checking and on-site verification are generally the responsibility of the landfill operator. The landfill operator will need to liaise with the waste producer, as the approach relies on the information from basic characterisation.

It is expected that arisings of natural soils from the excavations across this site would fall into the inert category under the European Waste Catalogue description 'Soil and Stones', EWC code 17 05 04 with restrictions excluding topsoil and peat.

GROUND ENGINEERING LIMITED



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M.Sc.(Eng.), M.A.E.G.

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Director

Site Location Plan

Map based on Ordnance Survey not to scale. With the permission of the Controller of Her Majesty's Stationery Office, © Crown Copyright. All rights reserved. Licence number AL100005523



Not To Scale

Project : Station Road, Long Sutton, Lincolnshire

Client : Nene Transport (Lincs) Limited

**GROUND
ENGINEERING
LIMITED**

Peterborough Tel : 01733 566566

Project No.

C13684

Exploratory Hole Location Plan

Plan from engineer Robert Doughty Consultancy based upon the Ordnance Survey not to scale with permission of the Controller of Her Majesty's Stationery Office, © Crown Copyright. All rights reserved. Robert Doughty Consultancy Licence no. 100005523

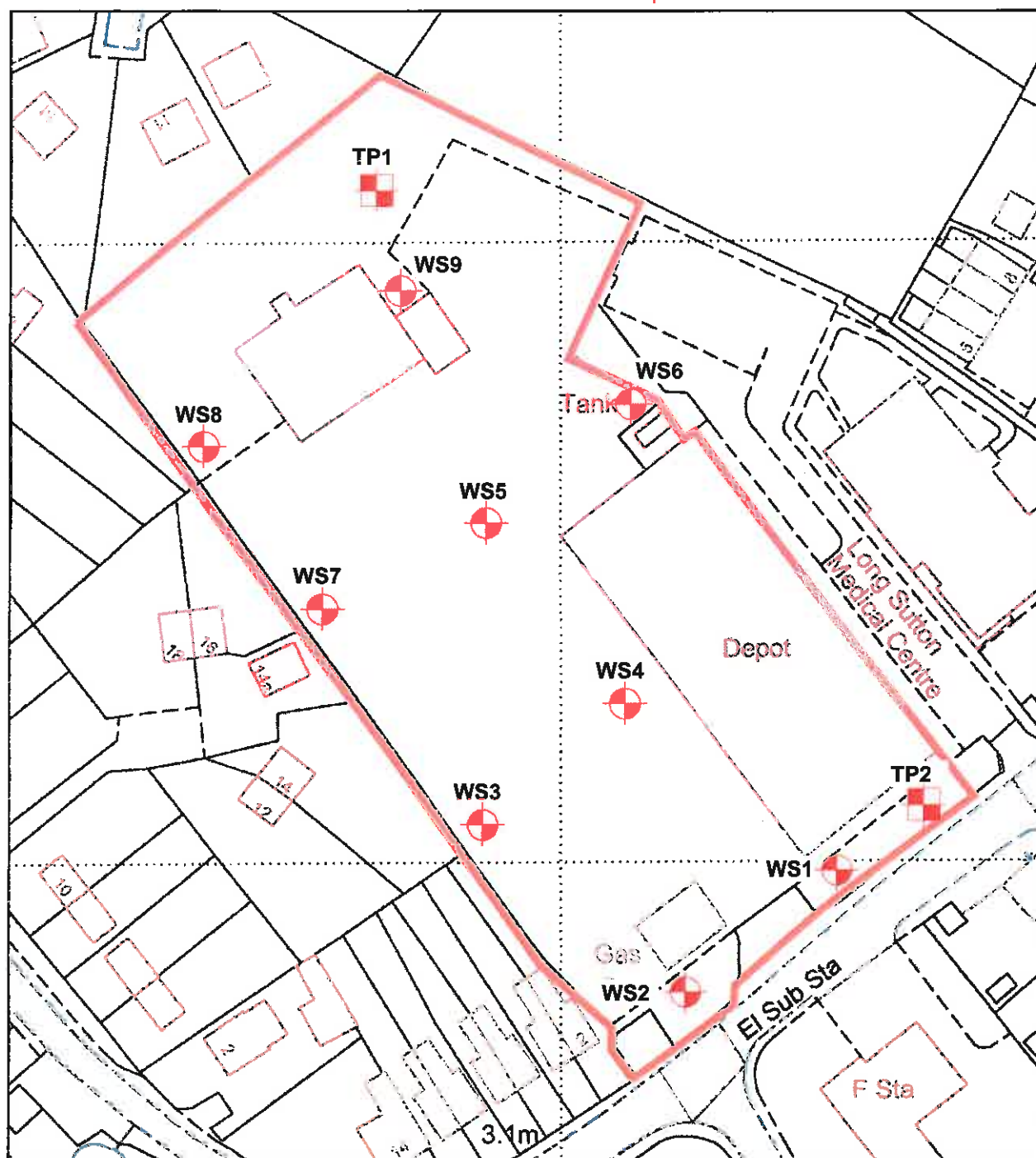
Key



Trial Pit



Borehole



0 25 50 75 100

Approximate scale bar



Project : Station Road, Long Sutton, Lincolnshire

Client : Nene Transport (Lincs) Limited

**GROUND
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C13684

L I M I T E D
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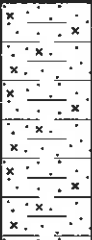
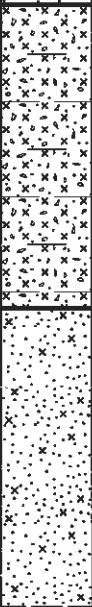
Date: 28/09/15

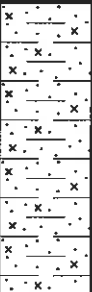
Hole Size:	87mm dia to 2.00m
	67mm dia to 3.00m
	57mm dia to 4.45m

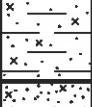
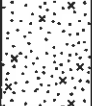
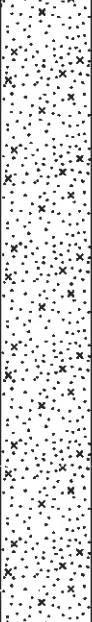
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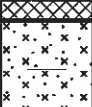
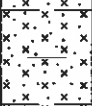
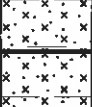
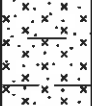
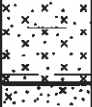
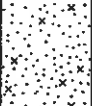
REMARKS	1. Starter pit excavated from GL to 1.20m depth 2. Live roots observed to 1.95m depth	Project No 13684	
		Scale 1:25	Page 1/1

[illegible]

GROUND ENGINEERING L I M I T E D Tel: 01733-566566 www.groundengineering.co.uk			Site: STATION ROAD, LONG SUTTON					WINDOW SAMPLE WS2				
			Date: 28/09/15		Hole Size: 77mm dia to 2.00m 67mm dia to 3.00m 57mm dia to 4.00m			Ground Level:				
Samples and in-situ Tests			(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m					
Depth m	Type	Result										
0.30	D1			MADE GROUND - Brown, slightly clayey, slightly gravelly, silty SAND. Gravel is angular to sub-rounded flint, ash, glass, plastic and brick fragments.		1.20						
0.60	D2											
0.90	D3											
1.20 1.25	D4 U1A											
1.50 1.50 1.60-1.90	U1B V1 U1C	(59)		Firm, brown/grey, sandy, silty CLAY. Sand is fine.		2.00						
				(TIDAL FLAT DEPOSIT)								
1.95	V2	(54)		Very soft, grey/orange brown mottled clayey, sandy SILT with pocket of light brown, sand and gravel at 2.75m depth. Gravel is angular and sub-angular flint.								
2.10-2.40	U2A			(TIDAL FLAT DEPOSIT)								
2.50	U2B			Grey, silty SAND. Sand is fine.		3.00						
2.90 3.00-4.00	U2C B1											
			1 ▽	(MARINE SAND)		4.00						
				Hole completed at 4.00m depth								
REMARKS 1. Starter pit excavated from GL to 1.20m depth 2. No live roots observed							Project No 13684					
							Scale 1:25	Page 1/1				
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample ▽ Water Strike ▽ Depth to Water on completion J - Jar Sample M - Mackintosh Probe V - Vane Shear Test Cohesion () kPa P () - Hand Penetrometer Cohesion () kPa ▽s Standpipe Level			Groundwater Strikes				Groundwater Observations					
			Depth m						Depth m			
			No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
1	3.50		seepage			28/09/15	4.00	0.00	4.00			

GROUND ENGINEERING L I M I T E D Tel: 01733-566566 www.groundengineering.co.uk			Site: STATION ROAD, LONG SUTTON						WINDOW SAMPLE WS3			
			Date: 28/09/15		Hole Size: 77mm dia to 2.00m 67mm dia to 3.00m 50mm dia to 4.45m				Ground Level:			
Samples and in-situ Tests			(Date) Water	Description of Strata			Legend	Depth m	O.D. Level m			
Depth m	Type	Result										
0.30	D1	N3		MADE GROUND - Soft, brown/grey, slightly gravelly, sandy, silty CLAY. Gravel is angular to sub-rounded flint, ash and brick fragments.				0.40				
0.60	D2			MADE GROUND - Soft, brown, slightly gravelly, silty CLAY. Gravel is angular and sub-angular flint, coal and brick fragments.								
0.90	D3											
1.20 1.30 1.35-1.65	D4 U1A S	N5		Soft, brown/grey, slightly sandy, silty CLAY.				1.60				
1.60-2.00	B1											
2.00 2.00-3.00 2.15-2.45	D5 U1 S			(TIDAL FLAT DEPOSIT)								
3.00 3.00-4.00 3.15-3.45	D6 U2 S	N6	1 ▽	Loose, light brown, silty SAND. Sand is fine.				2.60				
4.00	D7											
4.15-4.45	S			...Slightly gravelly at 4.00m depth. Gravel is fine and medium, sub-angular and sub-rounded flint. (MARINE SAND)								
				Hole completed at 4.45m depth				4.45				
REMARKS 1. Starter pit excavated from GL to 1.20m depth 2. No live roots observed									Project No 13684			
									Scale 1:25	Page 1/1		
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample ▽ - Water Strike ▽ - Depth to Water on completion J - Jar Sample M - Mackintosh Probe V - Vane Shear Test Cohesion () kPa P () - Hand Penetrometer Cohesion () kPa ▽s Standpipe Level			Groundwater Strikes						Groundwater Observations			
			Depth m						Depth m			
			No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
1	3.00		seepage			28/09/15	4.45	0.00	4.00			

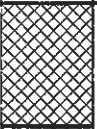
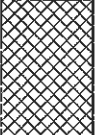
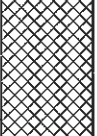
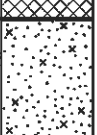
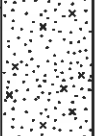
GROUND ENGINEERING LIMITED Tel: 01733-568566 www.groundengineering.co.uk			Site: STATION ROAD, LONG SUTTON						WINDOW SAMPLE WS4			
			Date: 28/09/15		Hole Size: 77mm dia to 2.00m 67mm dia to 3.00m 57mm dia to 4.00m				Ground Level:			
Samples and in-situ Tests			(Date) Water	Description of Strata				Legend	Depth m	O.D. Level m		
Depth m	Type	Result										
0.30	D1	(54)		MADE GROUND - CONCRETE AND ASPHALT. (Driller's description)					0.35			
0.60	D2			MADE GROUND - Brown, slightly sandy GRAVEL of angular to rounded flint.					0.50			
0.90	D3			MADE GROUND - Brown/grey, slightly gravelly, silty SAND. Gravel is sub-angular to rounded flint.					0.75			
1.20-2.00	B1			Firm, brown, very sandy, silty CLAY. Sand is fine.					1.30			
1.20	D4			(TIDAL FLAT DEPOSIT)								
1.20	V1			Brown/orange brown, very silty SAND with occasional specks. Sand is fine.								
2.00-3.00	B2			(MARINE SAND)								
3.00-4.00	B3		1 V									
				Grey, slightly silty SAND. (MARINE SAND)					3.80			
				Hole completed at 4.00m depth					4.00			
REMARKS 1. Concrete cored at 200mm diameter to 0.35m depth 2. Starter pit excavated from GL to 1.20m depth 3. No live roots observed										Project No 13684		
										Scale 1:25	Page 1/1	
KEY D - Disturbed Sample J - Jar Sample B - Bulk Sample M - Mackintosh Probe U - Undisturbed Sample V - Vane Shear Test W - Water Sample Cohesion () kPa ▽ Water Strike P () - Hand Penetrometer ▽ Depth to Water Cohesion () kPa on completion ∇s Standpipe Level			Groundwater Strikes						Groundwater Observations			
			Depth m						Depth m			
			No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
1	3.00		seepage			28/09/15	4.00	0.00	4.00			

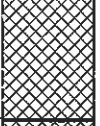
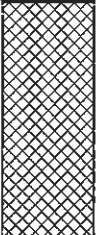
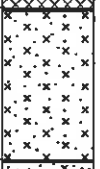
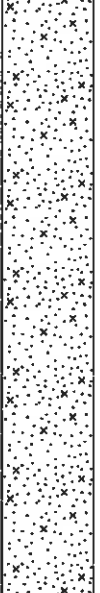
GROUND ENGINEERING L I M I T E D Tel: 01733-566566 www.groundengineering.co.uk			Site: STATION ROAD, LONG SUTTON					WINDOW SAMPLE WS5				
			Date: 28/09/15		Hole Size: 77mm dia to 2.00m 67mm dia to 3.00m 50mm dia to 4.45m			Ground Level:				
Samples and in-situ Tests			(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m					
Depth m	Type	Result										
0.40	D1			MADE GROUND - CONCRETE.		0.33						
0.60	D2			MADE GROUND - Brown, slightly gravelly, clayey SAND. Gravel is angular to sub-rounded flint and brick fragments. Soft, grey/light brown/dark grey, slightly sandy, CLAY/SILT.		0.40						
0.90	D3			(TIDAL FLAT DEPOSIT)								
1.20-2.00 1.20 1.35-1.65	B1 D4 S	N8		Loose, light brown/grey, clayey, sandy SILT with occasional thickly laminated soft, grey, sandy, silty clay partings. Sand is fine. (TIDAL FLAT DEPOSIT)		1.20						
2.00-3.00 2.00 2.15-2.45	B2 D5 S	N2		Very loose, becoming loose below 3.00m depth, brown/orange brown/grey, silty SAND. Sand is fine.		2.00						
3.00-4.00 3.00 3.15-3.45	B3 D6 S	N7	1 ▽	(MARINE SAND)								
4.00 4.15-4.45	D7 S	N7										
				Hole completed at 4.45m depth		4.45						
REMARKS 1. Concrete cored at 200mm diameter at 0.33m depth 2. Starter pit excavated from GL to 1.20m depth 3. No live roots observed							Project No 13684					
							Scale 1:25	Page 1/1				
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample ▽ Water Strike ▽ Depth to Water on completion J - Jar Sample M - Mackintosh Probe V - Vane Shear Test Cohesion () kPa P () - Hand Penetrometer Cohesion () kPa ▽s Standpipe Level			Groundwater Strikes				Groundwater Observations					
			Depth m						Depth m			
			No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
1	3.00		seepage			28/09/15	4.45	0.00	4.00			

GROUND ENGINEERING LIMITED Tel: 01733-568566 www.groundengineering.co.uk			Site: STATION ROAD, LONG SUTTON				WINDOW SAMPLE WS6																																	
			Date: 29/09/15		Hole Size: 77mm dia to 2.00m 67mm dia to 3.00m 57mm dia to 4.00m		Ground Level:																																	
Samples and in-situ Tests <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Depth m</th> <th>Type</th> <th>Result</th> </tr> </thead> <tbody> <tr><td>0.20</td><td>D1</td><td></td></tr> <tr><td>0.60</td><td>D2</td><td></td></tr> <tr><td>0.90</td><td>D3</td><td></td></tr> <tr><td>1.20</td><td>D4</td><td></td></tr> <tr><td>1.20-2.00</td><td>U1</td><td></td></tr> <tr><td>1.80</td><td>V1</td><td>(27)</td></tr> <tr><td>1.80</td><td>U1A</td><td></td></tr> <tr><td>2.00-3.00</td><td>U2</td><td></td></tr> <tr><td>3.00-4.00</td><td>U3</td><td></td></tr> </tbody> </table>			Depth m	Type	Result	0.20	D1		0.60	D2		0.90	D3		1.20	D4		1.20-2.00	U1		1.80	V1	(27)	1.80	U1A		2.00-3.00	U2		3.00-4.00	U3		(Date) Water	Description of Strata				Legend	Depth m	O.D. Level m
Depth m	Type	Result																																						
0.20	D1																																							
0.60	D2																																							
0.90	D3																																							
1.20	D4																																							
1.20-2.00	U1																																							
1.80	V1	(27)																																						
1.80	U1A																																							
2.00-3.00	U2																																							
3.00-4.00	U3																																							
				MADE GROUND - Soft, brown, slightly sandy, slightly gravelly CLAY. Gravel is angular to sub-rounded flint, concrete and brick fragments.					0.20																															
				MADE GROUND - Black/dark grey, silty SAND AND GRAVEL. Gravel is angular to sub-rounded ash, coal, slag, concrete and brick fragments.																																				
				MADE GROUND - Firm, brown, slightly sandy CLAY with rare ash fragments.					1.00																															
				Grey/light brown/orange brown mottled, very sandy SILT. Sand is fine. (TIDAL FLAT DEPOSIT)																																				
				Soft, grey/brown, slightly sandy, silty CLAY. (TIDAL FLAT DEPOSIT)					1.75																															
				Light brown/orange brown/grey, silty SAND.																																				
				(MARINE SAND)					1.90																															
									4.00																															
				Hole completed at 4.00m depth																																				

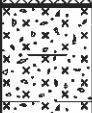
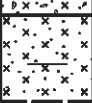
REMARKS 1. Starter pit excavated from GL to 1.20m depth 2. Live roots observed to 0.90m depth								Project No 13684	
								Scale 1:25	Page 1/1

KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample ∇ - Water Strike ∇s - Depth to Water on completion J - Jar Sample M - Mackintosh Probe V - Vane Shear Test Cohesion () kPa P () - Hand Penetrometer Cohesion () kPa ∇s - Standpipe Level		Groundwater Strikes						Groundwater Observations			
		Depth m						Depth m			
		No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
1	3.00		seepage			29/09/15	4.00	0.00	4.00		

GROUND ENGINEERING LIMITED Tel: 01733-566566 www.groundengineering.co.uk			Site: STATION ROAD, LONG SUTTON					WINDOW SAMPLE WS7				
			Date: 29/09/15		Hole Size: 77mm dia to 2.00m 67mm dia to 3.00m 57mm dia to 4.45m			Ground Level:				
Samples and in-situ Tests			(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m					
Depth m	Type	Result										
0.30	D1			MADE GROUND - Soft, brown/grey, slightly gravelly, sandy, silty CLAY. Gravel is angular to sub-rounded flint, brick fragments and rare ash.		0.40						
0.60	D2			MADE GROUND - Soft, brown/grey/orange brown mottled, slightly sandy, slightly gravelly to gravelly CLAY. Gravel is angular to sub-rounded flint, coal, ash and brick fragments.								
0.90	D3											
1.20	D4					1.50						
1.35-1.65	S	N4										
1.40	U1A											
1.60	U1B			MADE GROUND - Loose, light brown, clayey, silty SAND.		1.65						
1.70	U1C											
1.90	U1D			MADE GROUND - Soft, brown/grey, slightly gravelly, sandy, silty CLAY. Gravel is fine and medium, angular and sub-angular coal and ash.								
2.00-3.00	B1			Loose, light brown/orange brown, very silty SAND. Sand is fine.		1.80						
2.00	D5											
2.15-2.45	S	N6										
3.00	D6		1 Σ (MARINE SAND)									
3.00-4.00	U3											
3.15-3.45	S	N4										
4.00	D7											
4.15-4.45	S	N5										
				Hole completed at 4.45m depth		4.45						
REMARKS 1. Starter pit excavated from GL to 1.20m depth 2. Live roots observed to 1.90m depth							Project No 13684					
							Scale 1:25	Page 1/1				
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample ∇ - Water Strike ∇ - Depth to Water on completion J - Jar Sample M - Mackintosh Probe V - Vane Shear Test Cohesion () kPa P () - Hand Penetrometer Cohesion () kPa ∇s - Standpipe Level			Groundwater Strikes				Groundwater Observations					
			Depth m						Depth m			
			No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water
1	3.00		seepage			29/09/15	4.45	0.00	4.00			

GROUND ENGINEERING LIMITED Tel: 01733-666566 www.groundengineering.co.uk			Site: STATION ROAD, LONG SUTTON					WINDOW SAMPLE WS8			
			Date: 29/09/15		Hole Size: 77mm dia to 2.00m 67mm dia to 3.00m 57mm dia to 4.00m			Ground Level:			
Samples and in-situ Tests			(Date) Water		Description of Strata			Legend		Depth m O.D. Level m	
Depth m Type Result											
0.30 D1					MADE GROUND - Brown, silty, SAND AND GRAVEL. Gravel is angular to sub-rounded ash, concrete, mortar and brick fragments.					0.40	
0.60 D2					MADE GROUND - Brown/dark brown, silty SAND AND GRAVEL. Gravel is angular to sub-rounded flint, ash, glass, concrete, mortar and brick fragments.					0.70	
0.90 D3					MADE GROUND - Soft, brown/light brown/grey, slightly sandy, slightly gravelly CLAY. Gravel is angular to sub-rounded flint, shell and brick fragments.						
1.20 D4 1.30 U1A											
1.50-2.00 B1					Light brown, very sandy SILT with occasional black specks. Sand is fine. (TIDAL FLAT DEPOSIT)					1.50	
2.00-3.00 U1					Light brown/orange brown/grey, silty SAND with occasional black specks.					2.00	
3.00-4.00 U2			1 		(MARINE SAND)					4.00	
					Hole completed at 4.00m depth						
REMARKS 1. Starter pit excavated from GL to 1.20m depth 2. Live roots observed to 1.80m depth										Project No 13684	
										Scale Page 1:25 1/1	
KEY D - Disturbed Sample J - Jar Sample B - Bulk Sample M - Mackintosh Probe U - Undisturbed Sample V - Vane Shear Test W - Water Sample Cohesion () kPa  Water Strike P () - Hand Penetrometer  Depth to Water Cohesion () kPa on completion  Standpipe Level			Groundwater Strikes Depth m No Struck Rose to Rate Cased Sealed				Groundwater Observations Date Hole Casing Water Depth m				
			1 3.00 seepage				29/09/15 4.00 0.00 4.00				

GROUND ENGINEERING L I M I T E D Tel: 01733-566566 www.groundengineering.co.uk			Site: STATION ROAD, LONG SUTTON						WINDOW SAMPLE WS9					
			Date: 29/09/15		Hole Size: 77mm dia to 2.00m 67mm dia to 3.00m 50mm dia to 4.45m				Ground Level:					
Samples and in-situ Tests			(Date) Water	Description of Strata			Legend	Depth m	O.D. Level m					
Depth m	Type	Result												
0.30	D1	N9	1 ▽	MADE GROUND - Brown/grey, silty SAND AND GRAVEL. Gravel is angular to rounded flint, concrete, asphalt, ash and brick fragments.				1.30						
0.60	D2													
0.90	D3													
1.20-2.00	B1	N7		Loose, orange brown/grey, very sandy SILT. Sand is fine. (TIDAL FLAT DEPOSIT)				2.00						
1.20	D4													
1.35-1.65	S													
2.00-3.00	B2	N6		Loose, orange brown/light brown/grey mottled, slightly gravelly, very silty SAND. Sand is fine. Gravel is sub-rounded flint.				4.45						
2.15-2.45	S													
2.50	ES1													
3.00-4.00	B3	N10		(MARINE SAND)										
3.00	D5													
3.15-3.45	S													
4.15-4.45	S													
				Hole completed at 4.45m depth										
REMARKS 1. Starter pit excavated from GL to 1.20m depth 2. Live roots observed to 0.90m depth 3. ES = Environmental Sample										Project No 13684				
									Scale 1:25	Page 1/1				
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample W - Water Sample ▽ Water Strike ▽ Depth to Water on completion J - Jar Sample M - Mackintosh Probe V - Vane Shear Test Cohesion () kPa P () - Hand Penetrometer Cohesion () kPa ▽s Standpipe Level				Groundwater Strikes				Groundwater Observations						
				Depth m						Date	Depth m			
				No	Struck	Rose to	Rate	Cased	Sealed		Hole	Casing	Water	
				1	2.90		seepage				29/09/15	4.45	0.00	4.00

GROUND ENGINEERING LIMITED Tel: 01733-666566 www.groundengineering.co.uk			Site: STATION ROAD, LONG SUTTON		TRIAL PIT TP1	
Date: 30/11/15			Pit Size: 1.90m L x 0.35m W x 1.50m D.		Ground Level:	
Samples and in-situ Tests			(Date)	Description of Strata	Legend	O.D. Level
Depth m	Type	Result	Water			
0.30	D1			MADE GROUND - Brown/dark brown, slightly clayey, sandy, gravelly SILT with pockets of orange brown sand and gravel and occasional cobbles of concrete. Gravel is angular to sub-rounded flint, igneous rock, plastic strap, concrete and brick fragments.		
0.60	D2					0.80
0.90	D3			Firm, brown/orange brown, slightly sandy, slightly gravelly CLAY/SILT. Sand is fine. Gravel is angular to sub-rounded flint. (TIDAL FLAT DEPOSIT)		1.20
1.20	D4					
1.50	D5			Orange brown/brown, slightly clayey, sandy SILT. Sand is fine. (TIDAL FLAT DEPOSIT)		1.50
				Pit completed at 1.50m depth		

KEY	REMARKS
D - Disturbed Sample	1. Live roots observed to 0.95m depth
B - Bulk Sample	2. Pit dry
U - Undisturbed Sample	3. Pit sides stable
R - Root Sample	4. Soakaway test undertaken at 1.50m depth
W - Water Sample	
J - Jar Sample	
∇ - Water Strike	
∇ - Water Rise	
∇c - Level on completion	
MP - Mackintosh Probe	
P() - Hand Penetrometer	
V - Vane Shear Test	

Project No 13684	
Scale 1:25	Page 1/1

SOAKAWAY TEST RESULTS

BRE DIGEST 365 - SOIL INFILTRATION RATE

Project: Station Road, Long Sutton, Lincolnshire
Client: Nene Transport (Lincs) Limited

Project No: C13684
Sheet No: 1/1

Trial Pit: TP1 FIRST FILLING
Depth: 1.50
Length: 1.90
Width: 0.35

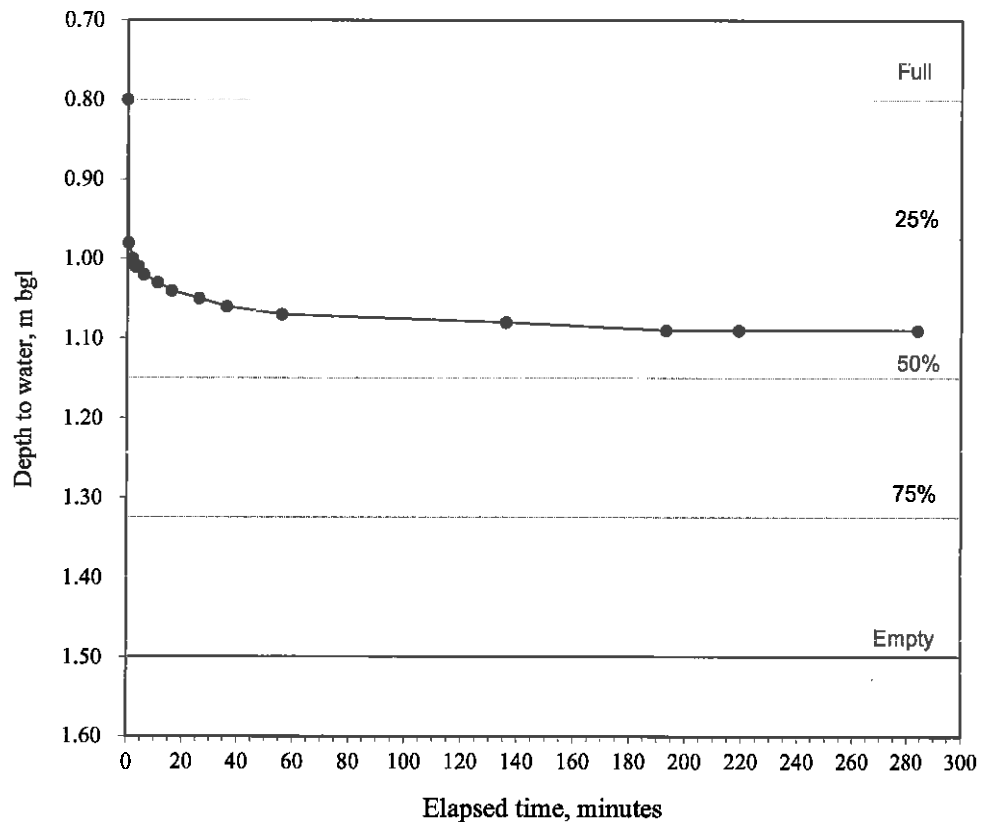
Description of Stratum under test: Firm, brown/orange brown, slightly sandy, slightly gravelly, CLAY/SILT over slightly clayey, sandy SILT

Depth to water prior to test: Dry
(below ground level)

Elapsed Time min	Depth to Water m
0	0.80
1	0.98
2	1.00
3	1.01
4	1.01
6	1.02
11	1.03
16	1.04
26	1.05
36	1.06
56	1.07
136	1.08
193	1.09
219	1.09
284	1.09

All dimensions given in metres

DEPTH TO WATER vs ELAPSED TIME



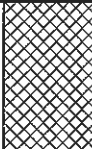
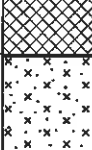
$$f = (V75-V25)/A50(T75-T25)$$

$$V75-V25 = 0.233$$

$$A50 = 2.240$$

$$T75-T25 = 1114$$

$$\text{Extrapolated Soil Infiltration Rate } f = \underline{1.55E-06} \text{ m/s}$$

GROUND ENGINEERING L I M I T E D Tel: 01733-666566 www.groundengineering.co.uk			Site: STATION ROAD, LONG SUTTON			TRIAL PIT TP2			
Date: 30/11/15			Pit Size: 1.70m L x 0.35m W x 1.75m D.			Ground Level:			
Samples and in-situ Tests			(Date) Water	Description of Strata		Legend	Depth m	O.D. Level m	
Depth m	Type	Result							
0.30	D1			MADE GROUND - Brown/orange brown, slightly sandy, slightly gravelly, clayey SILT. Sand is fine. Gravel is sub-angular and sub-rounded timber, flint, slate, concrete and brick fragments.			0.50		
0.60	D2			MADE GROUND - Stiff, desiccated, brown, slightly clayey, slightly gravelly, sandy SILT. Sand is fine. Gravel is angular to sub-rounded flint, slate, coal, ash, mortar and brick fragments.			1.15		
0.90	D3								
1.20	D4			Brown, sandy SILT. Sand is fine.					
1.50	D5			(TIDAL FLAT DEPOSIT)			1.75		
1.70	D6								
				Pit completed at 1.75m depth					
KEY D - Disturbed Sample B - Bulk Sample U - Undisturbed Sample R - Root Sample W - Water Sample J - Jar Sample  Water Strike  Water Rise  Level on completion MP - Mackintosh Probe P() - Hand Penetrometer Cohesion () kPa V - Vane Shear Test Cohesion () kPa			REMARKS 1. Dead tree roots and stump at 0.30m depth 2. Live roots observed to at least 1.75m depth 3. Pit dry 4. Pit sides stable 5. Soakaway test undertaken at 1.75m depth					Project No 13684	
								Scale 1:25	Page 1/1

SOAKAWAY TEST RESULTS

BRE DIGEST 365 - SOIL INFILTRATION RATE

Project: Station Road, Long Sutton, Lincolnshire
Client: Nene Transport (Lincs) Limited

Project No: C13684
Sheet No: 1/2

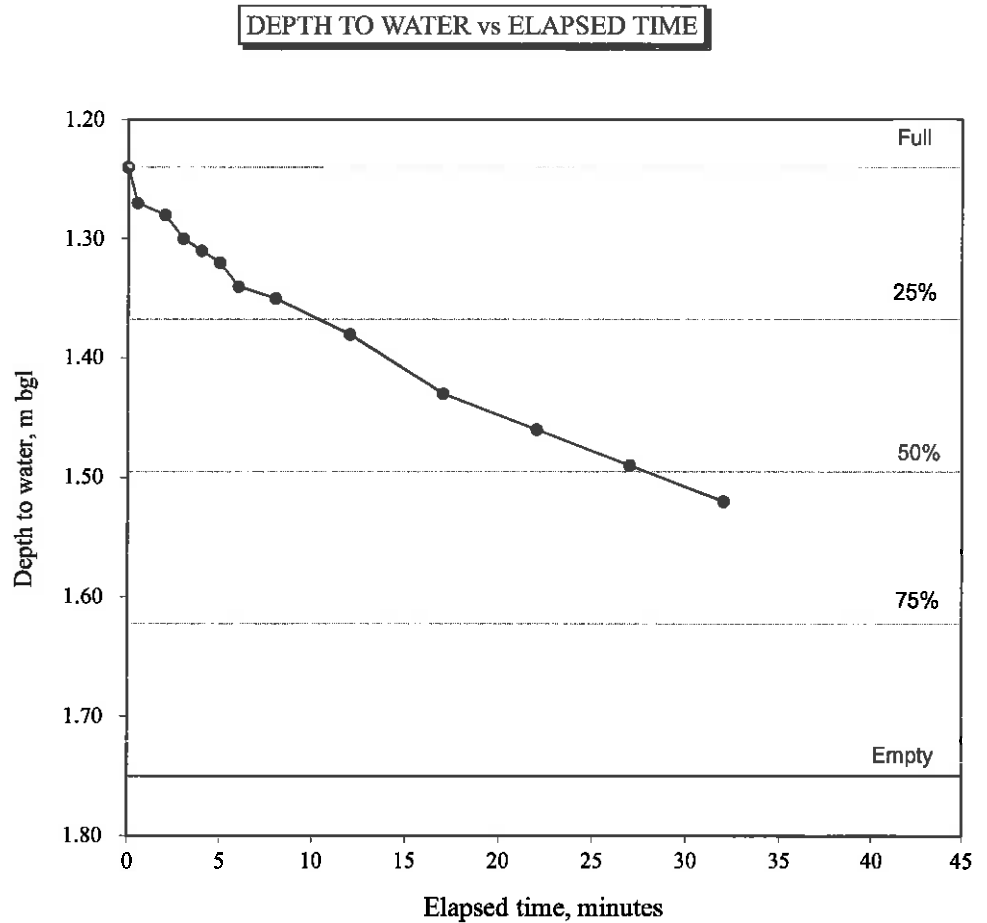
Trial Pit: TP2 FIRST FILLING
Depth: 1.75
Length: 1.70
Width: 0.35

Description of Stratum under test: Brown, sandy SILT. Sand is fine.

Depth to water prior to test: Dry
(below ground level)

Elapsed Time min	Depth to Water m
0	1.24
1	1.27
2	1.28
3	1.30
4	1.31
5	1.32
6	1.34
8	1.35
12	1.38
17	1.43
22	1.46
27	1.49
32	1.52

All dimensions given in metres



$$f = (V75-V25)/A50(T75-T25)$$
$$V75-V25 = 0.152$$
$$A50 = 1.641$$
$$T75-T25 = 39$$

Extrapolated Soil Infiltration Rate $f = \underline{\underline{3.95E-05}} \text{ m/s}$

SOAKAWAY TEST RESULTS

BRE DIGEST 365 - SOIL INFILTRATION RATE

Project: Station Road, Long Sutton, Lincolnshire
Client: Nene Transport (Lincs) Limited

Project No: C13684
Sheet No: 2/2

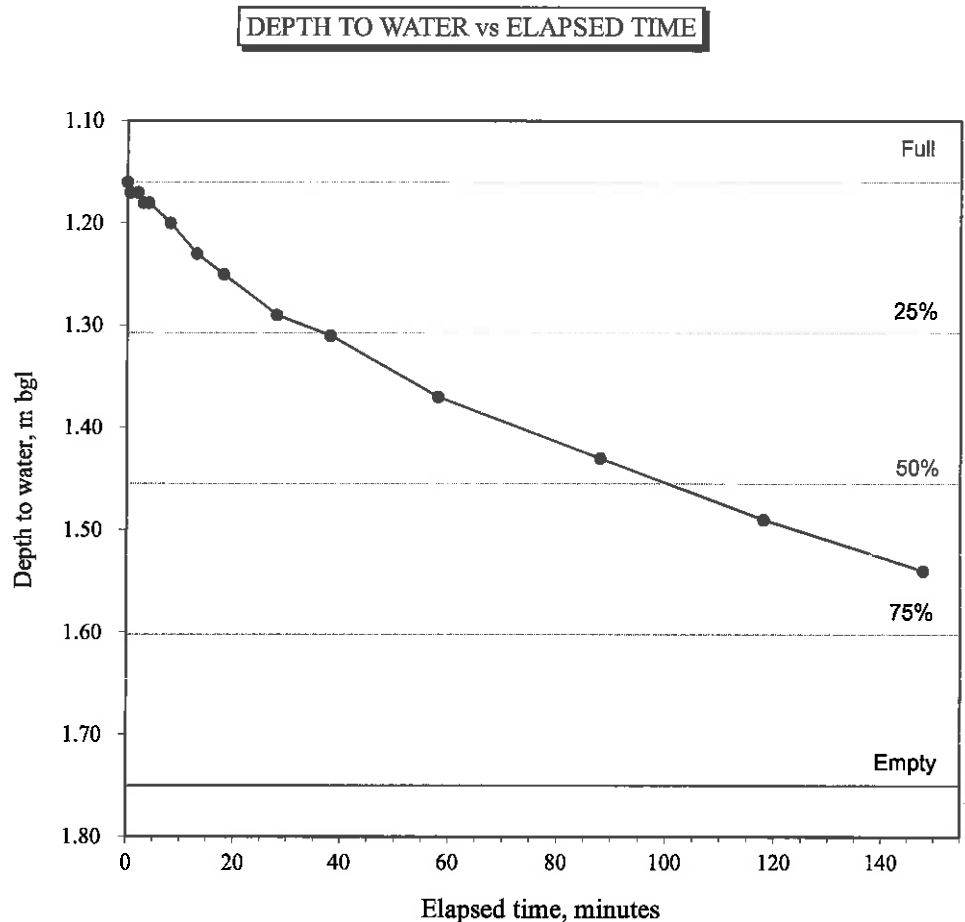
Trial Pit: TP2 SECOND FILLING
Depth: 1.75
Length: 1.70
Width: 0.35

Description of Stratum under test: Brown, sandy SILT. Sand is fine.

Depth to water prior to test: Dry
(below ground level)

Elapsed Time min	Depth to Water m
0	1.16
1	1.17
2	1.17
3	1.18
4	1.18
8	1.20
13	1.23
18	1.25
28	1.29
38	1.31
58	1.37
88	1.43
118	1.49
148	1.54

All dimensions given in metres



$$f = \frac{(V75-V25)}{A50(T75-T25)}$$

V75-V25 = 0.176
A50 = 1.805
T75-T25 = 145

Extrapolated Soil Infiltration Rate $f = \underline{1.12E-05} \text{ m/s}$

LABORATORY TEST RESULTS

CONTRACT STATION ROAD, LONG SUTTON

Bore-hole	Sample	Depth m	Classification				Density		Triaxial Compression					Sulphates (SO ₄)				Remarks
			Liquid Limit %	Plastic Limit %	Plasticity Index %	Moisture Content %	Bulk Mg/m ³	Dry Mg/m ³	Type	Principal Stress Difference kPa	Cell Pressure kPa	Shear Strength kPa	Angle of Shear Resistance degrees	Total Dry Wt. %	Soil Aqueous Extract mg/l	Water mg/l	pH	
WS1	U1A	1.40	37	20	17	14												SOIL CLASSIFICATION = CI 2% retained on 425µm sieve
	U1B	1.60				22												
	U1C	1.90				22												
	U2A	2.20				27												
	U2B	2.50				28												
	U2C	2.60				42	1.93	1.36	Q	30	50	15	0		346		7.6	
	U2C	2.90																
WS2	U3A	3.20				49												SOIL CLASSIFICATION = MI 0% retained on 425µm sieve
	U1A	1.25				26												
	U1B	1.50				30												
	U1C	1.60				21	1.97	1.63	QM	69	50	58	0					
	U1C	1.90								109	100							
	U1C									171	200							
	U2A	2.10				37	1.77	1.30	Q	26	50	13	0					
	U2A	2.40																
	U2B	2.50	36	29	7	32												

Aqueous Extract 2:1 Water:Soil

U - UNDISTURBED SAMPLE
D - DISTURBED SAMPLE
B - BULK SAMPLE
W - WATER SAMPLE
C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

LABORATORY TEST RESULTS

CONTRACT STATION ROAD, LONG SUTTON

Bore-hole	Sample	Depth m	Classification				Density		Triaxial Compression					Sulphates (SO ₄)			Remarks	
			Liquid Limit %	Plastic Limit %	Plasticity Index %	Moisture Content %	Bulk Mg/m ³	Dry Mg/m ³	Type	Principal Stress Difference kPa	Cell Pressure kPa	Shear Strength kPa	Angle of Shear Resistance degrees	Soil Total % Dry Wt.	Aqueous Extract mg/l	Water mg/l		pH
WS2	U2C	2.90				36								49			7.4	SOIL CLASSIFICATION = CL/ML 0% retained on 425µm sieve
WS3	U1A	1.30												41			7.8	
WS4	D3	0.90												49			7.8	
WS5	D3	0.90	31	23	8	19								58				
WS6	U1A	1.80															7.8	

Aqueous Extract 2:1 Water:Soil

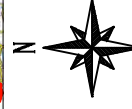
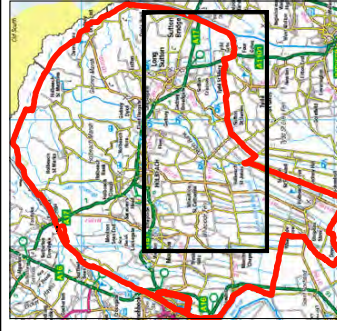
U - UNDISTURBED SAMPLE
D - DISTURBED SAMPLE
B - BULK SAMPLE
W - WATER SAMPLE
C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Document 6

LEGEND

- Catchment Boundary
- High Priority Watercourse
- IDB Ordinary Watercourse
- High Priority Pipeline
- Ordinary Pipeline
- Water Control Structure
- Pumping Station
- Inland Sluice
- Tidal Sluice

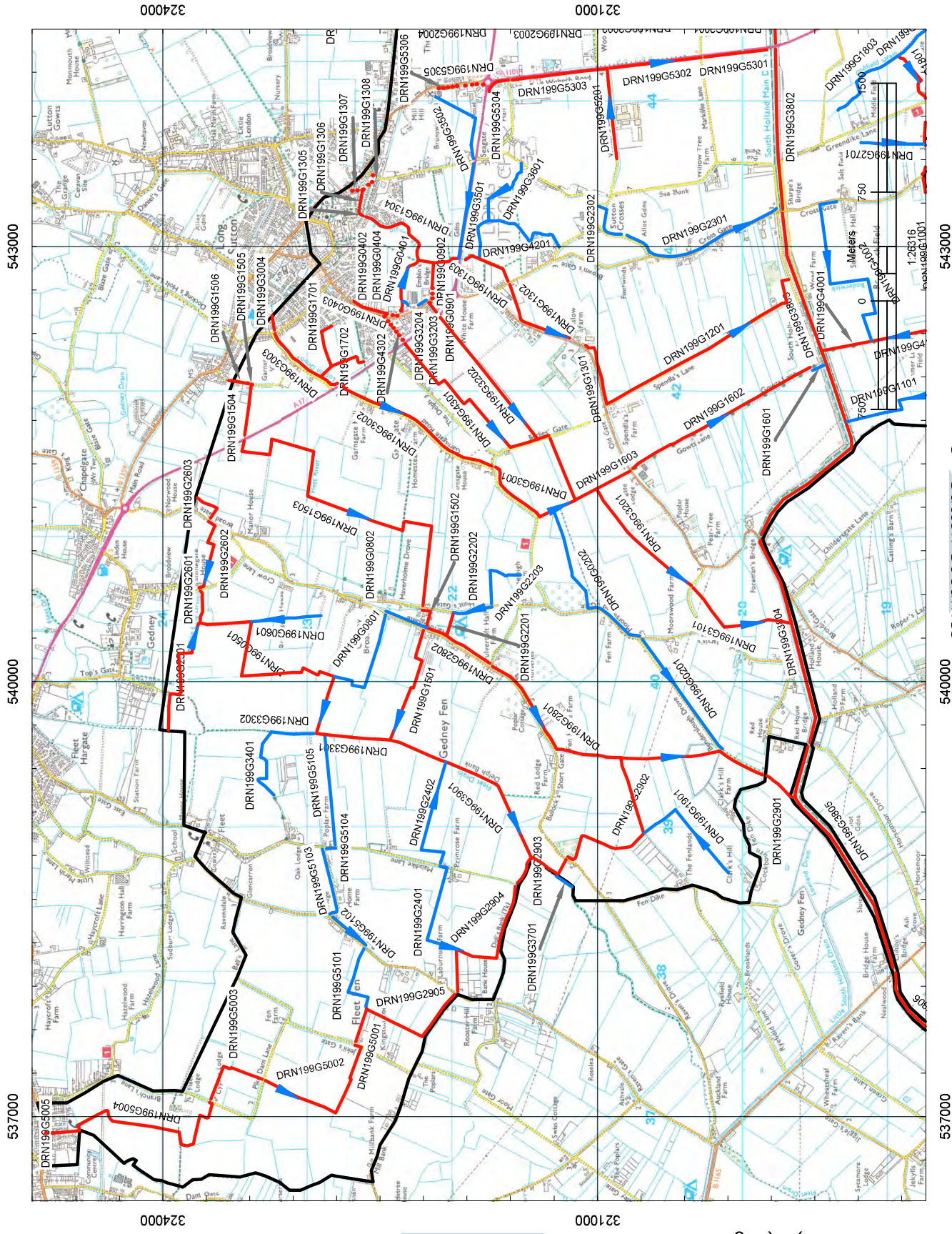
KEY MAP



SCALE	SHEET NUMBER
Best fit	© Crown Copyright and database rights [2012]. All rights reserved OS licence number 100029527.
PLOT DATE	CMT199G
05/01/2016	
FILE NAME	

SHIDB_webmap2013.dwg

K - Lutton Leam



G - Sutton St James

Document 7

Pre-Planning Assessment Report

Station Road, Long Sutton

Section 1: Proposed Development

Thank you for submitting a pre-planning enquiry. This has been produced for RM Associates. Your reference number is **00009366**. If you have any questions upon receipt of this report, please contact Carl Lee on 01733 414690 or email planningliaison@anglianwater.co.uk.

The response within this report has been based on the following information which was submitted as part of your application:

List of Planned Developments	
Type of Development	No. Of Units
C3 Dwellings	30

The anticipated residential build rate is:

Year	2015
Build Rate	30

- The grid reference for the site is TF4280822934.
- The site currently does not have planning permission and is located on a brownfield site.

Section 2: Assets Affected

Our records indicate that we have the following types of assets within or overlapping the boundary of your development site as listed in the table below.

Additionally, it is highly recommended that you carry out a thorough investigation of your proposed working area to establish whether any unmapped public or private sewers and lateral drains are in existence. We are unable to permit development either over or within the easement strip without our prior consent. The extent of the easement is provided in the table below. Please be aware that the existing water mains/public sewers should be located in highway or open space and not in private gardens. This is to ensure available access for any future maintenance and repair and this should be taken into consideration when planning your site layout.

Water and Used Water Easement Information		
Asset Type	Pipe Size (mm)	Total Easement Required (m)
Public Foul Sewer	300	3.0 m either side of the centre line

If it is not possible to avoid our assets then the water main/sewer may need to be diverted in accordance with Section 185 of the Water Industry Act (1991). We have a duty to divert our sewerage infrastructure if requested to do so although this would be at your expense. You will need to make a formal application if you would like a diversion to be considered. A copy of the section 185 diversion application form can be found at www.anglianwater.co.uk/developers

Due to the private sewer transfer in October 2011 many newly adopted public used water assets and their history are not indicated on our records. You also need to be aware that your development site may contain private water mains, drains or other assets not shown on our records. These are private assets and not the responsibility of Anglian Water but that of the landowner.

Section 3: Water Supply

In examining the available capacity for your development site we assess the capacity and costs for two categories of water main. These are:

Strategic – these are the offsite potable water mains which deliver water within an area to a large number of development sites often across a number of towns. The strategic provision of these water mains enables us to provide of the cheapest solution across a large geographical area.

Local reinforcement – these are the offsite potable water mains that connect your site to the closest available public water main. Alternatively, reinforcement may be needed to protect existing houses against the loss of water or water pressure.

On most sites we also have two categories of water mains the **Spine Mains** and **Housing Estate Mains (HEMS)**. To support your budgeting arrangements we have also examined the estimated cost for delivering the onsite water mains needed for a site of your size.

Water Supply Network

The water supply to the proposed development site can be provided from the existing mains as listed below. The water main has adequate capacity for your development site. Anglian Water cannot reserve capacity and therefore you are recommended to formally apply for a connection at your earliest convenience. Please note that available capacity in our network can be reduced at any time due to increased requirements from existing businesses and houses as well as from new housing and new commercial developments.

The connection point for the site will be from the existing 180PE water main in Station Road at National Grid Reference (NGR) TF4284422893.

Water Budget Costs

The costs provided in this report are based on the current information available. These costs are provided as an indicative estimate to help inform you on a budget for supplying water to your site.

- The **strategic costs** are based on a proportion of the total strategic scheme cost. These costs are calculated based on the flow rate that your development requires as compared to the total flow rate that the strategic main has been designed against.
- The **local reinforcement** costs have been calculated based on the typical costs of providing a length of water main across a similar distance as required for this development site.

- The onsite **Spine mains** and **HEMS** costs are provided based on historic Anglian Water construction information.

Based on these estimated and predicted costs, the cost to provide water to your site:

Predicted costs for supplying water to your development	
Strategic Water Mains	NONE
Estimated Local reinforcement Mains	NONE
Estimated Onsite Water Mains	
Onsite water mains costs	£ 18,000.00
Total Cost for providing the water infrastructure	£ 18,000.00

The above table provides an estimated breakdown of the costs to supply the water infrastructure. A more detailed cost provision will be provided following a formal application for a new water mains or water connection.

Financing your water costs

You will be required to partly contribute towards the cost of supplying water to your site. The amount that you contribute is dependent on your preferred method of financing the site. The Water Industry Act enables you to finance the water mains via either the relevant deficit or discounted aggregate deficit. A full breakdown of these methods is provided on our website at www.anglianwater.co.uk/developers.

In essence, the two deficit options allow us to offset future revenue (from the end customer after they purchase your houses) from the scheme cost. The scheme cost is determined as a hypothetical fixed rate loan provided over 12 years. The two statutory options are:

1. **Relevant deficit.** This takes the actual annual revenue offset from the actual annual scheme cost repayment. The difference is paid every year over the first twelve years of your site or until the revenue exceeds the annual scheme cost.
2. **Discounted aggregate deficit.** This enables us to offset the estimated future revenue from the scheme cost. This is calculated over the first twelve years of your site and a commuted sum is calculated as an upfront net present value amount.

Your estimated contribution towards the construction costs are provided in the table below:

Scheme Title:	Station Road
Developer:	RM Associates

Year	Occupation Rates
1	0
2	30
3	30
4	30
5	30
6	30
7	30
8	30
9	30
10	30
11	30
12	30
Total	30

Estimated Construction costs		
Onsite water	£	18,000
Offsite water	£	N/A
Estimated Scheme Cost	£	18,000

Your estimated contribution towards construction costs		
Relevant Deficit	£	1,835
Discounted Aggregate Deficit	£	1,778

In addition, you also have the ability to construct the onsite water mains under a self-lay agreement. In such cases, an Asset Payment is made by Anglian Water following commissioning and adoption of the assets. The Asset Payment is calculated as required in the Water Act 2003. For more information on the self-lay of water mains please see www.anglianwater.co.uk/developers/self-lay.

You will also need to budget for both infrastructure charges and connection costs. The 2015/16 charges are:

Infrastructure Charge	£351.00	per connection
-----------------------	---------	----------------

Please note that we offer alternative types of connections depending on your needs and these costs are available in our annual charges booklet, which can be downloaded from www.anglianwater.co.uk/developers/charges.

Section 4: Water Recycling Services

In examining the used water system we assess the ability for your site to connect to the public sewerage network without causing a detriment to the operation of the system. We also assess the receiving water recycling centre and determine whether the water recycling centre can cope with the increased flow and influent quality arising from your development.

