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Project Title
Panther House

Report Title
Flood Risk Assessment And Surface Water Drainage Statement

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Panther House Developments Ltd

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EXECUTIVE SUMMARY

I. Planning permission is sought for the development of the buildings at Panther House, Grays Inn Road, London. The development proposals require the provision of additional floors onto the existing buildings and some infill development.

II. The site is located Flood Zone 1 and is not within 20m of a Main River, however it is within Critical Drainage Area Group3_003 as defined within London Borough of Camden's Surface Water Management Plan, therefore the Environment Agency are considered to be a Statutory Consultee as part of the planning process.

III. The risk of flooding from all sources is found to be Low and no mitigation measures are required to reduce the risk further.

IV. As the development is considered to be "Major" development as defined within the Town and Country Planning (Development Management Procedure) (England) Order 2010, the Lead Local Flood Authority (London Borough of Camden) will be considered to be statutory consultees for the planning process.

V. The surface water strategy for the development incorporates the addition of green roofs onto the new roof space and the provision of below ground attenuation. Through the use of hydraulic models it has been demonstrated that the run-off from the site will achieve the Mandatory standard within the Mayor's London Plan by reducing peak runoff rates by 50%. Discharge volumes will be reduced by 14%, both of these measures will reduces the risk of flooding downstream.

VI. The drainage strategy for the development complies with the NPPF, the Mayor's London Plan and LBC's planning policies CS13, DP22 and DP23.

VII. The drainage strategy also complies with the relevant provision of DEFRA's Non-Statutory Technical Standards for Sustainable Drainage Systems and as such is expected to achieve the specific requirements of the LLFA.

Site Location	*Grays Inn Road, London WC1X 0AN. 530982mE,182069mN*
Size and Current Land Use	*0.2ha. Commercial use*
EA Flood Zone	*Flood Zone 1*
Fluvial Flood Risk	*Low*
Tidal Flood Risk	*Low*
Surface Water Flood Risk	*Low*
Reservoir Flood Risk	*Negligible*
Groundwater Flood Risk	*Low*
Sewer Flood Risk	*Negligible*
Historical Flooding	*None*
Proposed Development	*The provision of additional floors to existing buildings and infill development*
Flood Risk Vulnerability	*Less Vulnerable*
Drainage Strategy (Based on Indicative Layout)	*Green roofs to new roof areas and below ground attenuation storage.*

Summary of Flood Risk

1.0 INTRODUCTION

1.1 Robert West was appointed by Panther House Developments Ltd in August 2015 to provide surface water management advice in relation to the development of Panther House, Grays Inn Road, London, WC1X 0AN. The location of the site is illustrated on **Figure 1** (below).

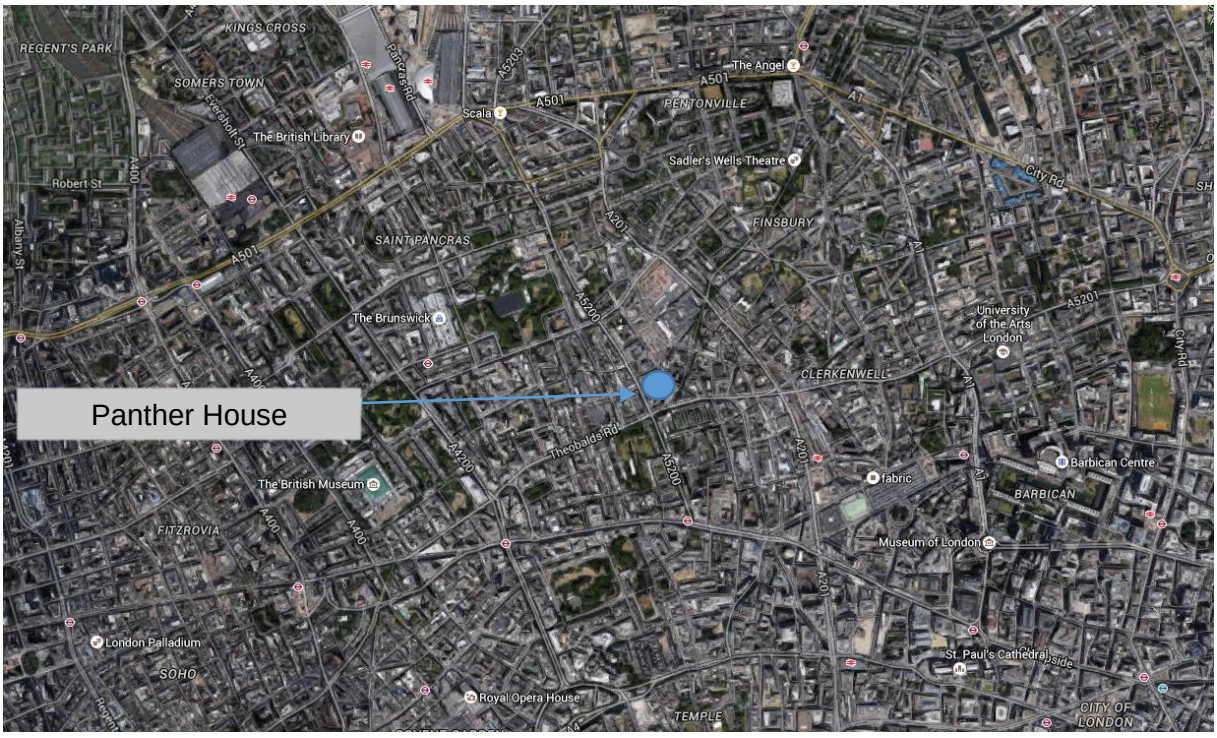

Figure 1 - Site Location Plan

Development description and location

1.2 The site is approximately 0.2 hectares in area and contains a number of office buildings of varying height. Planning permission is sought for the provision of additional floors onto the existing buildings and some infill development. A topographical survey and a buried services survey are provided in Appendix A.

1.3 Although the site is located Flood Zone 1[1] and is not within 20m of a Main River, it is within Critical Drainage Area Group3_003 as defined within London Borough of Camden's Surface Water Management Plan, therefore the Environment Agency are considered to be a Statutory Consultee as part of the planning process and a Flood Risk Assessment (FRA) is required to facilitate that consultation.[2]

1.4 As the development is considered to be "Major" development as defined within the Town and Country Planning (Development Management Procedure) (England) Order 2010, the Lead Local Flood Authority (London Borough of Camden) will be considered to be statutory consultees for the planning process. A Surface Water Drainage Statement (SWDS) will be required to facilitate that consultation.

1.5 This report incorporates the FRA and SWDS for the proposed development. The assessment and strategy have been carried out in accordance with the guidelines set out in the National Planning Policy Framework (NPPF), the Environment Agency (EA), London Borough of Camden (LBC) planning policy and LBC's requirements acting as the Lead Local Flood Authority (LLFA).

1.6 The aim of the FRA is to demonstrate that the site can be developed safely, without exposing the new development to an unacceptable degree of flood risk or increasing the flood risk to third parties. The objectives are to:

i. Identify potential sources of flooding and assess the risk they pose to the site;

ii. Consider the effect of predicted climate change on future flood risk to the site;

iii. Determine the impact of the development on flood risk to third parties;

iv. Determine an appropriate surface water drainage strategy; and

v. Recommend appropriate flood risk mitigation measures.

1.7 The aim of the SWDS is to demonstrate that the site can manage the surface water runoff from the new development in such a way to mitigate the impact of the new development on persons and property downstream. The objectives are to:

i. Identify the points of discharge from the new development;

ii. Calculate the peak discharge rates and volumes and compare those to the pre-development condition;

iii. Calculate the attenuation volumes required on the site and how the runoff rate will be controlled; and

iv. Demonstrate how SuDS features will be managed and maintained.

1.8 This report provides an assessment of how the proposed development will adequately drain surface water from the site to mitigate the risk of flooding to those on the site and those downstream. It is based upon readily-available existing information, which will be used to inform discussions with the Planning Authority (LBC) to support a planning application. These include, in no particular order:

i. the NPPF and the Technical Guidance to the NPPF;

ii. The latest revision of the Mayor's London Plan;

iii. LBC's Core Strategy 2010-2025 adopted November 2010;

iv. LBC's Development Policies 2010-2025;

v. LBC's Camden Planning Guidance (CPG) 3: Sustainability;

vi. LBC's Strategic Flood Risk Assessment (SFRA) published in July 2014;

vii. LBC's Surface Water Management Plan (SWMP) published in July 2011 and updated June 2013.

viii. Environment Agency's (EA's) flood maps;

ix. Non-statutory technical standards for sustainable drainage systems published by DEFRA in March 2015; and

x. The SuDS Manual (CIRIA C697);

Planning Policy Review

1.9 The following policies relevant to flood risk mitigation are taken from The London Plan and incorporate the Further Alterations to the London Plan, which were implemented in March 2015.

Policy 5.12

Flood risk management

Strategic

A. The Mayor will work with all relevant agencies including the Environment Agency to address current and future flood issues and minimise risks in a sustainable and cost effective way.

Planning decisions

B. Development proposals must comply with the flood risk assessment and management requirements set out in the NPPF and the associated Technical Guidance on flood risk over the lifetime of the development and have regard to measures proposed in Thames Estuary 2100 (TE2100 – see paragraph 5.55) and Catchment Flood Management Plans.

C. Developments which are required to pass the Exceptions Test set out in the NPPF and the Technical guidance will need to address flood resilient design and emergency planning by demonstrating that:

a) the development will remain safe and operational under flood conditions

b) a strategy of either safe evacuation and/ or safely remaining in the building is followed under flood conditions

c) key services including electricity, water etc will continue to be provided under flood conditions

d) buildings are designed for quick recovery following a flood.

D. Development adjacent to flood defences will be required to protect the integrity of existing flood defences and wherever possible should aim to be set back from the banks of

watercourses and those defences to allow their management, maintenance and upgrading to be undertaken in a sustainable and cost effective way.

Policy 5.13

Sustainable drainage

Planning decisions

A. Developments should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield runoff rates and ensure that surface water runoff is managed as close to its source as possible in line with the following drainage hierarchy:

1) store rainwater for later use

2) use infiltration techniques, such as porous surfaces in non-clay areas

3) attenuate rainwater in ponds or open water features for gradual release

4) attenuate rainwater by storing in tanks or sealed water features for gradual release

5) discharge rainwater direct to a watercourse

6) discharge rainwater to a surface water sewer/drain

7) discharge rainwater to the combined sewer.

Drainage should be designed and implemented in ways that deliver other policy objectives of this Plan, including water use efficiency and quality, biodiversity, amenity and recreation.

1.10 In addition to the London Plan policies, the Water Pollution and Flooding Essential Standard detailed within the Sustainable Design and Construction Supplementary Planning Guidance supporting The Mayor's London Plan states that the Mandatory Standard for new development requires the post-development peak runoff rate to be less than 50% of the pre-development runoff rate.

1.11 The policy detailed below has been taken from LBC's Core Strategy and the Development Policies. This policy list is not intended to be an exhaustive list of applicable local planning policies.

CS13 – