Flood Risk Assessment
And
Soil Report

For

Flat 1, 31 Heath Drive,
NW1 7SB.

Date Issued: **May 2015**
Issued by: **R. Kearney MSc(hons)**
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1. INTRODUCTION

UK-Hydrosciences have been commissioned to undertake a hydro-geological flood risk assessment of the proposed basement extension construction at Flat 1, 31 Heath Drive, NW3 7SB with particular regard to the local groundwater regime and the risk posed by flooding. This is in response to requirements laid out in the London Borough of Camden's Core Strategic Policy and in accordance with Planning Policy Statement (PPS) 25.

This report presents the findings of a desktop based study of the available conditions in the surrounding area taking into account information gathered from published geological records from the British Geological Survey, North London Strategic Flood Risk Assessment August 2008, prepared by Ian Bakewell (Mouchel), RBKC Town Planning Policy on Subterranean Developments, Phase 1, scoping study, by ArupGeotechnics, June 2008, Camden geological, hydrogeological and hydrological study by ARUP Hydrogeolocical Report (3nr documents)Text/Appendices/Figures, adopted version 2010, information on groundwater conditions, the Environment Agency, GroundSure Flood Report and previous borehole logs from the records of the British Geological Survey, for all other sources please refer to the bibliography of the document.

Using this information conclusions are drawn on the possible impact of the proposed basement structure on the local groundwater and drainage regime.

Planning Policy Statement 25 (PPS25). In simple terms PPS25 requires local planning authorities to review the variation in flood risk across their district and to steer vulnerable development towards areas of lowest risk.
A full description of flood risk vulnerability classification can be found within PPS25 Table D.2. Where this cannot be achieved and development is to be permitted in areas that may be subject to some degree of flood risk, PPS25 requires the Council to demonstrate that there are sustainable mitigation solutions available that will ensure that the risk to property and life is minimized (and most certainly not increased) throughout the lifetime of the development, should flooding occur.

What is a Strategic Flood Risk Assessment (SFRA)? This is a document commissioned by most London Boroughs with regards to flooding risk within its jurisdiction, they have been put together in order to set out the guidelines needed to mitigate any risk of damage to persons or property within the area as well working towards strategic management for the future, the following key objectives within the SFRA are outlined:

- To collate all known sources of flooding, including river, surface water (local drainage), sewers and groundwater, that may affect existing and/or future development within the Borough;

- To delineate areas that have a 'low', 'medium' and 'high' probability of flooding within the Borough, in accordance with Planning Policy Statement 25 (PPS25), and to map these:

- Areas of 'high' probability of flooding are assessed as having a 1 in 100 or greater chance of river flooding (>1%) or 1 in 200 (>0.5%) chance of tidal flooding in any year, and are referred to as High Risk Zone 3;

- Areas of 'medium' probability of flooding are assessed as having between a 1 in 100 and 1 in 1000 chance of river and/or tidal flooding (1% to 0.1%) in any year, and are referred to as Zone 2 Medium Probability;

- Areas of 'low' probability of flooding are assessed as having a less than 1 in 1000 chance of flooding (<0.1%) in any year, and are referred to as Zone 1 Low Probability.

- Within flood affected areas, to recommend appropriate land uses (in accordance with the PPS25 *Sequential Test*) that will not unduly place people or property at risk of flooding.

- Where flood risk has been identified as a potential constraint to future development, recommend possible flood mitigation solutions that may be integrated into the design (by the developer) to minimise the risk to property and life should a flood occur (in accordance with the PPS25 *Exception Test*).

[1] Sourced from the Environment Agency National Property Dataset (2006).

It is understood that a subterranean development can have an impact on the water environment beyond the site where it takes place by altering the flow of water above and below ground and changing where water is absorbed or rises to the surface. For example, the construction of a basement could cause surface water flooding if its location forces water to the surface or could cause flooding elsewhere if the movement of water below ground is altered. Changing water movements can alter soil conditions in the wider area.

Further information regarding proposed water management systems is presented in Appendix B of this report.

2. SITE LOCATION

2.1 General

The site is located at Nr. Flat 1, 31 Heath Drive, NW3 7SB.

The property is located in the London Borough of Camden. Heath Drive is located between Finchley Road (A41) and Hampstead Village, Its location is therefore in close proximity to Hampstead Heath. The nearest transport stations are Hampstead Tube Station and Finchley and Frognal Train Station High.

A site location [map] is presented in [6.1] & [6.2] Figure 1.

2.2 Proposed development

The proposal is to form a basement below the existing lower ground floor of the existing property, which is a substantial brick built house.

The property is a family dwelling and the additional space is intended not to be solely habitable as a self-contained dwelling, as such the risk to life has been fully considered and steps taken to ensure all risks will be considerably reduced or eliminated.

Details of the water management systems are presented in Appendix B.

3. GEOLOGY AND GROUNDWATER CONDITIONS

3.1 Published Geology

According to British Geological Survey the site lies on the London Clay Formation, the most widespread and best known of the English Paleogene deposits and accounts for the greater part of the Paleogene outcrop in the London Basin. It forms an ideal medium for tunneling and its presence below Greater London has facilitated development of this nature.

3.2 London Clay Formation

London Clay-Up to 150m Fine, sandy, silty clay. The London Clay Formation is an over consolidated firm to very stiff, becoming hard with depth, fissured, blue to grey silty clay of low to very high plasticity. The upper and lower parts may contain silty or fine grained sand partings. It also contains, within it, laminated structured, nodular claystone and rare sand partings. The London Clay is approximately 90m thick in the area. The London Clay is relatively impermeable and this is confirmed by the relatively low permeability typically 1×10^{-9} m/s and lower. *(See appendix D)*

3.3 Available ground investigation information

Numerous local reports were taken from the archives of the British Geological Society and a site investigation borehole tests in the surrounding area have been examined in order to confirm the general geology of the area. The factual reports are included as Appendix B.

3.4 Aquifer classification

The London Clay is classified as an aquitard, although is slightly more permeable where weathered or where it has a higher proportion of sand. An Aquitard is a zone within the earth that restricts the flow of groundwater from one aquifer to another. An aquitard can sometimes, if completely impermeable, be called an Aquiclude or Aquifuge. Aquitards comprise layers of either clay or non-porous rock with low hydraulic conductivity. From 1st April 2010 new aquifer designations replace the old system of classifying aquifers as Major, Minor and Non-Aquifer. This new system is in line with the Environment Agencies Groundwater Protection Policy (GP3) and the Water Framework Directive (WFD) and is based on British Geological Survey mapping.

3.5 Groundwater

The London Clay has a relatively low permeability to ground water. In essence, the London Clay presents an almost complete barrier to groundwater. In practice, this barrier is not complete: groundwater can permeate slowly through intact London Clay (typically at about the same speed that human hair grows), and it can move more quickly along any fissures and cracks in the clay, and through localized zones that contain a higher proportion of silts or sands. However, even in the presence of fissures or silty zones, ground water flow rates in the London Clay are significantly slower than in the River Terrace Deposits. The clayey minerals in the London Clay make it responsive chemically to water. *(See appendix D)*

Moisture present within the clay can bond chemically with particles of clay minerals, and cause the particles to swell. The well-known phenomenon of the seasonal swelling (in wet winters) and shrinkage (in dry summers) of London Clay is caused by this chemical bonding.

3.6 River Terrace Deposits

According to British Geological Survey the site lies on River Terrace Deposits over the London Clay Formation, the most widespread and best known of the English Paleogene deposits and accounts for the greater part of the Paleogene outcrop in the London Basin.

The River Terrace Deposits locally comprise of the Taplow Gravels, Flood Plain Gravel and Boyn Hill Gravels, these were deposited between 130,000 to 190,000 years ago during ice age conditions when the flow of the Thames was considerably stronger than today, the Lithological Description of these formations is "sand and gravel, locally with lenses of silt clay or peat" the upper boundary being at the surface with an average thickness of between 5m to 9m resting with a sharp base on the bedrock geology e.g. London Clay, these formations are classed as Aquifers and do not impede the flow of water allowing surface water to percolate through to the relatively impermeable London Clay Formation, locally at the site a layer of made ground is present which also is comprises of sand, gravels, silted clays, brick and flint fragment and other evidence of human occupation.

4. SITE SPECIFIC OBSERVATIONS

4.1 Location Categorization and Site Specific Findings

In figure 6.20 – Map 13 of the North London Strategic Flood Risk Assessment, we have an extract showing the sewer flooding incidents by postcode. Here we have shown the approximate location of NW3 7SB and we can see that this area has no recorded incidents. This is also confirmed in the Groundsure report in appendix C (pages 18-19) where it states that within a 250m radius of the site there has been no historic flooding.

In fig 6.21 – Map 12 of the North London SFRA, we see an extract showing the groundwater contours of the area surrounding the site. The site is situated above the highest contour which is denoted in light green at 90m depth below ground level. The Groundsure report states in appendix C (page 20) that the susceptibility to groundwater flooding in the search area based on underlying geological conditions has limited potential, therefore subject to the site specific borehole records, there is a low likelihood for groundwater to reach the surface.

Fig 6.22 shows the Environment Agency's map for risk of flooding from surface water. We can clearly see that Heath Drive is denoted in the light blue colour descending to medium blue. The site is located in the lighter blue indicating that the risk is low.

In figure 6.23 we have an extract form Figure 8 of the Arup Hydro-geological Figures 1-10 – Aquifer Designation. The site is denoted in the pink shade which represents an 'Unproductive Strata', these are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Figure 6.24 shows an extract from a topographical map (figure 10 FROM Camden's Geological, Hydrological and Hydrological Study). The approximate location falls between the mid orange to dark orange giving an approximate range of between 70 – 80, showing that the site is situated on a decline.

Finally in figure 6.25 we see a map showing the historic rivers from the 'Lost Rivers of London', by Nicholas Barton, 1972. We can clearly see that Heath Drive seems to follow one of the main tributaries of the River Westbourne, which is now built over and eventually empties out into 'The Serpentine' at Hyde Park and then on into the 'River Thames'. Interestingly the Environment Agency's map (*fig 6.22*) shows the blue denoted colour for surface water flooding has an almost direct correlation to the path of this tributary. While this is noted, we cannot suggest its significance excepting to state that this tributary can both contribute to both the run-off from of surface-water swell but also could contribute to the swell during periods of high rainfall.

The overall findings so far are shown in the table below which will be considered in conjunction with the soil conditions and mitigating circumstances in the conclusions of this report.

Flood Risk	Assessment	Action
Flood Risk from rivers and/or tidal sources	Very low	None
Groundwater Flooding Susceptibility Areas	Limited Potential	See conclusions and Recommendations
Historic Flooding	None	None
JBA Consultants assessment of surface water (pluvial) flood risk within 25m of the centre of the site	High	See Recommendations
JBA Consultants assessment of surface water (pluvial) flood risk at the of the centre of the site	Negligible	See recommendations

4.2 Soil investigation

We will now review the site specific soil sample boreholes taken on the 16th of April 2015 and two sample of boreholes form the British Geological Survey website in order to check the consistency of the soil structure with in the general area. Please see Appendix A for the location of the site investigation and the borehole samples.

The first site specific borehole carried out by Sub Surface South East Ltd on 16thApril 2015 goes down to a depth of .70m (mini pile). For the first .30m we see made-ground with dark brown slightly gravelly sandy silty clay with gravel size fragments of fine stone and brick. The borehole stops as it meets a concrete slab and the borehole is discontinued after another 40cm.
The second borehole shows made-ground down to .30m, then down to .50 we see light brown mottled orang gravelly sand with fragments of stone and brick. Moving down to 1m we see soft brownish and orangy grey mottled gravelly sandy silty clay with gravel size fragments with brick and clinker. From 1m to 1.9 we see soft to firm low strength brown orange mottled grey gravelly silty clay with lenses of dark grey ashy sand and gravel sized coal fragments and again fragments of brick and stone.
After 1.9m we see stiff strength brown and occasional grey mottled silty clay and at 2.9 we have sandstone/ironstone cobble, the borehole stops at 5.45m showing stiff medium strength brown and occasional grey mottled silty clay and is declared dry with almost 100% recovery.

In the final borehole we see made–ground down to .50m and moving down to 1m we see made-ground soft brownish and orange grey mottled gravelly sandy silty clay with gravel sized fragments of brick, clinker and concrete.

Moving down to 1.9m we see made-ground soft to firm low strength brownish orange mottled grey gravelly silty clay with lenses of dark grey ashy sand and gravel sized fragments of coal at 1.3m and again we also see fragments of brick, clinker and stone. Then continuing down to 5.45m we see firm becoming stiff medium strength brown and occasional grey mottled silty clay. At 2.9m it was also noted that there was sandstone/ironstone cobble. The final comments towards the end of the borehole, state stiff medium brown and occasional grey mottled silty clay.

Next we will look at some sample boreholes from the BGS website, the first sample is TQ28NE119 which is located west of NW3 7SB, two streets away. There are four boreholes taken on this site, the first shows made-ground down to 1'9" (.3m), moving down to 14'6"(4.45m) we see mottled grey and brown clay silt becoming brown and more sandy below 7ft(Claygate beds). Then moving down to 19'6"(5.97m) wwe see light grey-brown sandy clay silt with more clay below 17ft. And finally moving down to 50ft (15.24m) we see stiff dark grey silty clat with slightly fissured and very stiff after 40ft (London clay.

The second sample borehole is TQ28NE104 situated north east of NW3 7SB close to the top of Heath Drive, here we have two boreholes going down to 82ft(24m) and 60ft18.24m) respectively. The first shows made ground down to about 1m and going down to 41ft(12m) we have firm brown clay with layers of sand then on to the end of the borehole we have silty layers of silty clay. The second borehole again show similar results with silty clay and sand brfore the last 10ft where it becomes grey clay down to 42ft.

With regards to groundwater flooding susceptibility, as mentioned earlier in section 4.1, potential for groundwater flooding to occur at surface is not indicated and the borehole findings of the underlying geological conditions suggest that surface water would percolate with reasonable efficiency in a given time scale, however this might not withstand if any prolonged inclement weather or flash flooding, we therefore have in our recommendations measures which would mitigate such an event.

5. CONCLUSIONS

5.1 Current hydrological regime

The ground and groundwater conditions indicate that precipitation falling on the site where not already collected by gulley's from roof and hard standing has and will continue to infiltrate through the made ground and silty clay passing downwards until it reaches the top of the relatively low permeability London Clay formation where the direction of flow will become lateral contribution to local groundwater. Vertical infiltration of rainwater is likely to be very limited at this site and the development should not affect the existing local groundwater sewers. Therefore due to the nature of the proposed works not extending beyond the existing footprint of the building, it will not burden the existing sewers and the fact there has been no historic flooding we can conclude the statistical risk of flood is lower on this site than the surrounding area, we therefore conclude there is a lower risk of flooding to this specific site and we assess it as having a less than 1 in 1000 chance of flooding (<0.1%) in any year, and are referring it to as 'Zone 1' (Low Probability).

5.2 Recommendations for proposed basement construction.

In accordance with PPS 25 we make the following recommendations in order to ensure that the current hydrological regime will not be burdened by this development;

I. The installation of a type "C "cavity drain as a fast line defense against groundwater flooding the basement.

II. The installation and continued active maintenance of a sump fitted with 'dual' pumps capable of discharging 2 l/s installed as standard. These to be fitted with a high level alarm with battery backup to warn in the event of pump failure.

III. In addition we advise the provision of anti- backflow valves at basement level; this will enhance the prevention of flooding from surcharged public sewers.

IV. We also recommend that localized measures for flood mitigation such as brick up-stands around the new light well should be installed and furthermore any new external hard-standings should be set to falls away from the property preferably to storm gulleys.

V. The provision for access for maintenance of all existing drains and proposed drains via manholes are recommended.

VI. The provision and maintenance of unrestricted access to an upper level in order for people to escape at all times.

VII. Finally a localized drainage search i.e. 'Con29DW' with Build-Over Agreement would be recommend before any works commences in order to ascertain whether any drainage facilities are shared, as we also provide this service we would be happy to you with a quotation upon request.

UK-Hydrosciences therefore, with the above recommendations in place, advise that the proposed development has an acceptable flood risk within the terms and requirements of PPS 25.

6. FIGURES

6.1 Site location plan

6.2 Flood risk maps

6.3 Geology Map & Water Features

Figure 6.10 – Location & Site Map

Figure 6.20 - Flood risk maps

Map 13 of the North London Strategic Flood Risk Assessment – Extract of the Sewer Flooding Incidents by Postcode.

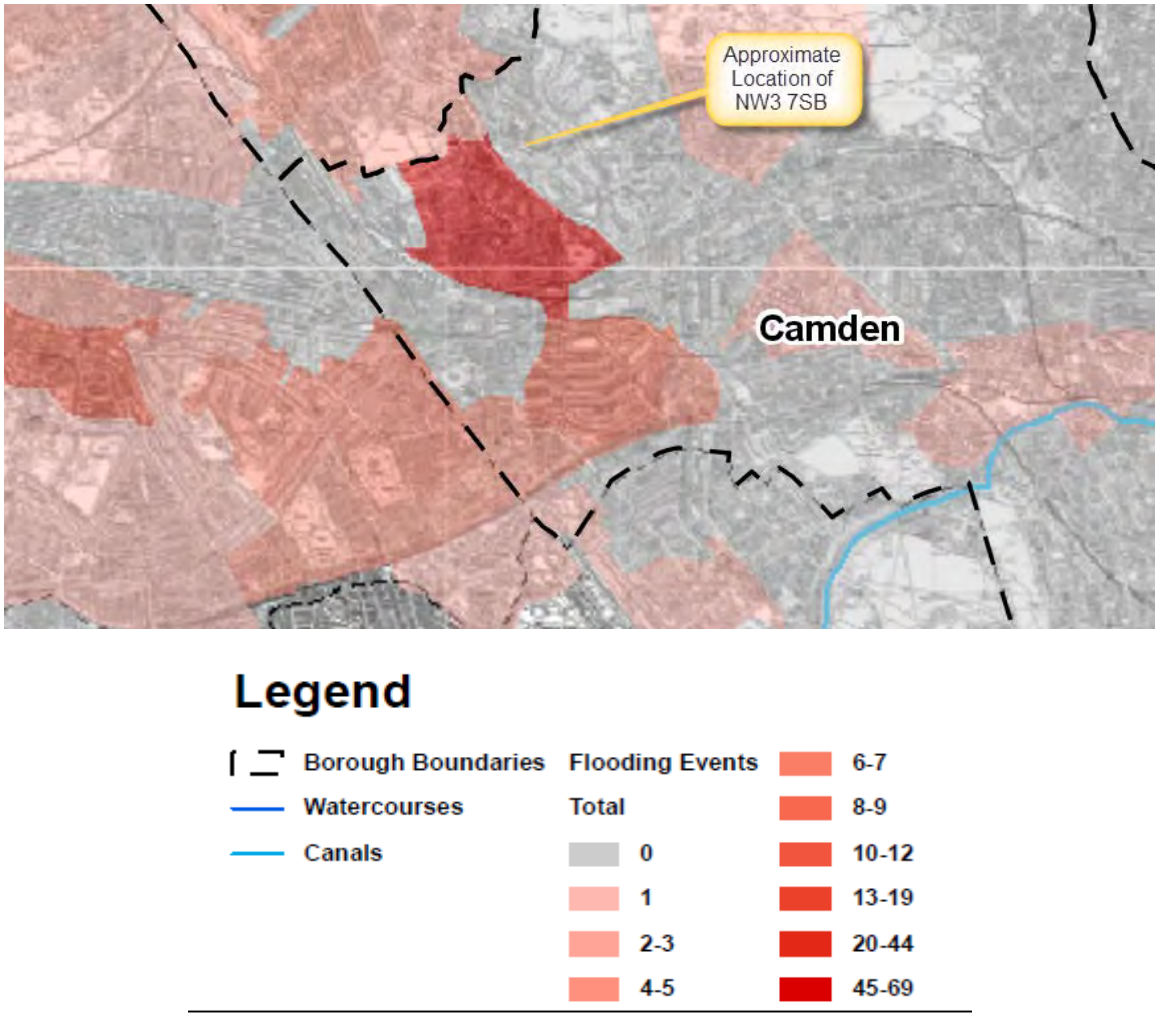
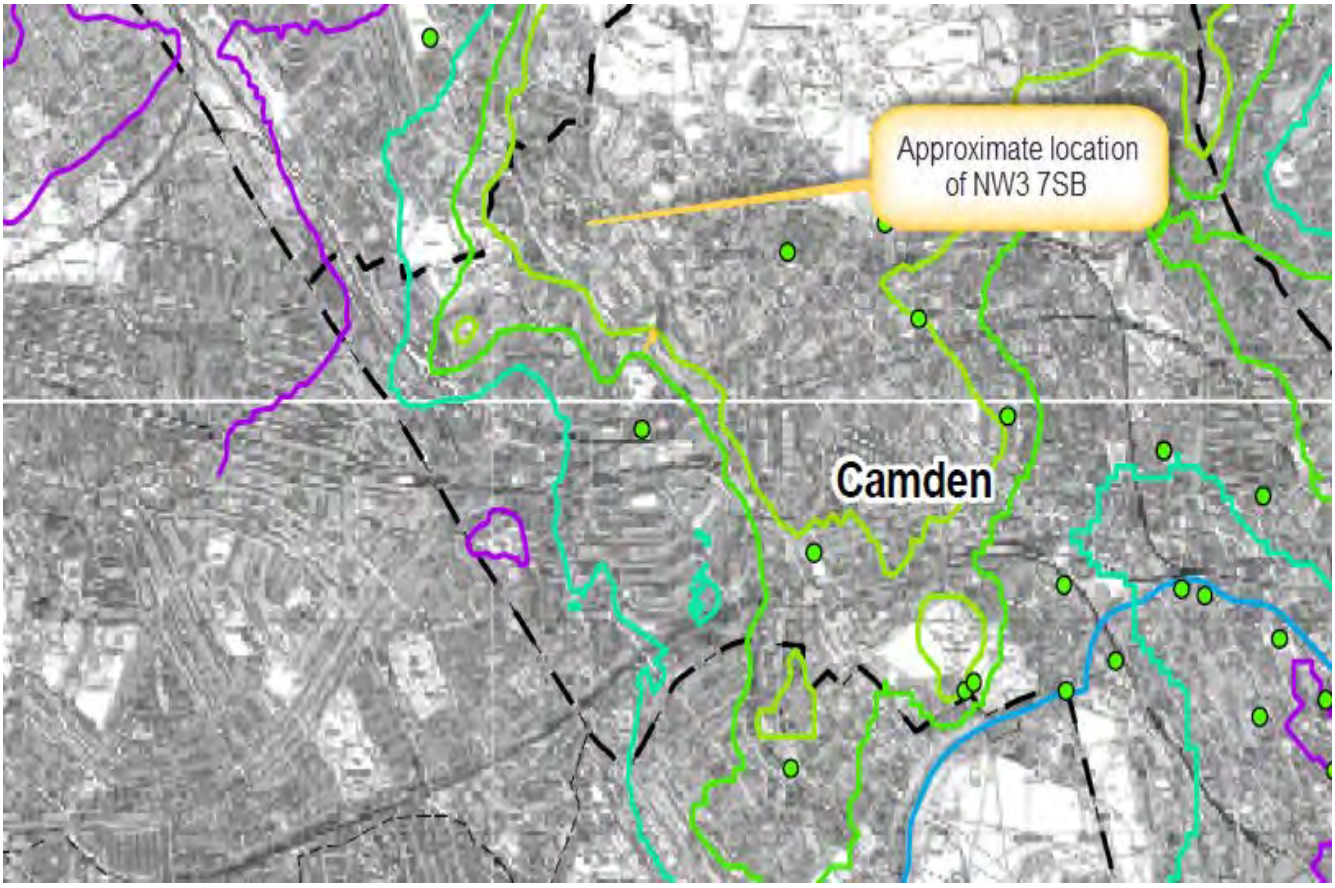


Figure 6.21 - Flood risk maps cont……
Map 12 of the North London Strategic Flood Risk Assessment – Groundwater Contours



Legend

- Borough Boundaries
- Watercourses
- Canals
- Borehole

Groundwater Contours

Depth below Ground Level (m)

- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90

Figure 6.22 - Geology Map & Water Features
Environment Agency Map – Showing the risk of flooding from surface.

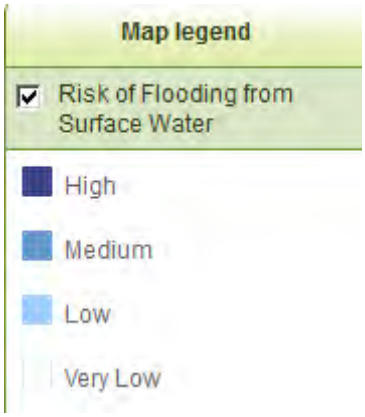


Figure 6.23 - Geology Map & Water Features
Figure 8 of the Arup Hydro-geological Figures 1-10 – Aquifer Designation

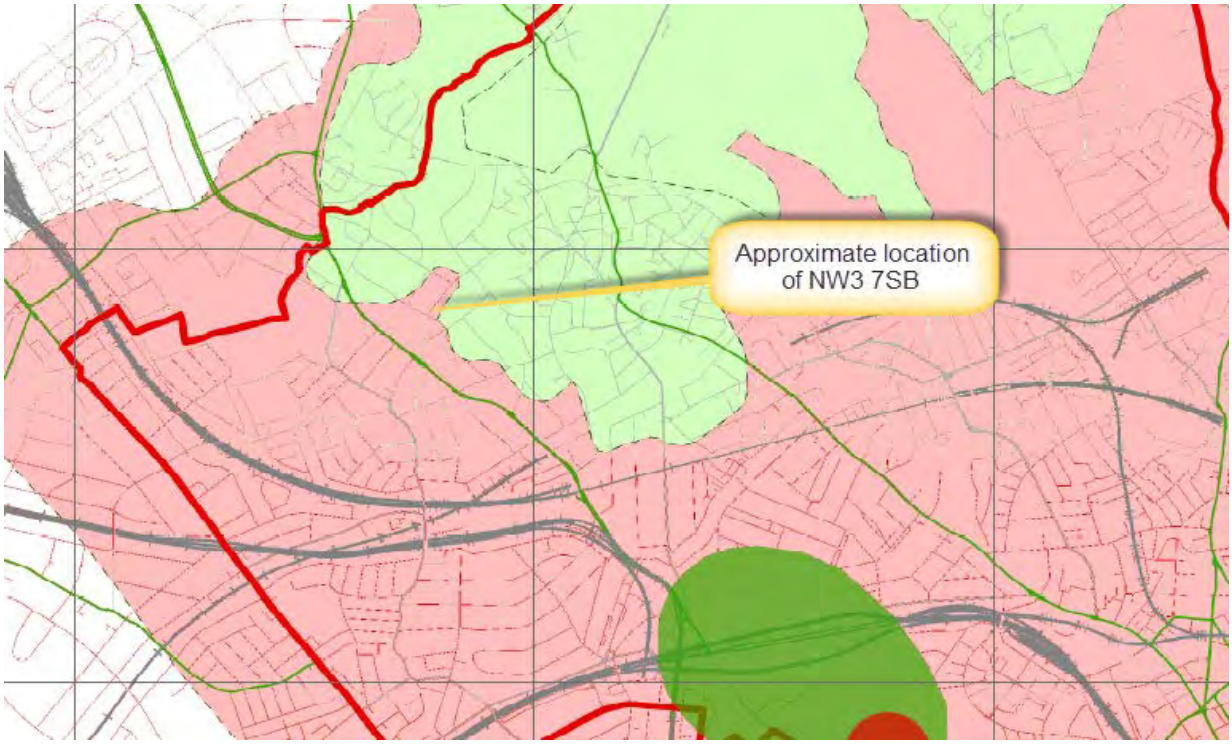


Figure 6.24 - Geology Map & Water Features
Figure 8 of the Arup Hydro-geological Figures 1-10 – Topographic

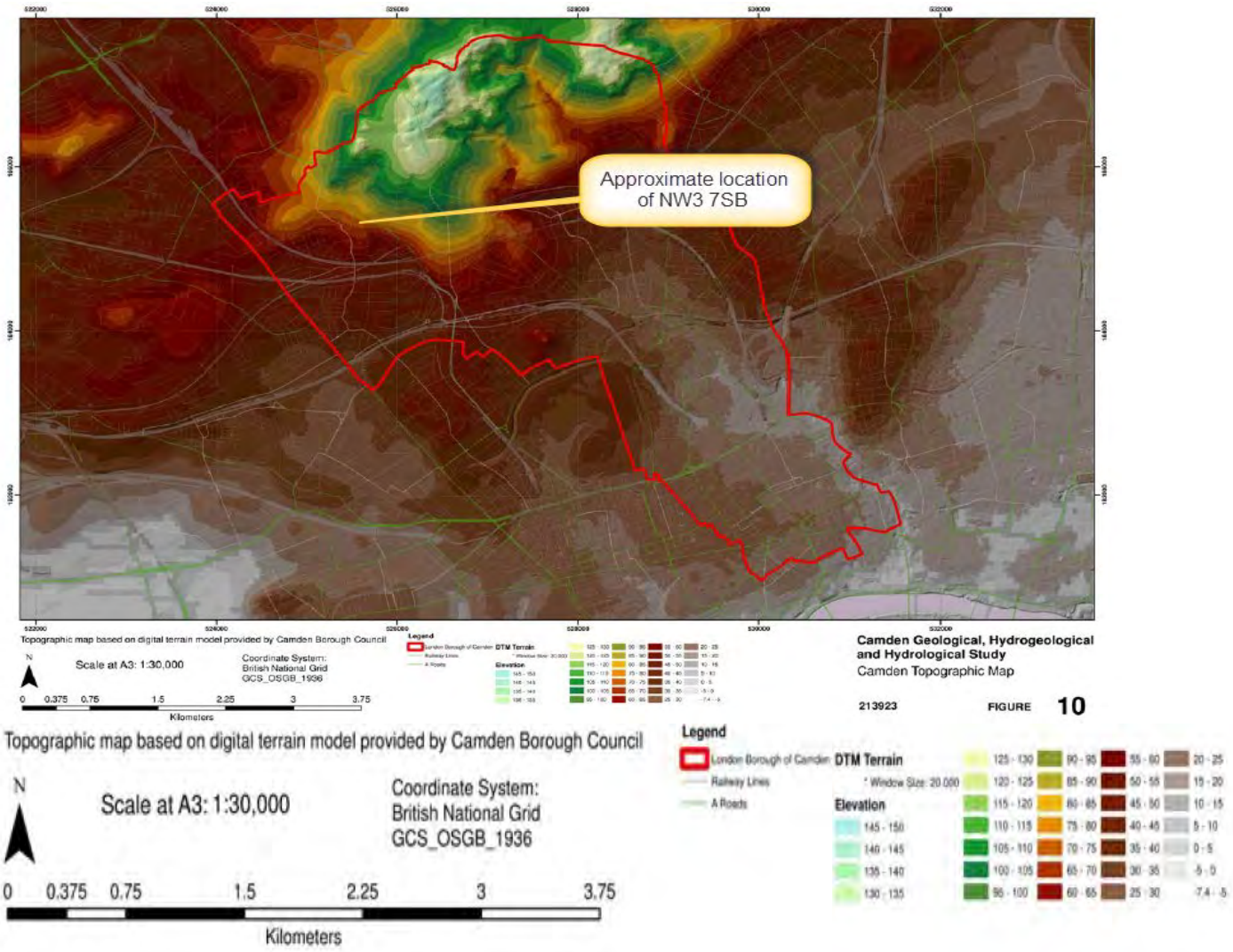
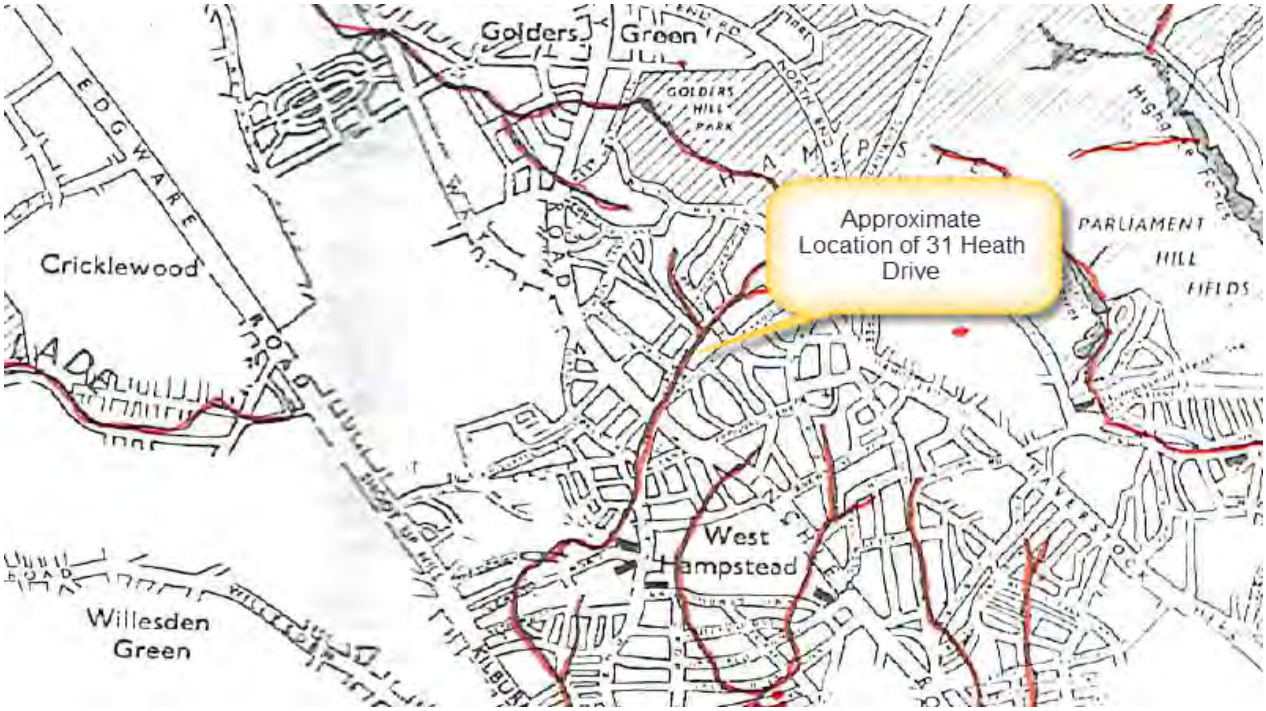


Figure 6.25 - Flood risk maps
Historic Rivers of London Map - Lost Rivers of London, by Nicholas Barton, 1972.



Environment Agency map- Showing surface water flooding appears to follow the path of one of the main tributaries of the River Westbourne, which now runs underground.

7. APPENDICES

A - Site investigation records

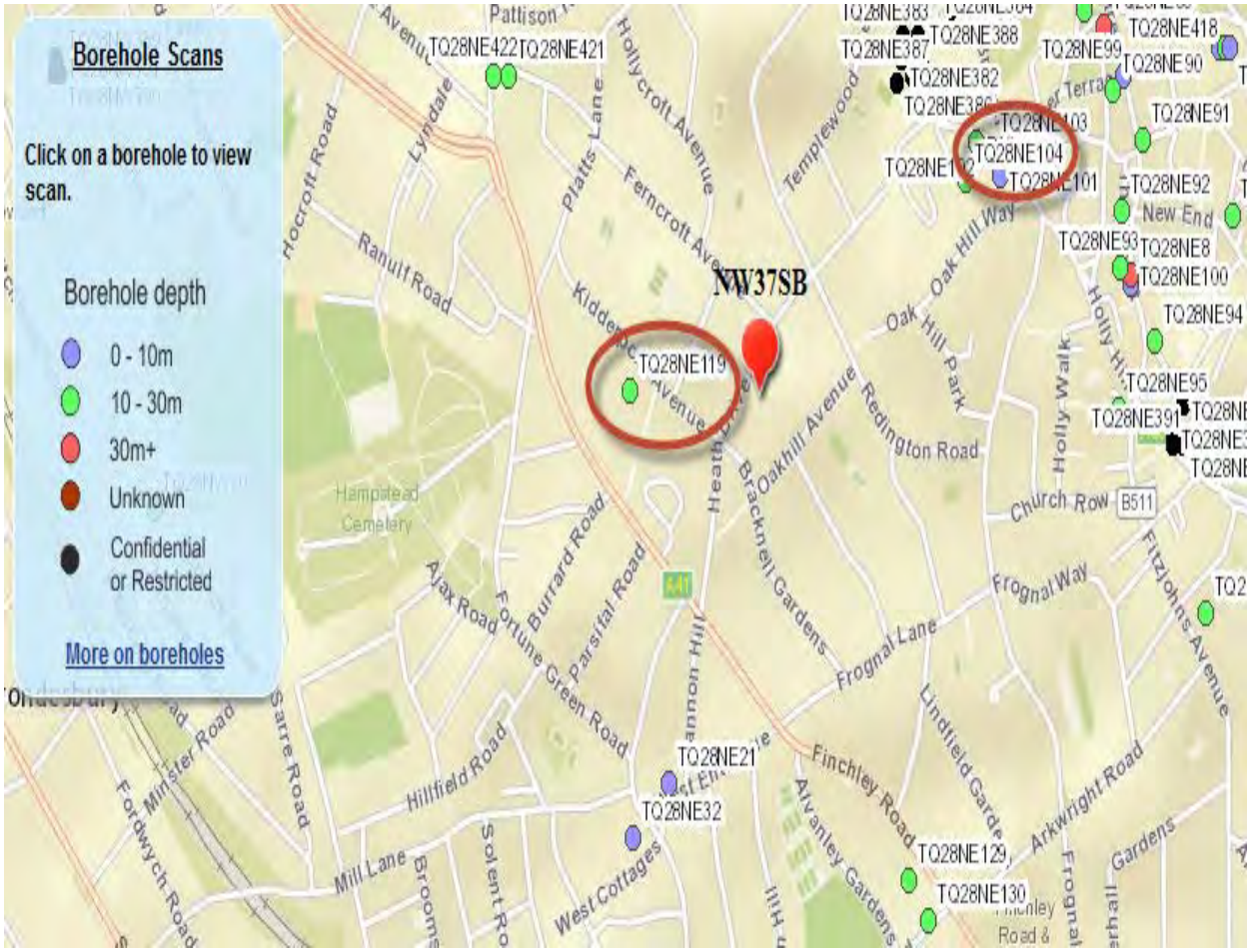
B - Flood Report by GroundSure

C - Sustainable Urban Drainage Systems (SUDS)

D - Bibliography

Appendix A - Site investigation records

Note: Below is a map from the Geology of Britain Viewer from the British Geological Survey's website showing the available boreholes in the NW3 7SB area, in this section, as well as the site specific record, we have taken two samples circled in red from the area for comparative purposes.



NW3 7SB - Site Borehole Report

This report was carried out by Chelmer Site Investigations on 16th April 2015

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SUB SURFACE SOUTH EAST LTD

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Our ref: AJP/SE1281

Your ref:

16 April 2015

Crownwell Design and Build
Garden Flat,
9 Cliff Road,
Greater London
NW1 9AN

For the attention of Mr Jake Puddy

GROUND INVESTIGATION AT 31 HEATH DRIVE, HAMPSTEAD, GREATER LONDON

Dear Sirs,

Following our quote, ref. ESE1699 dated 16 March 2015, and an email instruction from yourselves, dated 16 March 2015, we have undertaken two mini boreholes in the existing cellar to the above property.

Please find enclosed two copies of our Mini Boreholes Records.

If you require further assistance please do not hesitate to contact Mr Gurbinder Singh Mann at our High Wycombe office.

Yours faithfully,

A. J. Parker, B.Sc.(Hons.), C.Geol., F.G.S.,
Principal Geotechnical Engineer,
For and on behalf of
Sub Surface South East Limited

Director C.A. MARSDEN, B.Sc. (Hons.), C.Eng., M.I.C.E.

NW3 7SB - Site Borehole Report continued…….

SUB SURFACE
SITE INVESTIGATION, GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
3 Peel Street, Preston, PR2 2QS. Tel. (01772) 561135 Fax (01772) 204907

Standard Penetration Test Results

Site : 31 HEATH DRIVE, HAMPSTEAD, GREATER LONDON

Client : CROWNWELL DESIGN AND BUILD

Engineer:

Job Number: SE1281

Sheet: 1 / 1

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
M1A	1.00	1.15	1.45	CPT	1	1	1	1	2	3	N=7	
M1A	2.00	2.15	2.45	CPT	2	2	2	3	3	4	N=12	
M1A	3.00	3.15	3.45	CPT	3	3	4	4	5	6	N=19	
M1A	4.00	4.15	4.45	CPT	1	1	1	2	3	4	N=10	
M1A	5.00	5.15	5.45	CPT	3	3	2	4	4	5	N=15	

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NW3 7SB - Site Borehole Report continued…….

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Site	Borehole Number
31 HEATH DRIVE, HAMPSTEAD, GREATER LONDON	M1

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
MINI PERCUSSIVE			CROWNWELL DESIGN AND BUILD	SE1281
	Location AS PLAN	**Dates** 19/03/2015	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.30)	MADE GROUND: dark brown slightly gravelly sandy silty clay. Gravel sized fragments are fine stone and brick.		
						0.30 (0.10) 0.40	MADE GROUND: concrete slab		
						(0.30)	MADE GROUND: orangish yellow gravelly sand. Gravel sized fragments are fine to coarse stone, brick, concrete and asbestos.		
				19/03/2015:DRY		0.70	Complete at 0.70m		

Remarks
Hand dug inspection pit from GL to 0.70m to check for services.
Asbestos fragments found from 0.40m , terminated at 0.70m, backfilled with arisings and moved to M1A.

Scale (approx)	Logged By
1:25	EB/MJE

Figure No. SE1281.M1

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NW3 7SB - Site Borehole Report continued…….

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3 Peel Street, Preston, PR2 2QS. Tel: (01772) 561135 Fax (01772) 204907

Site	Borehole Number
31 HEATH DRIVE, HAMPSTEAD, GREATER LONDON	M1A

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
MINI PERCUSSIVE			CROWNWELL DESIGN AND BUILD	SE1281
	Location AS PLAN	**Dates** 19/03/2015	**Engineer**	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.30)	MADE GROUND: dark brown slightly gravelly sandy silty clay. Gravel sized fragments are fine stone and brick.		
						0.30			
0.40	D					(0.20)	MADE GROUND: light brown mottled orange gravelly sand. Gravel sized fragments are fine to medium stone and brick.		
						0.50			
0.70	DA V					(0.50)	MADE GROUND: soft brownish and orangish grey mottled gravelly sandy silty clay. Gravel sized fragments fine to medium brick, clinker and concrete.		
1.00-1.45	SPT(C) N=7			1,1/1,1,2,3		1.00			
1.00-2.00	C			1.00m to 2.00m - 100% Recovery			MADE GROUND: soft to firm low strength brownish orange mottled grey gravelly silty clay with lenses of dark grey ashy sand and gravel sized fragments of coal at 1.30m. Gravel sized fragments are fine to coarse brick and stone.		
1.20	DA V					(0.90)			
1.90	D					1.90			
2.00-2.45	SPT(C) N=12			2,2/2,3,3,4			Firm becoming stiff medium strength brown and occasional grey mottled silty CLAY.		
2.00-3.00	C			2.00m to 3.00m - 90% Recovery					
2.20	D								
2.70	D								
2.90	D						....at 2.90m: sandstone/ironstone cobble		
3.00-3.45	SPT(C) N=19			3,3/4,4,5,6					
3.00-4.00	C			3.00m to 4.00m - 100% Recovery					
3.70	D					(3.55)			
4.00-4.45	SPT(C) N=10			1,1/1,2,3,4					
4.00-5.00	C			4.00m to 5.00m - 100% Recovery					
4.40	D								
4.80	D								
5.00-5.45	SPT(C) N=15			3,3/2,4,4,5					

Remarks
Hand dug inspection pit from GL to 1.00m to check for services.
On completion backfilled with arisings.

Scale (approx)	Logged By
1:25	EB/MJE

Figure No. SE1281.M1A

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NW3 7SB - Site Borehole Report continued…….

SUB SURFACE
SITE INVESTIGATION, GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
3 Peel Street, Preston, PR2 2QS. Tel. (01772) 561135 Fax (01772) 204907

Site	Borehole Number
31 HEATH DRIVE, HAMPSTEAD, GREATER LONDON	M1A

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
MINI PERCUSSIVE			CROWNWELL DESIGN AND BUILD	SE1281
Location		**Dates**	**Engineer**	**Sheet**
AS PLAN		19/03/2015		2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
							Stiff medium strength brown and occasional grey mottled silty CLAY.		
				19/03/2015:DRY		5.45	Complete at 5.45m		

Remarks	Scale (approx)	Logged By
	1:25	EB/MJE
	Figure No.	SE1281.M1A

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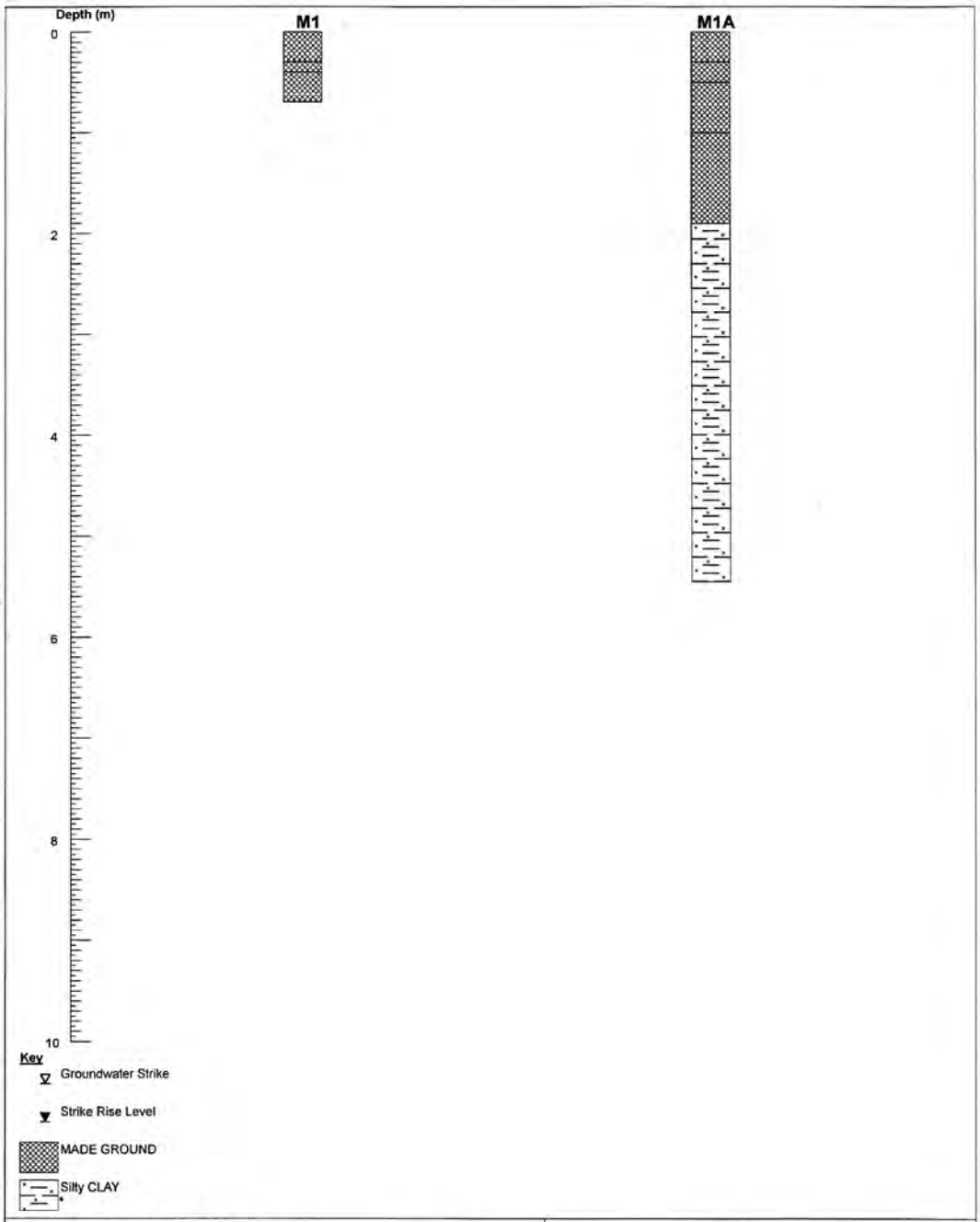
NW3 7SB - Site Borehole Report continued…….



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Nominal Section

Site	Date Drawn	Date Checked	Sheet	Job Number
31 HEATH DRIVE, HAMPSTEAD, GREATER LONDON	15/04/2015		1/1	SE1281
Client	**Drawn By**	**Checked By**	**Scale**	**Figure No.**
CROWNWELL DESIGN AND BUILD			1:50[V]	M3105.1

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NW3 7SB - Site Borehole Report continued…….

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Standard Penetration Test Results

Site : 31 HEATH DRIVE, HAMPSTEAD, GREATER LONDON

Client : CROWNWELL DESIGN AND BUILD

Engineer:

Job Number SE1281

Sheet 1 / 1

Borehole Number	Base of Borehole (m)	End of Seating Drive (m)	End of Test Drive (m)	Test Type	Seating Blows per 75mm		Blows for each 75mm penetration				Result	Comments
					1	2	1	2	3	4		
M1A	1.00	1.15	1.45	CPT	1	1	1	1	2	3	N=7	
M1A	2.00	2.15	2.45	CPT	2	2	2	3	3	4	N=12	
M1A	3.00	3.15	3.45	CPT	3	3	4	4	5	6	N=19	
M1A	4.00	4.15	4.45	CPT	1	1	1	2	3	4	N=10	
M1A	5.00	5.15	5.45	CPT	3	3	2	4	4	5	N=15	

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NW3 7SB - Site Borehole Report continued…….

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Site 31 HEATH DRIVE, HAMPSTEAD, GREATER LONDON			**Borehole Number** M1
Boring Method MINI PERCUSSIVE	**Casing Diameter**	**Ground Level (mOD)**	**Client** CROWNWELL DESIGN AND BUILD	**Job Number** SE1281
	Location AS PLAN	**Dates** 19/03/2015	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.30)	MADE GROUND: dark brown slightly gravelly sandy silty clay. Gravel sized fragments are fine stone and brick.		
						0.30 (0.10) 0.40	MADE GROUND: concrete slab		
						(0.30)	MADE GROUND: orangish yellow gravelly sand. Gravel sized fragments are fine to coarse stone, brick, concrete and asbestos.		
				19/03/2015:DRY		0.70	Complete at 0.70m		

Remarks
Hand dug inspection pit from GL to 0.70m to check for services.
Asbestos fragments found from 0.40m , terminated at 0.70m, backfilled with arisings and moved to M1A.

Scale (approx)	Logged By
1:25	EB/MJE

Figure No. SE1281.M1

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NW3 7SB - Site Borehole Report continued…….

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Site	Borehole Number
31 HEATH DRIVE, HAMPSTEAD, GREATER LONDON	M1A

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
MINI PERCUSSIVE			CROWNWELL DESIGN AND BUILD	SE1281

Location	Dates	Engineer	Sheet
AS PLAN	19/03/2015		1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						(0.30)	MADE GROUND: dark brown slightly gravelly sandy silty clay. Gravel sized fragments are fine stone and brick.		
						0.30			
0.40	D					(0.20)	MADE GROUND: light brown mottled orange gravelly sand. Gravel sized fragments are fine to medium stone and brick.		
						0.50			
0.70	DA V					(0.50)	MADE GROUND: soft brownish and orangish grey mottled gravelly sandy silty clay. Gravel sized fragments fine to medium brick, clinker and concrete.		
						1.00			
1.00-1.45 1.00-2.00	SPT(C) N=7 C			1,1/1,1,2,3 1.00m to 2.00m - 100% Recovery			MADE GROUND: soft to firm low strength brownish orange mottled grey gravelly silty clay with lenses of dark grey ashy sand and gravel sized fragments of coal at 1.30m. Gravel sized fragments are fine to coarse brick and stone.		
1.20	DA V					(0.90)			
1.90	D					1.90	Firm becoming stiff medium strength brown and occasional grey mottled silty CLAY.		
2.00-2.45 2.00-3.00	SPT(C) N=12 C			2,2/2,3,3,4 2.00m to 3.00m - 90% Recovery					
2.20	D								
2.70	D								
2.90	D						...at 2.90m: sandstone/ironstone cobble		
3.00-3.45 3.00-4.00	SPT(C) N=19 C			3,3/4,4,5,6 3.00m to 4.00m - 100% Recovery					
3.70	D					(3.55)			
4.00-4.45 4.00-5.00	SPT(C) N=10 C			1,1/1,2,3,4 4.00m to 5.00m - 100% Recovery					
4.40	D								
4.80	D								
5.00-5.45	SPT(C) N=15			3,3/2,4,4,5					

Remarks
Hand dug inspection pit from GL to 1.00m to check for services.
On completion backfilled with arisings.

Scale (approx)	Logged By
1:25	EB/MJE

Figure No. SE1281.M1A

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NW3 7SB - Site Borehole Report continued…….

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3 Peel Street, Preston, PR2 2QS. Tel: (01772) 561135 Fax (01772) 204907

Site 31 HEATH DRIVE, HAMPSTEAD, GREATER LONDON			**Borehole Number** M1A
Boring Method MINI PERCUSSIVE	**Casing Diameter**	**Ground Level (mOD)**	**Client** CROWNWELL DESIGN AND BUILD	**Job Number** SE1281
	Location AS PLAN	**Dates** 19/03/2015	**Engineer**	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				19/03/2015:DRY		5.45	Stiff medium strength brown and occasional grey mottled silty CLAY.		
							Complete at 5.45m		

Remarks

Scale (approx)	Logged By
1:25	EB/MJE

Figure No. SE1261.M1A

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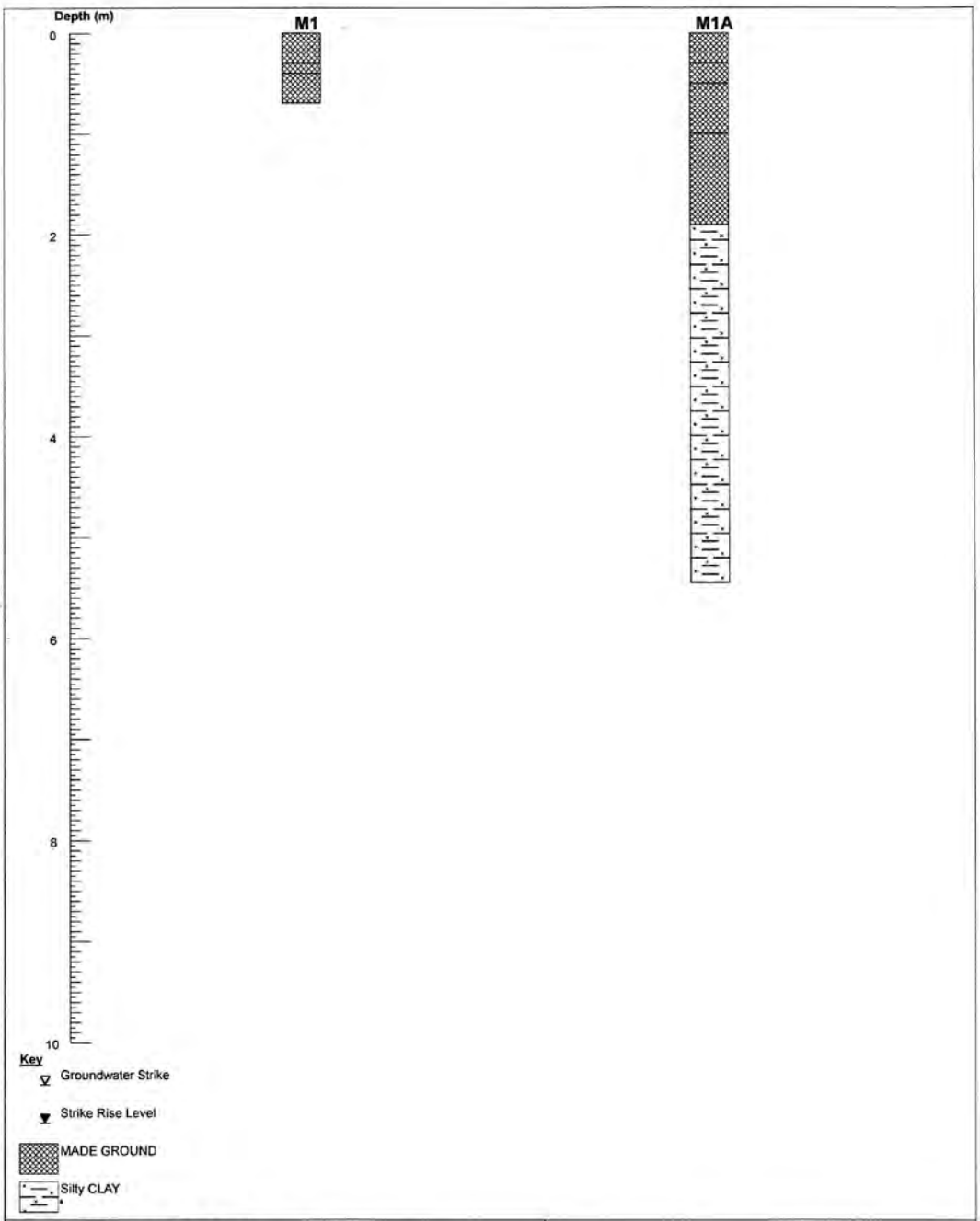
NW3 7SB - Site Borehole Report continued…….



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Nominal Section

Site	Date Drawn	Date Checked	Sheet	Job Number
31 HEATH DRIVE, HAMPSTEAD, GREATER LONDON	15/04/2015		1/1	SE1281
Client	**Drawn By**	**Checked By**	**Scale**	**Figure No.**
CROWNWELL DESIGN AND BUILD			1:50[V]	M3105.1

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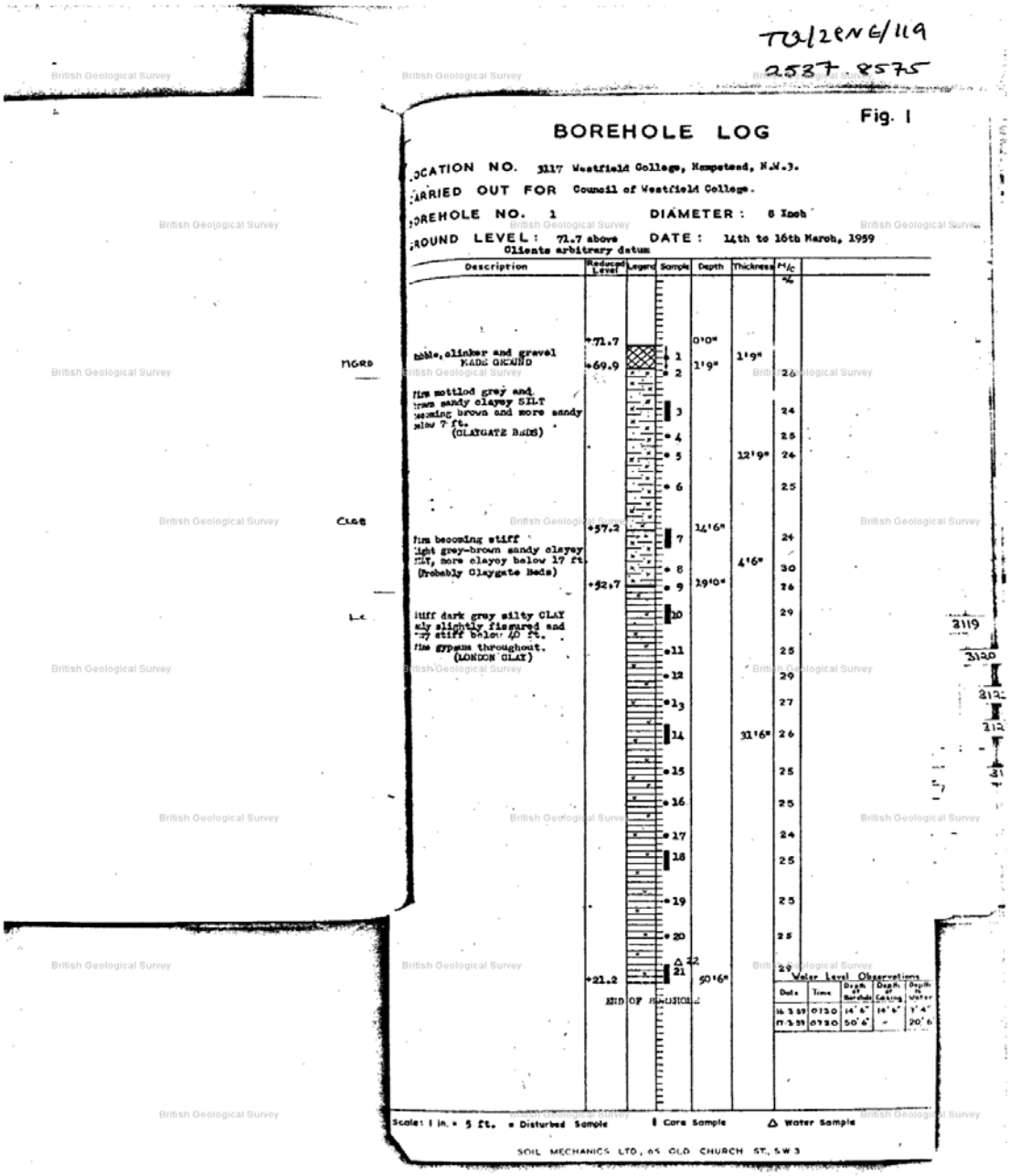
Sample Borehole Record
BGS TQ28NE119 – West of NW3 7SB.



TQ28NE/119
2587.8575

Fig. 1

BOREHOLE LOG

LOCATION NO. 3117 Westfield College, Hampstead, N.W.3.
CARRIED OUT FOR Council of Westfield College.
BOREHOLE NO. 1 DIAMETER : 8 Inch
GROUND LEVEL : 71.7 above Clients arbitrary datum DATE : 14th to 16th March, 1959

Description	Reduced Level	Legend	Sample	Depth	Thickness	M/C %
Rubble, clinker and gravel MADE GROUND	+71.7		1	0'10"	1'9"	
	+69.9		2	1'9"		26
Firm mottled grey and brown sandy clayey SILT becoming brown and more sandy below 7 ft. (CLAYGATE BEDS)			3			24
			4			25
			5		12'9"	24
			6			25
	+57.2		7	14'6"		24
Firm becoming stiff light grey-brown sandy clayey SILT, more clayey below 17 ft. (Probably Claygate Beds)			8		4'6"	30
	+52.7		9	19'0"		26
Stiff dark grey silty CLAY fairly slightly fissured and very stiff below 40 ft. Fine gypsum throughout. (LONDON CLAY)			10			29
			11			25
			12			29
			13			27
			14		31'6"	26
			15			25
			16			25
			17			24
			18			25
			19			25
			20			25
			21	50'6"		29
	+21.2					

END OF EXPLORATION

Water Level Observations

Date	Time	Depth of Borehole	Depth of Casing	Depth to Water
14.3.59	0730	14'6"	14'6"	7'4"
17.3.59	0730	50'6"	-	20'6

Scale: 1 in. = 5 ft. • Disturbed Sample ▮ Core Sample △ Water Sample

SOIL MECHANICS LTD., 65 OLD CHURCH ST., S.W.3

Sample Borehole Record continued…..
BGS TQ28NE104 – North East of NW3 7SB.

B/1 (1965)
Height 405.08 O.D.

TQ/28NE/103
2608. 8603.

	Thickness (ft)	Depth (ft)
Top Soil	¼	
Brown sand with stones	4½	¼
Brown sandy mottled clay	4¼	4½
Firm brown clay with layers of sand	32	9
Very sandy brown clay	8½	41
Silt with layers of silty clay	11	49½
Soft brown mottled silty clay	2½	60½
Silt with layers of silty clay	8	63
Firm silty blue clay	11	71
Hard blue clay with layers of sand	37½	82
	119½	

? 81 ft of Wash

BB

CB

B/HL (1968)

TQ/28NE/104 c. 370'+OD
2603. 8603.

	Thickness (ft)	Depth (ft)
Dirty sand	4	
Silty clayey sand	38	4
Silty grey clay	2	42
Silty sand	6	44
Grey silt (liquid)	10	50
Grey clay	10	60
	70	

BB

CB

KEY PLAN AT BACK OF REPORT.

Appendix B - Flood Report by GroundSure

Groundsure
LOCATION INTELLIGENCE

Groundsure Flood

Address:	31,HEATH DRIVE,LONDON, NW3 7SB
Date:	20 May 2015
Reference:	GS-2109920
UK-Hydrosciences	UK-Hydrosciences

W  E

Aerial Photograph Capture date: 20-Apr-2013
Grid Reference: 525595,185722

Groundsure
LOCATION INTELLIGENCE

Table of Contents

20 May 2015

Groundsure
LOCATION INTELLIGENCE

GROUNDSURE FLOOD OVERVIEW

Overall Flood Risk

A Moderate overall risk of flooding has been identified within 25m of the centre of the property.

JBA Overall Insurability Index

Green

The property has been rated as Green within JBA's Insurability Index. Green indicates a level of flood hazard such that (subject to terms, applicant's status and individual insurers' approach to risk, and any other factors which may be relevant) insurance covering flood risk may be obtainable relatively easily as part of a standard household insurance contract.

Please note: this rating is only valid for an individual residential property.

RoFRaS

Very Low

This indicates the chance of flooding at the site or an area within 25m is less than 1 in 1000 in any given year.

JBA Pluvial

High

This indicates that the site or an area within 25m would be expected to be affected by surface water flooding in a 1 in 75 year rainfall event to a depth of between 0.1m to 0.3m

Historic Flood Events

The site or an area within 25m has not been subject to historic flooding as recorded by the Environment Agency.

Areas Benefiting from Flood Defences

The site or an area within 25m has not been considered to be within an area benefiting from flood defences.

Address:

31,HEATH DRIVE,LONDON, NW3 7SB

Your Reference

31 Heath Drive, NW3 7SB

Groundsure Reference

GS-2109920

Grid Reference

525595,185722

Client

UK Hydrosciences

iema

COPSO
EXECUTIVE MEMBER

EXPERT ASSESSMENT

OVERVIEW AND GUIDANCE

Groundsure
LOCATION INTELLIGENCE

Overall Flood Risk

Groundsure consider that the area within 25m of the centre of the property has a **Moderate** risk of flooding. Please note this rating is calculated using a weighted assessment of fluvial, coastal and pluvial risk and historic flood events only.

Recommendations

A Very Low risk of tidal/fluvial flooding and a High risk of surface water (pluvial) flooding have been identified within 25m of the centre of the property. Please refer to the individual flood assessment sections below for further specific guidance. Alternatively, flood resistance measures may assist in reducing the flood risk to the property. Please see Flood Resistance Measures section for further details.

Please be aware that this is an automated assessment based upon the highest flood risk found within 25m of the centre of the property. Therefore a purchaser may wish to check the maps provided within this report to confirm whether the flood risk area lies on or in close proximity to the property. If you would like Groundsure to manually assess the property a £35 + VAT fee may be applicable. Please note this manual assessment does not include a site visit.

JBA Overall Insurability Index

Guidance

The property has been rated as Green within JBA's Insurability Index. Green indicates a level of flood hazard such that (subject to terms, applicant's status and individual insurers' approach to risk, and any other factors which may be relevant) insurance covering flood risk may be obtainable relatively easily as part of a standard household insurance contract.

The JBA Insurability Index is categorised on a fivefold scale (subject to terms, applicant's status and individual insurers' approach to risk, and any other factors which may be relevant):

- Green indicates a level of flood hazard such that insurance covering flood risk may be obtainable relatively easily as part of a standard household insurance contract.
- Amber indicates a level of flood hazard such that insurance covering flood risk may be available but may be subject to increased premiums and non-standard and/or additional terms.
- Red indicates a level of flood hazard such that insurance covering flood risk may be more difficult to obtain.
- Black 1 indicates a level of flood hazard such that insurance covering flood risk may be significantly more difficult to obtain.
- Black 2 indicates a level of flood hazard such that insurance covering flood risk may be extremely difficult to obtain.

EXPERT ASSESSMENT

OVERVIEW AND GUIDANCE

Please note that due to the methodology employed to produce the dataset, JBA insurability ratings are only suitable for individual residential properties, and as such any rating given for commercial property should be considered invalid.

RoFRaS

As the site lies within or in close proximity to an area with a Very Low risk rating in the RoFRaS database, no further recommendations are required.

Guidance

The Environment Agency RoFRaS database provides an indication of river and coastal flood risk at a national level on a 50m grid with the flood rating at the centre of the grid calculated and given above. The data considers the likelihood of flood defences overtopping or breaching by considering their location, type, condition and standard of protection.

A number of major insurance companies refer to this information within their risk model, although they may also utilise additional information such as claims histories, which may further influence their decision. Where a High risk of flooding is identified flood risk insurance may be difficult to obtain without further work being undertaken. Property owners of sites within Low and Medium risk areas are still considered to be at risk of flooding and insurance premiums may be increased as a result. Owners of properties within Low, Medium and High risk areas, are advised to sign up to the Environment Agency's Flood Warning scheme. Please see Section 1 for further details.

JBA Pluvial

The study site or an area within 25m of the centre of the study site has been assessed to be at a High Risk of surface water (pluvial) flooding. This indicates that this area would be expected to be affected by surface water flooding in a 1 in 75 year rainfall event to a depth of between 0.1m to 0.3m

Guidance

Surface Water (pluvial) flooding is defined as flooding caused by rainfall-generated overland flow before the runoff enters a watercourse or sewer. In such events, sewerage and drainage systems and surface watercourses may be entirely overwhelmed.

Surface Water (pluvial) flooding will usually be a result of extreme rainfall events, though may also occur when lesser amounts of rain falls on land which has low permeability and/or is already saturated, frozen or developed. In such cases overland flow and 'ponding' in topographical depressions may occur. Please see Section 2 for further details.

EXPERT ASSESSMENT

OVERVIEW AND GUIDANCE

Groundsure
LOCATION INTELLIGENCE

Historic Flood Events

The site is not recorded to have been subject to historic flooding. However, the absence of data does not provide a definitive conclusion that the site has never flooded, only that the Environment Agency hold no record of any flooding at the site.

Guidance

Over 21,000 separate events are recorded within this database, dating back to 1947. This data is used to understand where flooding has occurred in the past and provides details as available. Absence of a historic flood event for an area does not mean that the area has never flooded, but only that the Environment Agency do not currently have records of flooding within the area. Equally, a record of a flood footprint in previous years does not mean that an area will flood again, and this information does not take account of flood management schemes and improved flood defences. Please see Section 3 for further details.

Areas benefiting from Flood Defences

The property does not lie in or within 25m of an area the Environment Agency consider to benefit from flood defences. Property-level defences and some older schemes may not be included in the Environment Agency database of areas considered to benefit from flood defences.

Guidance

These are areas that may benefit from the presence of major defences during a 1% fluvial (river) or 0.5% tidal flood event. These areas would flood if the defence were not present, but may not flood because the defence is present.

Proposed Flood Defences

The property does not lie in or within 25m of an area the Environment Agency consider to benefit from proposed flood defences.

Guidance

Flood defences seek to reduce the risk of flooding and to safeguard life, protect property, sustain economic activity and the natural environment. Flood defences are designed to protect against flood events of a particular magnitude, expressed as risk in any one year.

EXPERT ASSESSMENT

OVERVIEW AND GUIDANCE

Groundsure
LOCATION INTELLIGENCE

Flooding from Groundwater

There is limited potential for groundwater flooding to occur at the study site. Where limited potential for groundwater flooding to occur is indicated, this means that although given the geological conditions there may be a groundwater flooding hazard, unless other relevant information, e.g. records of previous flooding, suggests groundwater flooding has occurred before in this area, you need take no further action in relation to groundwater flooding hazard.

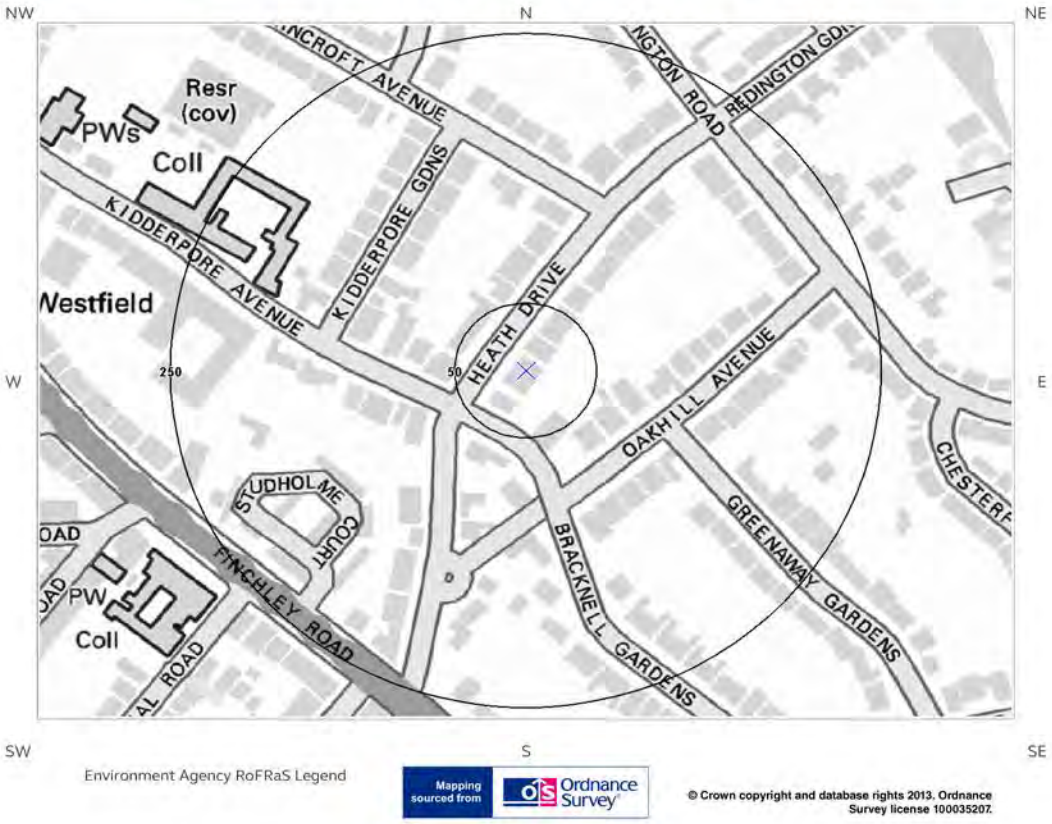
Guidance

The BGS Susceptibility to Groundwater Flooding hazard dataset identifies areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface.

The susceptibility data is suitable for use for regional or national planning purposes where the groundwater flooding information will be used along with a range of other relevant information to inform land-use planning decisions. It might also be used in conjunction with a large number of other factors, e.g. records of previous incidence of groundwater flooding, rainfall, property type, and land drainage information, to establish relative, but not absolute, risk of groundwater flooding at a resolution of greater than a few hundred metres. The susceptibility data should not be used on its own to make planning decisions at any scale, and, in particular, should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding.

Groundsure
LOCATION INTELLIGENCE

1. ENVIRONMENT AGENCY RoFRaS MAP



Environment Agency RoFRaS Legend

Mapping sourced from Ordnance Survey

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Site Centre

Site Outline

250 / 500 Search Buffers (m)

RoFRaS Rating	Flood Defences
Very Low	Areas used for Flood Storage
Low	Areas Benefiting from Flood Defences
Medium	Flood Defences
High	Proposed Flood Defence Scheme

Report Reference: GS-2109920

Client Reference: 31 Heath Drive, NW3 7SB

10

Groundsure
LOCATION INTELLIGENCE

1 FLOODING FROM RIVERS AND THE SEA

1.1 Risk of Flooding from Rivers and the Sea (RoFRaS)

What is the highest risk of flooding on or within 25m of the centre of the study site?	**Very Low**

Guidance: RoFRaS data for the study site indicates the property has a Very Low (less than 1 in 1000) chance of flooding in any given year.

1.2 Areas Benefiting from Flood Defences

Are there any areas benefiting from Flood Defences within 25m of the study site?	**No**

Guidance: These are areas that may benefit from the presence of major defences during a 1% fluvial (river) or 0.5% tidal flood event. These areas would flood if the defence were not present, but may not flood because the defence is present.

1.3 Flood Defences

Are there any Flood Defences within 250m of the study site?	**No**

Guidance: This search consists only of flood defences present in the dataset provided by the Environment Agency.

1.4 Proposed Flood Defences

Are there any Proposed Flood Defences within 250m of the study site?	**No**

Guidance: This search consists only of proposed flood defences present in the dataset provided by the Environment Agency. Please note that proposed flood defence schemes will not influence the current RoFRaS ratings for the site until they have been constructed.

1.5 Areas used for Flood Storage

Are there any areas used for Flood Storage within 250m of the study site?	**No**

Flood Storage Areas are considered part of the functional floodplain, and are areas where water has to flow or be stored in times of flood. Technical Guidance to the National Planning Policy Framework states that only water-compatible development and essential infrastructure should be permitted within flood storage areas, and existing development within this area should be relocated to an area with a lower risk of flooding. Any relevant data is represented on Map 1 - Flood Map for Planning.

Groundsure
LOCATION INTELLIGENCE

Notes on RoFRaS data

RoFRaS is an assessment of flood risk for England and Wales produced using local data and expertise. It shows the chance of flooding from rivers or the sea presented in categories taking account of flood defences and the condition those defences are in. The RoFRaS model uses local water level and flood defence data to model flood risk. It has divided England and Wales into 50m X 50m impact cells. Each cell has been assigned a flood risk likelihood from the categories below:

- Less than **1 in 1000 (0.1%)** chance in any given year **Very Low**
- Less than **1 in 100 (1%)** but greater than or equal to **1 in 1000 (0.1%)** chance in any given year **Low**
- Less than **1 in 30 (3.3%)** but greater than or equal to **1 in 100 (1%)** chance in any given year **Medium**
- Greater than or equal to **1 in 30 (3.3%)** chance in any given year **High**

Notes on Existing Flood Defences

Flood defences seek to reduce the risk of flooding and to safeguard life, protect property, sustain economic activity and the natural environment. Flood defences are designed to protect against flood events of a particular magnitude, expressed as risk in any one year.

Notes on Proposed Flood Defences

This information is taken from the Environment Agency's database of Areas to Benefit from New and Reconditioned Flood Defences under the Medium Term Plan (MTP). The dataset contains funding allocation for the first financial year (from April). Funding for the following four financial years is not guaranteed, being only indicative, and will be reviewed annually. Projects within the Medium Term Plan qualify for inclusion in this dataset if:

- the investment leads to a change in the current standard of protection (change projects);
- the investment is a replacement or refurbishment in order to sustain the current standard of protection (sustain projects);
- the project has an initial construction budget of £100,000 or more; and
- the project is included within the first five years of the MTP.

The data includes all the Environment Agency's projects over £100K that will change or sustain the standards of flood defence in England and Wales over the next 5 years. It also includes the equivalent schemes for all Local Authority and Internal Drainage Boards. The number of households and areas of land contributing to DEFRA's Outcome Measures (OM) are also attributed i.e. could benefit from major work on flood defences.

These data also contain Intermittence Flood Maintenance Programmes that show the annual maintenance programme of work scheduled to be carried out by the Environment Agency, Local Authority or Internal Drainage Board on flood defences. Data details routine maintenance as well as intermittent work that has been funded for the coming year. The data contains a start and end coordinate defining the relevant river section where work is planned.

Groundsure
LOCATION INTELLIGENCE

Information Warning

Please note that the maps show the areas where investment is being made to reduce the flood and coastal erosion risk and are not detailed enough to account for individual addresses. Individual properties may not always face the same risk of flooding as the areas that surround them. Also, note that funding figures are indicative and any use or interpretation should account for future updates where annual values may change.

Every possible care is taken to ensure that the maps reflect all the data possessed by the Environment Agency and that they have applied their expert knowledge to create conclusions that are as reliable as possible. The Environment Agency consider that they have created the maps as well as they can and so should not be liable if the maps by their nature are not as accurate as might be desired or are misused or misunderstood, despite their warnings. For this reason, they are not able to promise that the maps will always be accurate or completely up to date.

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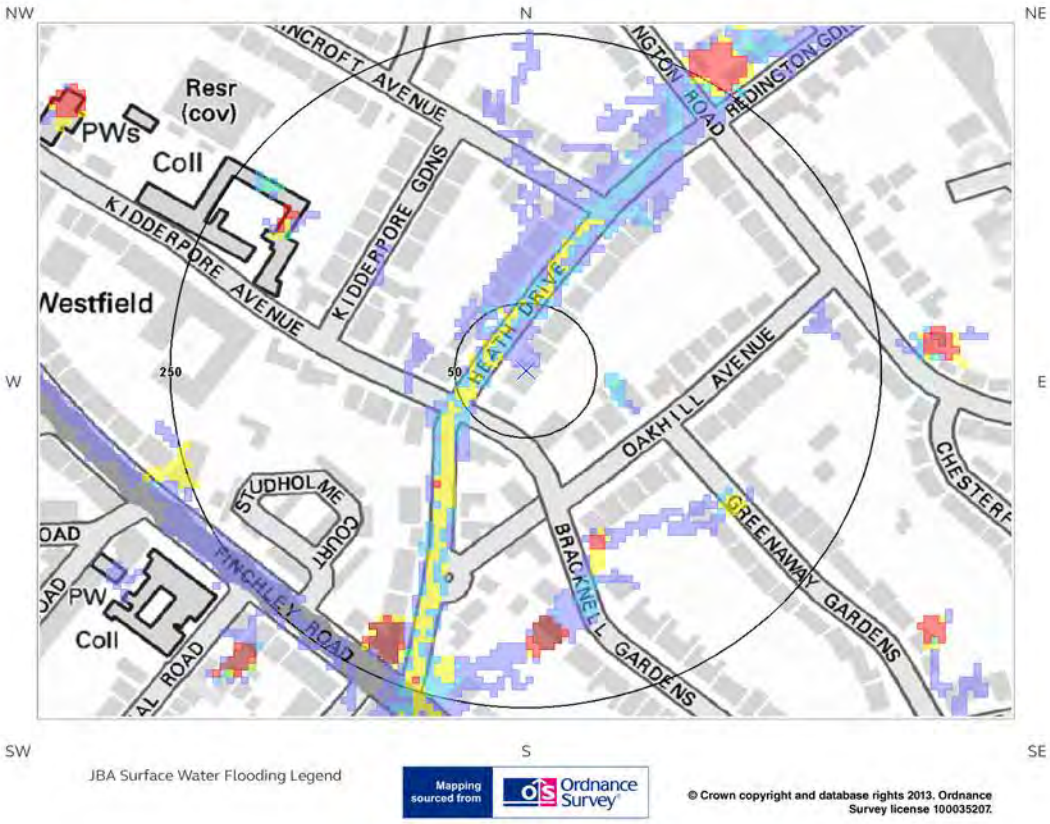
Flood Storage Areas

Flood Storage Areas may also act as flood defences. A flood storage area may also be referred to as a balancing reservoir, storage basin or balancing pond. Its purpose is to attenuate an incoming flood peak to a flow level that can be accepted by the downstream channel. It may also delay the timing of a flood peak so that its volume is discharged over a longer time interval.

A flood storage area may take the form of a wet or dry reservoir. A wet reservoir is a water storage facility in which storage can be effected by allowing water levels to rise during flood times. A dry reservoir is typically adjacent to a river and comprises an enclosed area that accepts water only at peak times. These areas are also referred to as Zone 3b or 'the functional floodplain' and has a 5% or greater chance of flooding in any given year, or is designed to flood in the event of an extreme (0.1%) flood or another probability which may be agreed between the Local Planning Authority and the Environment Agency, including water conveyance routes. Development within Flood Storage Areas is severely restricted.

Groundsure
LOCATION INTELLIGENCE

2. JBA Surface Water Flooding Map



JBA Surface Water Flooding Legend

Mapping sourced from Ordnance Survey

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Site Outline

125
250
Search Buffers (m)

Highly Significant
Significant
High
Moderate to High
Moderate
Low to Moderate
Low

Report Reference: GS-2109920

Client Reference: 31 Heath Drive, NW3 7SB

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Groundsure
LOCATION INTELLIGENCE

2 JBA SURFACE WATER FLOODING

2.1 JBA Surface Water (Pluvial) Flooding

Surface Water (pluvial) flooding is defined as flooding caused by rainfall-generated overland flow before the runoff enters a watercourse or sewer. In such events, sewerage and drainage systems and surface watercourses may be entirely overwhelmed.

Surface Water (pluvial) flooding will usually be a result of extreme rainfall events, though may also occur when lesser amounts of rain falls on land which has low permeability and/or is already saturated, frozen or developed. In such cases overland flow and 'ponding' in topographical depressions may occur.

What is the risk of pluvial flooding at the centre of the study site?	**Negligible**
What is the highest risk of pluvial flooding within 25m of the centre of the study site?	**High**

Guidance: This indicates that the site or an area within 25m would be expected to be affected by surface water flooding in a 1 in 75 year rainfall event to a depth of between 0.1m to 0.3m

Flood data provided by JBA RISK MANAGEMENT LIMITED Copyright © JBA RISK MANAGEMENT LIMITED 2008-2015

The following pluvial (surface water) flood risk records **within 50m** of the study site are shown on the JBA Surface Water Flooding Map:

Distance	Direction	JBA Flood Risk
3.0	N	Low
16.0	NW	Low to Moderate
17.0	NW	High
20.0	W	High
25.0	W	Low to Moderate
30.0	W	High
33.0	NW	Low
33.0	N	Low to Moderate
34.0	NW	Low
34.0	NW	Low
36.0	NW	Low to Moderate
38.0	NW	Low to Moderate

Distance	Direction	JBA Flood Risk
38.0	N	Low to Moderate
40.0	W	Low
40.0	W	Low to Moderate
41.0	SW	Low
43.0	NW	Low
43.0	N	Low
44.0	N	Low
46.0	N	High
47.0	NW	Low to Moderate
48.0	N	High
48.0	N	High
48.0	N	Low to Moderate
48.0	SW	Low to Moderate
49.0	NW	Low
49.0	N	Low to Moderate
50.0	SW	Low to Moderate

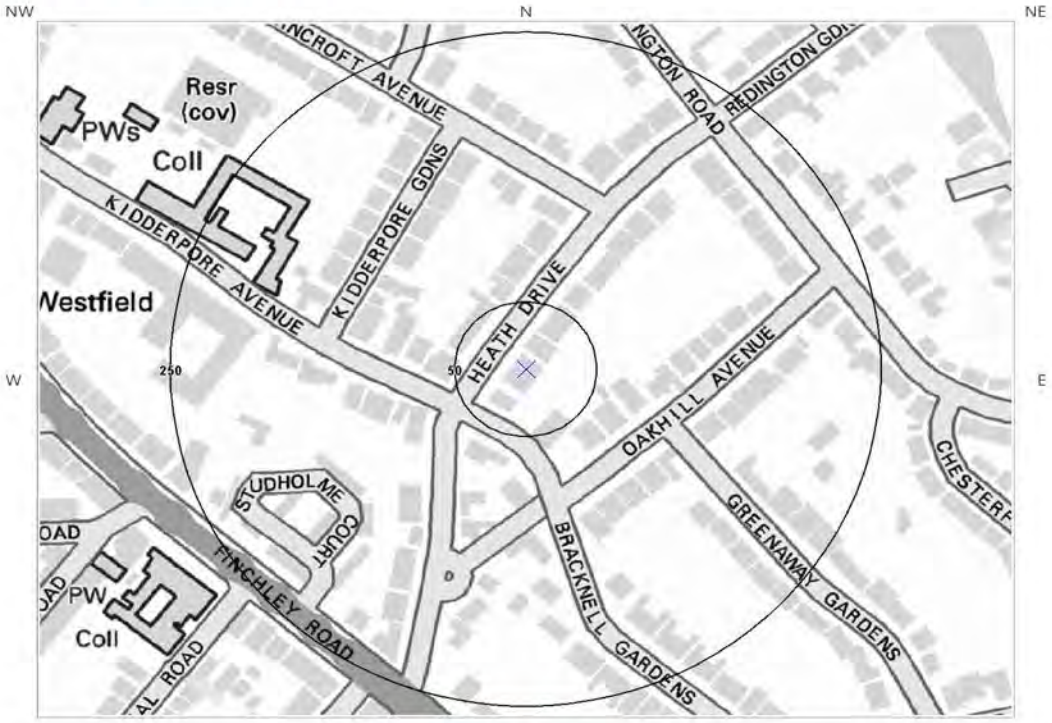
Notes on Surface water (Pluvial) Flooding data:

JBA Risk Management surface water flood map identifies areas likely to flood following extreme rainfall events, i.e. land naturally vulnerable to surface water or "pluvial" flooding. This data set was produced by simulating 1 in 75 year, 1 in 200 year and 1 in 1000 year rainfall events. Modern urban drainage systems are typically built to cope with rainfall events between 1 in 20 and 1 in 30 years, though older ones may even flood in a 1 in 5 year rainstorm event.

The model provides the maximum depth of flooding in each 5m "cell" of topographical mapping coverage. The maps include 7 bands indicating areas of increasing natural vulnerability to surface water flooding. These are:

- Less than **0.1m** in a **1 in 1000** year rainfall event — **Negligible**
- Greater than **0.1m** in a **1 in 1000** year rainfall event — **Low**
- Between **0.1m and 0.3m** in a **1 in 200** year rainfall event — **Low to Moderate**
- Between **0.3m and 1m** in a **1 in 200** year rainfall event — **Moderate**
- Greater than **1m** in a **1 in 200** year rainfall event — **Moderate to High**
- Between **0.1m and 0.3m** in a **1 in 75** year rainfall event — **High**
- Between **0.3m to 1m** in a **1 in 75** year rainfall event — **Significant**
- Greater than **1m** in a **1 in 75** year rainfall event — **Highly Significant**

3. Environment Agency Historic Flooding Map



EA Historic Flooding Legend

Mapping sourced from Ordnance Survey

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Site Outline

125
250
Search Buffers (m)

Historic Flood Events

Report Reference: GS-2109920

Client Reference: 31 Heath Drive, NW3 7SB

18

Groundsure
LOCATION INTELLIGENCE

3 ENVIRONMENT AGENCY HISTORIC FLOODING

3.1 Historic Flood Outlines

Has the site or any area within 250m been subject to historic flooding as recorded by the Environment Agency?	**No**

This database shows the individual footprint of every flood event recorded by the Environment Agency and previous bodies.

Any records found within the search radius are displayed on Map 3 – Historic Flooding Events.

Notes on Historic Flooding data:

Over 21,000 separate events are recorded within this database, dating back to 1947. This data is used to understand where flooding has occurred in the past and provides details as available. Absence of a historic flood event for an area does not mean that the area has never flooded, but only that the Environment Agency do not currently have records of flooding within the area. Equally, a record of a flood footprint in previous years does not mean that an area will flood again, and this information does not take account of flood management schemes and improved flood defences.

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4 BGS GROUNDWATER FLOODING

4.1 Groundwater Flooding Susceptibility Areas

Where land that is prone to groundwater flooding has been built on, the effect of a flood can be costly. Because groundwater responds slowly compared with rivers, floods can last for weeks or even months.

What is the highest susceptibility to groundwater flooding in the search area based on the underlying geological conditions?	**Limited potential**

Guidance: Where limited potential for groundwater flooding to occur is indicated, this means that although given the geological conditions there may be a groundwater flooding hazard, unless other relevant information, e.g. records of previous flooding, suggests groundwater flooding has occurred before in this area, you need take no further action in relation to groundwater flooding hazard.

Notes:Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

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Notes on Groundwater Flooding

The BGS Susceptibility to Groundwater Flooding hazard dataset identifies areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface.

The susceptibility data is suitable for use for regional or national planning purposes where the groundwater flooding information will be used along with a range of other relevant information to inform land-use planning decisions. It might also be used in conjunction with a large number of other factors, e.g. records of previous incidence of groundwater flooding, rainfall, property type, and land drainage information, to establish relative, but not absolute, risk of groundwater flooding at a resolution of greater than a few hundred metres. The susceptibility data should not be used on its own to make planning decisions at any scale, and, in particular, should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding.

Groundwater flooding is assessed on a fourfold scale:

- The area is not considered to be prone to groundwater flooding based on rock type.
- There is limited potential for groundwater flooding to occur and further relevant information should be considered to determine this assessment.
- There is potential for groundwater flooding of property situated below the surface such as basements and other below surface infrastructure. Further relevant information should be considered to determine whether groundwater flooding has previously occurred.
- There is potential for groundwater flooding to occur at the surface and groundwater flooding hazard should be considered in all land use planning decisions. Other relevant information should be considered to establish the risk of groundwater flooding to property.

Contact Details

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info@groundsure.com

British Geological Survey Enquiries
Kingsley Dunham Centre
Keyworth, Nottingham NG12 5GG
Tel: 0115 936 3143.
Fax: 0115 936 3276.
Email:enquiries@bgs.ac.uk
Web:www.bgs.ac.uk
BGS Geological Hazards Reports and general geological enquiries

Environment Agency
Floodline tel: 0845 988 1188
General enquiry tel: 08708 506 506
Web: www.environment-agency.gov.uk
Email: enquiries@environment-agency.gov.uk

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Ordnance Survey
Adanac Drive,
Southampton
SO16 0AS

Tel: 08456 050505
Website: http://www.ordnancesurvey.co.uk/

Flood Authority

Flood Authority Name:Camden London Boro
Type: London Borough
County Unitary Name: Greater London Authority
Description: CIVIL ADMINISTRATION AREA

Getmapping PLC
Virginia Villas, High Street, Hartley Witney
Hampshire RG27 8NW
Tel: 01252 845444
Website: http://www1.getmapping.com/

Watertight International Ltd
The Old Rectory, Church Lane
Thornby
Northampton
NN6 8SN
Phone: 0800 093 3463
Website: http://www.watertightinternational.com

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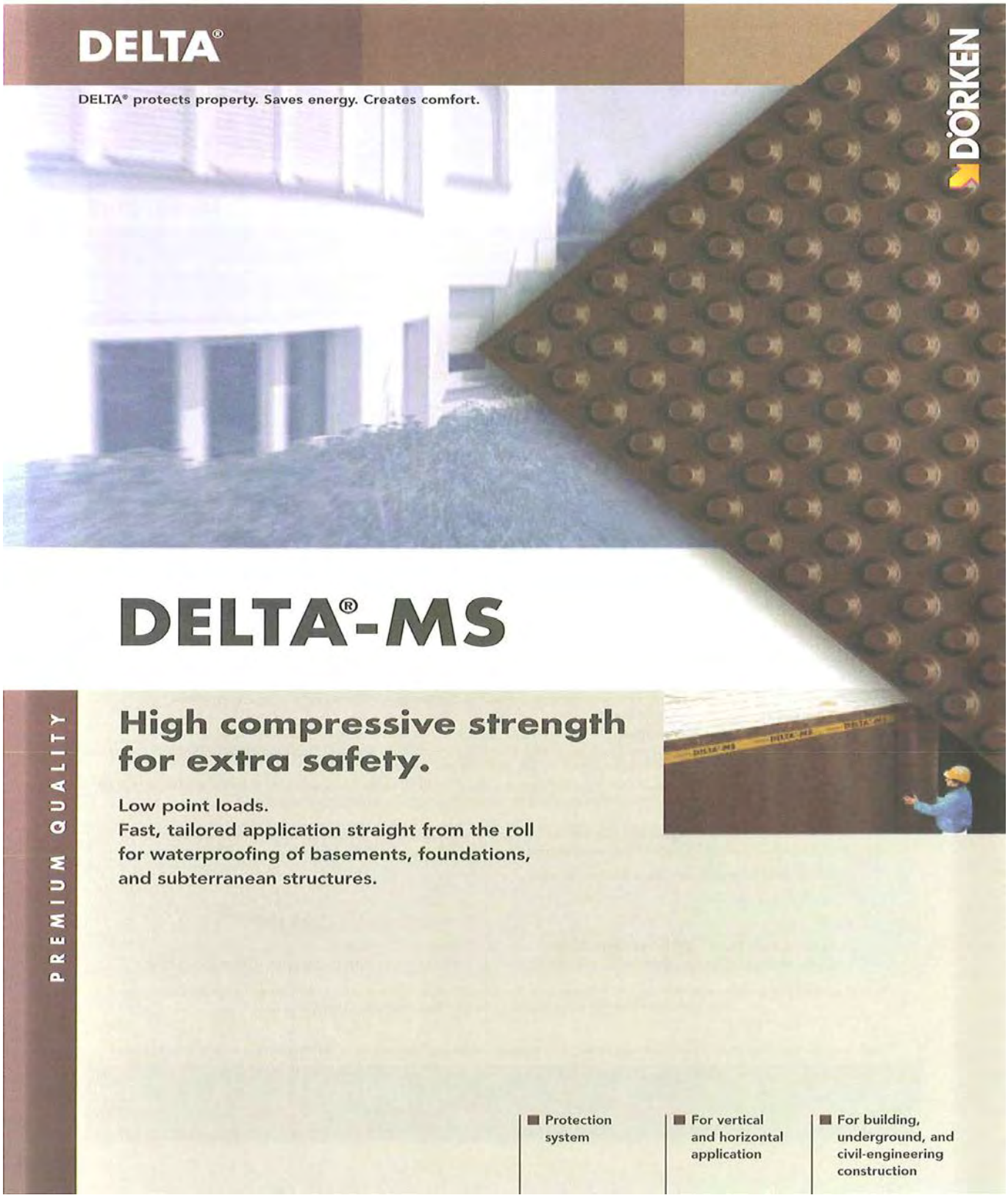
Report Reference: GS-2109920

Client Reference: 31 Heath Drive, NW3 7SB

Appendix C – Sustainable Urban Drainage Systems (SuDs) Water management systems



CI/SfB

21.9 Ln6

Delta Membrane Systems Ltd
Unit 7
Bassett Business Centre
Hurricane Way
North Weald, Epping
Essex CM16 6AA
Tel: 01992 523811 Fax: 01992 524046
e-mail: info@deltamembranes.com
website: www.deltamembranes.com

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

Agrément Certificate
No 00/3742

DELTA MEMBRANE SYSTEMS

PRODUCT SHEET 1 — DELTA-MS500

PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to Delta-MS500, a moulded HDPE sheet, used as damp-proofing on walls, floors and vaulted ceilings in new construction or in existing buildings over a contaminated or damp background, to support a dry lining or flooring.

THIS CERTIFICATE INCLUDES:

- factors relating to compliance with UK Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Resistance to water and water vapour — the membrane is water resistant and has a high resistance to water vapour (see section 5).

Resistance to salt transfer — the membrane provides an effective barrier to the transmission of salts or other contaminants from the substrate (see section 6).

Resistance to puncture, impact and loading — the membrane has a high resistance to puncture and will not be damaged by normal foot traffic during installation or while laying concrete or screeding. It can support the long-term loadings likely to be experienced in service without undue deformation (see section 7).

Durability — under normal conditions of use the membrane will provide an effective barrier to the transmission of salts, liquid water and water vapour for the life of the structure in which it is incorporated (see section 9).

The BBA has awarded this Agrément Certificate for Delta-MS500 to Delta Membrane Systems Ltd as fit for its intended use provided it is installed, used and maintained as set out in this Agrément Certificate.

On behalf of the British Board of Agrément

Date of First issue: 24 November 2000
Date of Second issue: 24 December 2007

Greg Cooper: Chief Executive

The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.

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website: www.bbacerts.co.uk

DELTA®

DELTA® protects property. Saves energy. Creates comfort.

DÖRKEN

DELTA®-MS 20

PREMIUM QUALITY

General-purpose seepage layer for long-term safety.

Resistant to compression and degradation in soil.

DELTA®-branded quality products made by Dörken.

- Drainage system
- For building construction and civil engineering
- For vertical and horizontal application

CI/SfB

21.9 ln6

Delta Membrane Systems Ltd
Unit 7
Bassett Business Centre
Hurricane Way
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website: www.deltamembranes.com

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

Agrément Certificate
No 00/3742

DELTA MEMBRANE SYSTEMS

PRODUCT SHEET 2 — DELTA-MS20

PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to Delta-MS20, a moulded HDPE sheet, used as damp-proofing on walls, floors and arches in new construction or in existing buildings over a contaminated or damp background, to support a dry lining or flooring.

THIS CERTIFICATE INCLUDES:

- factors relating to compliance with UK Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Resistance to water and water vapour — the membrane is water resistant and has a high resistance to water vapour (see section 5).

Resistance to salt transfer — the membrane provides an effective barrier to the transmission of salts or other contaminants from the substrate (see section 6).

Resistance to puncture, impact and loading — the membrane has a high resistance to puncture and will not be damaged by normal foot traffic during installation or while laying concrete or screeding. It can support the long-term loadings likely to be experienced in service without undue deformation (see section 7).

Durability — under normal conditions of use the membrane will provide an effective barrier to the transmission of salts, liquid water and water vapour for the life of the structure in which it is incorporated (see section 9).

The BBA has awarded this Agrément Certificate for Delta-MS20 to Delta Membrane Systems Ltd as fit for its intended use provided it is installed, used and maintained as set out in this Agrément Certificate.

On behalf of the British Board of Agrément

Date of First issue: 24 November 2000
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website: www.bbacerts.co.uk

DELTA®

DELTA DÖRKEN

delta dual retrofit sump installation instructions and technical details

application

The Delta Dual Retrofit Sump is designed to excavate water collected from the Delta cavity membrane system installed in basement applications.

The Dual Retrofit Sump can also be used for collecting wastewater from small light wells, baths, showers, wash hand basins, sinks, dishwashers and washing machines. It is not possible to collect wastewater from a W.C.

Ground water in basement applications is collected via the cavity membrane system through the clear opening at the top of the chamber or can enter the chamber through one of the three 110mm inlets on the side of the chamber. It is important to note that ground water is collected at slab level to prevent dewatering below this level.

method of operation

The Delta Dual Retrofit sump chamber is manufactured from high-density polyethylene and is designed to resist ground water pressure.

Two powerful Delta 302SE/HP pumps are fitted, one to operate as the main duty pump the other to act as a back up. During regular maintenance the operation of the two pumps are reversed.

The sump chamber is fitted with two brass nonreturn valves to prevent water travelling back into the chamber once the pumps have stopped and a gate valve for isolation or maintenance purposes.

maintenance

The Delta Dual Retrofit sump chamber is manufactured using high quality components designed to give a long a trouble free life. With any piece of mechanical equipment regular preventative maintenance is important to keep this product working efficiently on a day-to-day basis. We recommend the sump is serviced twice a year by specialist pump engineers.

electrical connections

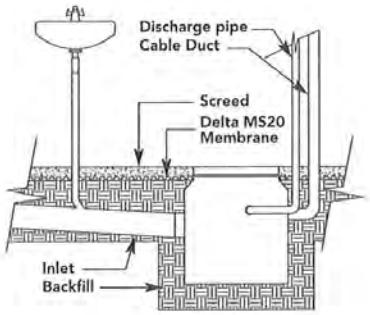
Each pump and high level alarm are to be electrically connected to a non switched fused spur (total of three). This spur should have it's own dedicated supply from the main fuse board.

It is advisable to leave 500mm of the pump electrical cable in the sump to allow for servicing of the pump(s) outside the sump.

Pumps must not be wired to a 'RCD' or similar protective device.

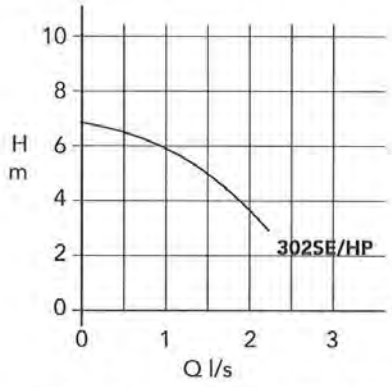
float(s)

Ensure float(s) does not foul chamber sides. It may be necessary to rotate pipe work on pump to achieve this as there may have been some movement during transit.

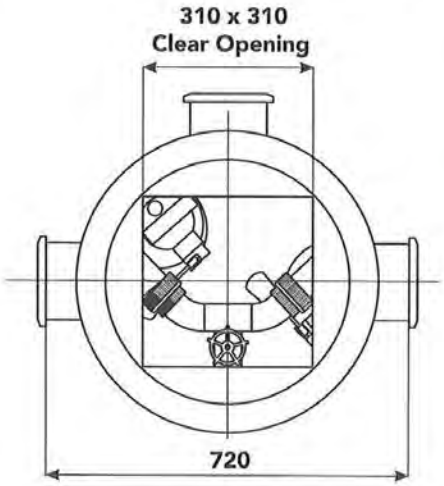


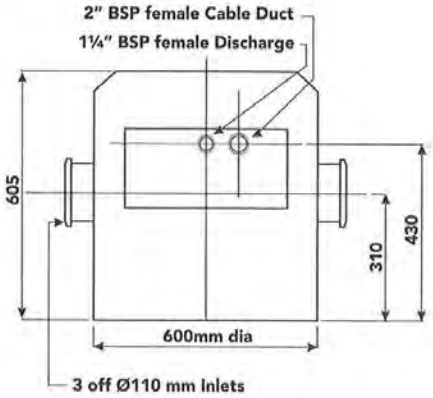
Cutaway of Delta Dual Retrofit Sump

delta dual retrofit sump - 302SE/HP technical details



Performance tolerance to ISO 2548, Class C (water under normal conditions)





high level alarm

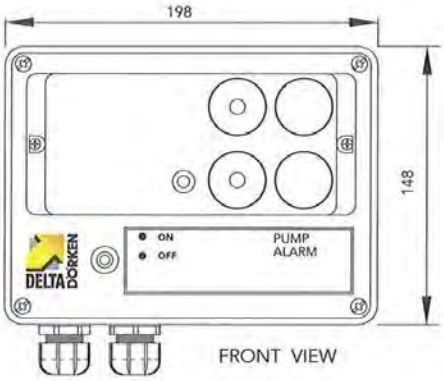
The Delta Dual Retrofit sump chamber can be fitted with a mains dependent / mains independent high-level alarm. An audible signal will be heard in case of pump failure. This alarm is normally operational from the mains power supply (240/1/50) however in case of a power cut the alarm is power by a built in back up battery.

Overall Size of Alarm Box:

L = 198mm

W = 148mm

D = 106mm



FRONT VIEW

DELTA®

DELTA DÖRKEN

delta foul retrofit sump installation instructions and technical details

application

The Delta Foul Retrofit Sump is designed to collect foul water from kitchens, bathrooms and utility rooms installed in basements.

The Foul Retrofit Sump can be used for collecting waste water from baths, showers, wash hand basins, sinks, dishwashers and washing machines.

It is not possible to collect ground water from the Delta cavity membrane system due to the possibilities of odour problems. It is important that the membrane system is completely sealed from the pump chamber.

Foul water will enter the chamber through one of the three 110mm inlets on the side of the chamber. If only using one inlet the other two can be blocked using the plugs supplied.

method of operation

The Delta Foul Retrofit sump chamber is manufactured from high density polyethylene and is designed to resist ground water pressure. A single Delta V501X pump is fitted in the chamber and designed to handle solid waste.

Due to the tank capacity and non macerating action, the pump will operate infrequently and is very quite in operation.

The sump chamber is fitted with a brass non return valve to prevent waste water travelling back into the chamber once the pump has stopped.

maintenance

The Delta Foul Retrofit sump chamber is manufactured using high quality components designed to give a long a trouble free life.With any piece of mechanical equipment regular preventative maintenance is important to keep this product working efficiently on a day to day basis.We recommend the sump is serviced twice a year by specialist pump engineers.

electrical connections

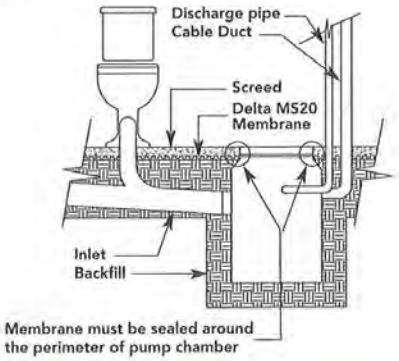
The V501X pump and high level alarm are to be electrically connected to non switched fused spurs (total of two). These spurs should have their own dedicated supply from the main fuse board.

It is advisable to leave 500mm of the pump electrical cable in the sump to allow for servicing of the pump(s) outside the sump.

The pump must not be wired to a 'RCD' or similar protective device.

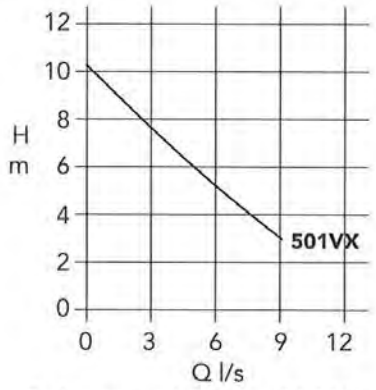
float

Ensure float switch does not foul chamber sides. It may be necessary to rotate pipe work on pump to achieve this as there may have been some movement during transit.



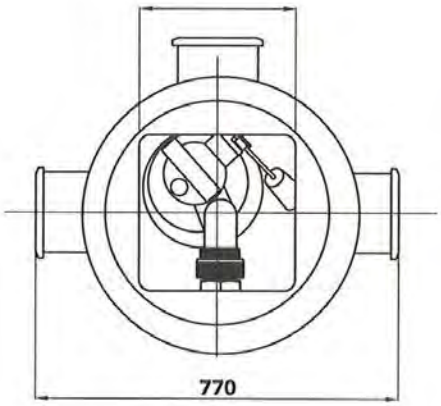
Cutaway of Delta Foul Retrofit Sump

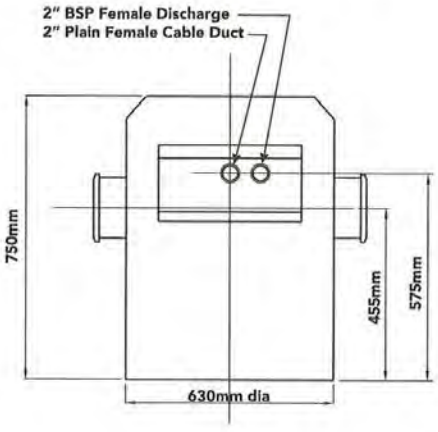
delta foul retrofit sump - 501VX technical details



Performance tolerance to ISO 2548, Class C (water under normal conditions)

310 x 310
Clear Opening



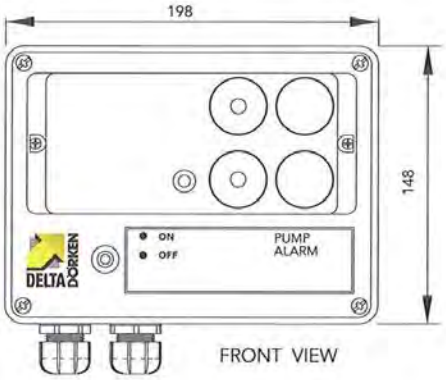


high level alarm

The Delta Foul Retrofit sump chamber can be fitted with a mains dependent / mains independent high-level alarm. An audible signal will be heard in case of pump failure. This alarm is normally operational from the mains power supply (240/1/50) however in case of a power cut the alarm is power by a built in back up battery.

Overall Size of Alarm Box:

L = 198mm
W = 148mm
D = 106mm



FRONT VIEW

Appendix D - Bibliography

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Damage Assessment Report - Assessment of Impact of Proposed Basement on Surrounding Structures – by GCG

GroundSure – Flood Report, commissioned by UK-Hydrosciences on the 20th May 2015

The British Geological Society, http://www.bgs.ac.uk/home.html?src=topNav , BGS, Borehole Records, http://www.bgs.ac.uk/data/boreholescans/

The Environment Agency, http://www.environment-agency.gov.uk/ , EA, Flood Maps, http://www.environment-agency.gov.uk/homeandleisure/37837.aspx

Lost Rivers of London, by Nicholas Barton,1972.

Factual report on Site Investigation for Flat 1, 31 Heath Drive, NW3 7SB carried out by Sub Surface South East Ltd, dated 16th April 2015.

The British Geological Society, http://www.bgs.ac.uk/home.html?src=topNav , BGS, Borehole Records, http://www.bgs.ac.uk/data/boreholescans/

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