Water Recycling Centre

The foul drainage from the proposed development is in the catchment of Sutton Bridge Water Recycling Centre, which currently has capacity to treat the flows from your development site. Anglian Water cannot reserve capacity and the available capacity at the water recycling centre can be reduced at any time due to growth, environmental and regulation driven changes.

Used Water Network

Anglian Water has assessed the impact of gravity flows from the planned development to the public foul sewerage network. We can confirm that this is acceptable as the foul sewerage system, at present, has available capacity for your site. The connection point will be to manhole 8802 in Station Road at National Grid Reference (NGR) TF4282222867.

Please note that pumping may be required depending on the site topography.

Surface Water Disposal

We have examined your development site for available surface water discharge options. It is our understanding that the evidence to confirm your compliance with the surface water hierarchy is not currently available. However once the evidence has been confirmed, then a connection point may be made to manhole 8851 in Station Road at National Grid Reference (NGR) TF4284322887 at a rate of 5l/s.

It is your responsibility to provide the evidence to confirm that all alternative methods of surface water disposal have been explored and these will be required before your connection can be agreed. This is subject to satisfactory evidence which shows the surface water management hierarchy as outlined in Building Regulations Part H has been explored. This would encompass the results from the site specific infiltration testing and/or confirmation that the flows cannot be discharged to a watercourse.

Anglian Water's surface water policy follows the Surface Water hierarchy, outlined in Part H of the Building Regulations. Should your assumptions or evidence change then an alternative solution, connection point or flow rate may be required. You are therefore advised to update Anglian Water with the key supporting evidence at your earliest convenience.

As you may be aware, Anglian Water will consider the adoption of SuDs provided that they meet the criteria outline in our SuDs adoption manual. This can be found on our website at <http://www.anglianwater.co.uk/developers/suds.aspx>. We will adopt features located in public open space that are designed and constructed, in conjunction with the Local Authority and Lead Local Flood Authority (LLFA), to the criteria within our SuDs adoption manual. Specifically, developers must be able to demonstrate:

1. Effective upstream source control,
2. Effective exceedance design, and
3. Effective maintenance schedule demonstrating that the assets can be maintained both now and in the future with adequate access.

If you wish to look at the adoption of any SuDs then an expression of interest form can be found on our website at: <http://www.anglianwater.co.uk/developers/suds.aspx>

Trade Effluent

We note that you do not have any trade effluent requirements. Should this be required in the future you will need our written formal consent. This is in accordance with Section 118 of the Water Industry Act (1991).

Used Water Budget Costs

It has been assumed that the onsite used water network will be provided under a section 104 Water Industry Act application. It is recommended that you also budget for both infrastructure charges and connection costs. The 2015/16 charges are:

Infrastructure Charge	£351.00 per connection
-----------------------	------------------------

Please note that we offer alternative types of connections depending on your needs and these costs are available in our annual charges booklet, which can be downloaded from www.anglianwater.co.uk/developers/charges.

Section 5: Map of Proposed Connection Points

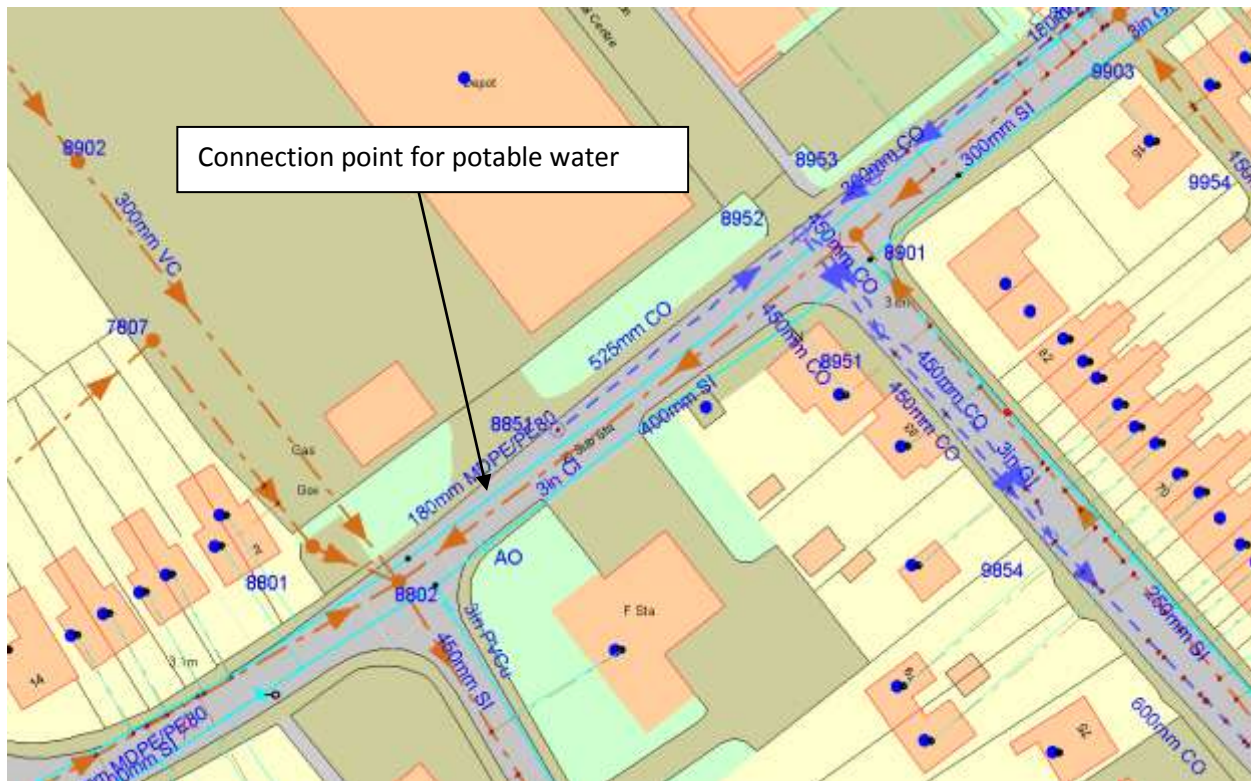


Figure 1: Showing your water point of connection at Station Road

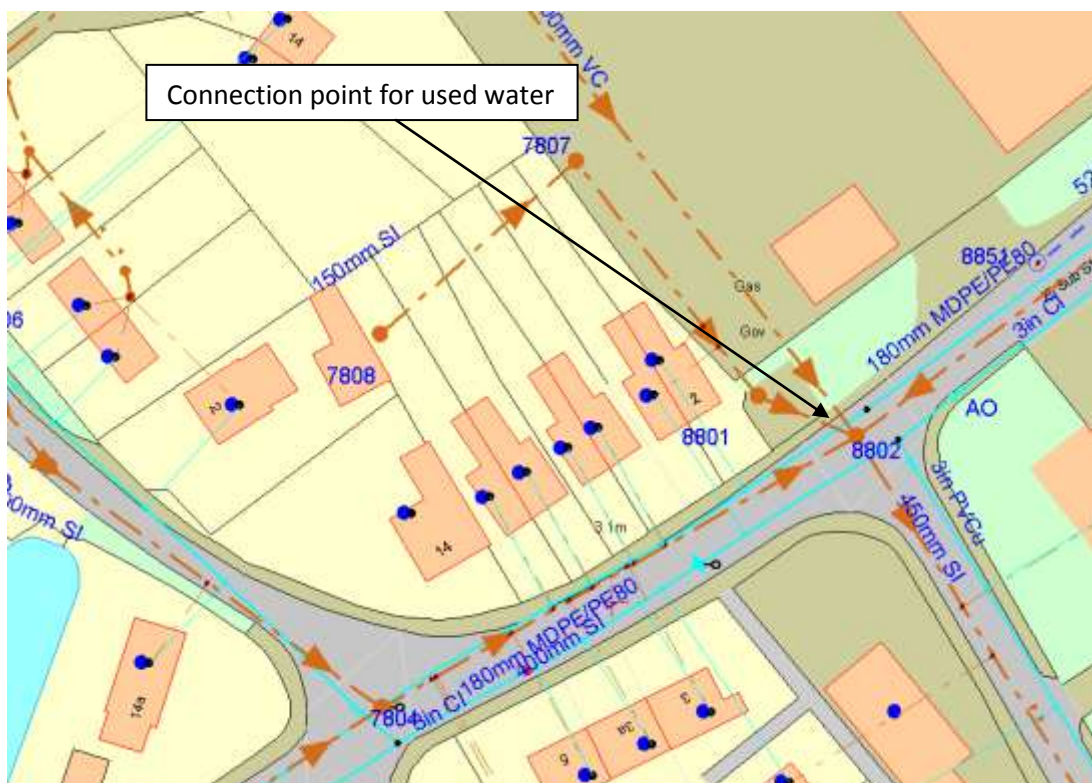
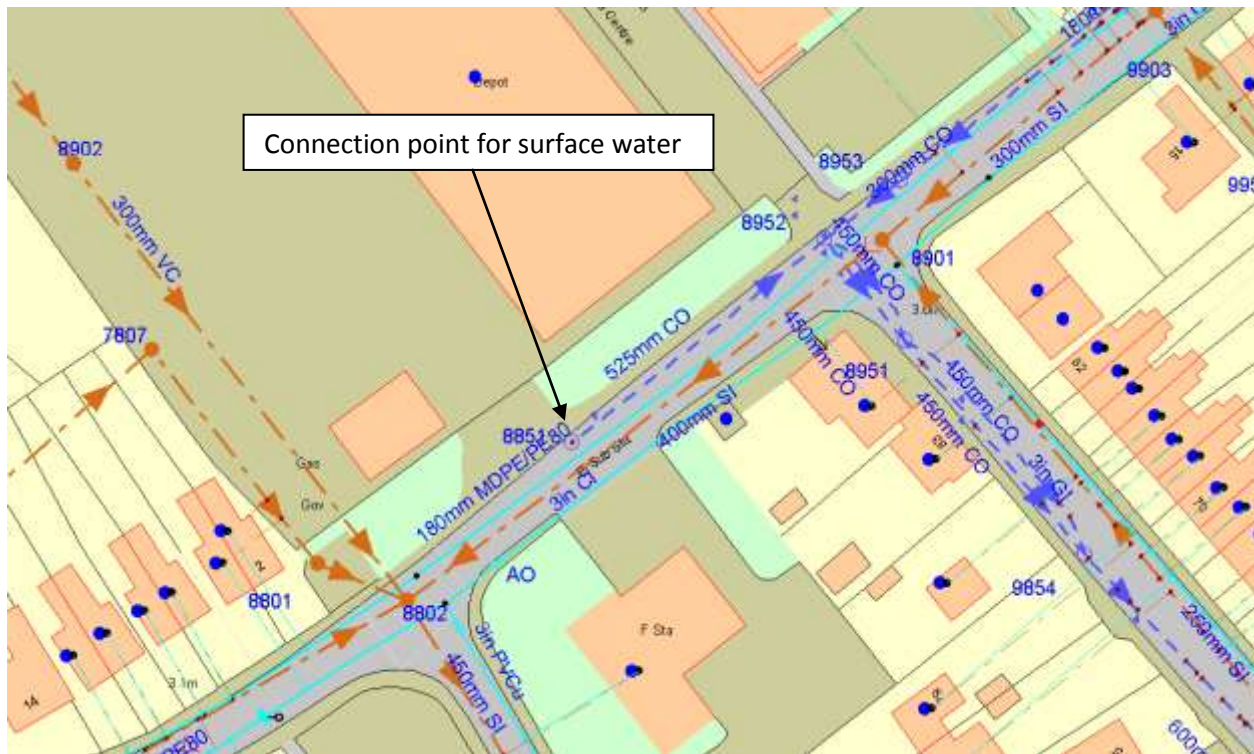


Figure 2: Showing your used water point of connection at manhole 8802 with a Cover Level of 3.25m and an Invert Level of -1.46



Section 6: Useful Information

Water

Water Industry Act – Key Water Sections:

- **Section 41:** This provides you with the right to requisition a new water main for domestic purposes to connect your site to the public water network.
- **Section 45:** This provides you with the right to have a connection for domestic purposes from a building or part of a building to the public water main.
- **Section 51A - E:** This provides you with the right to provide the water main or service connection yourself and for us to vest them into our company.
- **Section 55:** This applies where you request a supply of water for non domestic purposes.
- **Section 185:** This provides you with the right to make a reasonable request to have a public water main, sewer or public lateral drain removed or altered, at your expense. Details on how to make an application and the s185 form is available on our website at <http://www.anglianwater.co.uk20/developers> or via our Developer Services team on 08457 60 66 087.

Details on how you can make a formal application for a new water main, new connection or diversion are available on from our Developer Services team on 08457 60 66 087 or via our website at www.anglianwater.co.uk/developers

If you have any other queries on the rights to requisition or connect your housing to the public water and sewerage infrastructure then please contact our developer services team at: Developer Services, Anglian Water, PO Box 495, Huntingdon, PE29 6YY or Telephone: 0845 60 66 087 or Email: developerservices@anglianwater.co.uk

Water pressure and flow rate: The water pressure and consistency that we must meet for your site is laid out in the Water Industry Act (1991). This states that we must supply a flow rate of 9 litres per second at a pressure of 10 metres of head to the external stop tap. If your water pressure requirements exceed this then you will need to provide and maintain any booster requirements to the development site.

Self Lay of Water Mains: A list of accredited Self Lay Organisations can be found at www.lloydsregister.co.uk/schemes/WIRS/providers-list.aspx.

Used Water

Water Industry Act – Key Used Water Sections:

- **Section 98:** This provides you with the right to requisition a new public sewer. The new public sewer can be constructed by Anglian Water on your behalf. Alternatively, you can construct the sewer yourself under section 30 of the Anglian Water Authority Act 1977.

- **Section 102:** This provides you with the right to have an existing sewerage asset vested by us. It is your responsibility to bring the infrastructure to an adoptable condition ahead of the asset being vested.
- **Section 104:** This provides you with the right to have a design technically vetted and an agreement reached that will see us adopt your assets following their satisfactory construction and connection to the public sewer.
- **Section 106:** This provides you with the right to have your constructed sewer connected to the public sewer.
- **Section 185:** This provides you with the right to have a public sewerage asset diverted.

Details on how to make a formal application for a new sewer, new connection or diversion are available on our website at www.anglianwater.co.uk/developers or via our Developer Services team on 08457 60 66 087.

Sustainable Drainage Systems:

Many existing urban drainage systems can cause problems of flooding, pollution or damage to the environment and are not resilient to climate change in the long term. Therefore our preferred method of surface water disposal is through the use of Sustainable Drainage Systems (SuDS). SuDS are a range of techniques that aim to mimic the way surface water drains in natural systems within urban areas. For more information on SuDS, please visit our website at <http://www.anglianwater.co.uk/developers/suds.aspx>. We also recommend that you contact the Local Authority and Lead Local Flood Authority (LLFA) for the area to discuss your application.

Private Sewer Transfers: Sewers and lateral drains connected to the public sewer on the 1 July 2011 transferred into Water Company ownership on the 1 October 2011. This follows the implementation of the Floods and Water Management Act (FWMA). This included sewers and lateral drains that were subject to an existing Section 104 Adoption Agreement and those that were not. There were exemptions and the main non-transferable assets were as follows:

- Surface water sewers and lateral drains that did not discharge to the public sewer, e.g. those that discharged to a watercourse.
- Foul sewers and lateral drains that discharged to a privately owned sewage treatment/collection facility.
- Pumping stations and rising mains will transfer between 1 October 2011 and 1 October 2016.

The implementation of Section 42 of the FWMA will ensure that future private sewers will not be created. It is anticipated that all new sewer applications will need to have an approved section 104 application ahead of a section 106 connection.

Encroachment: Anglian Water operates a risk based approach to development encroaching close to our used water infrastructure. We assess the issue of encroachment if you are

planning to build within 400 metres of a water recycling centre or, within 15 metres to 100 metres of a pumping station. We have more information available on our website at <http://anglianwater.co.uk/developers/encroachment.aspx>

Locating our assets: Maps detailing the location of our water and used water infrastructure including both underground assets and above ground assets such as pumping stations and recycling centres are available from www.digdat.co.uk. All requests from members of the public or non-statutory bodies for maps showing the location of our assets will be subject to an appropriate administrative charge. We have more information on our website at: www.anglianwater.co.uk/developers/our-assets/

Summary of charges: A summary of this year's water and used water connection and infrastructure charges can be found at <http://www.anglianwater.co.uk/developers/charges/>

Disclaimer: The information provided within this report is based on the best data currently recorded, recorded within the last 12 months or provided by a third party. The position must be regarded as approximate. If there is further development in the area or for other reasons the position may change.

The accuracy of this report is therefore not guaranteed and does not obviate the need to make additional appropriate searches, inspections and enquiries. You are advised therefore to renew your enquiry should there be a delay in submitting your application for water supply/sewer connection to re-confirm the situation.

Any cost calculations provided within the report are estimated only and may be subject to change.

The responses made in this report are based on the presumption that your proposed development obtains planning permission. Whilst this report has been prepared to help assess the viability of your proposal, it must not be considered in isolation. Anglian Water supports the plan led approach to sustainable development that is set out in the National Planning Policy Framework (NPPF). As a spatial planning statutory consultee, we assist planning authorities in the preparation of a sustainable local plan on the basis of capacity within our water and water recycling (formerly referred to as wastewater) infrastructure. Consequently, any infrastructure needs identified in this report must only be considered in the context of up to date, adopted or emerging local plans. Where local plans are absent, silent or out of date these needs should be considered against the definition of sustainability set out in the NPPF as a whole.

No liability whatsoever including liability for negligence is accepted by Anglian Water Services Limited for any error or inaccuracy or omission including the failure to accurately record or record at all, the location of any water main, discharge pipe, sewer, or drain or disposal main or any item of apparatus.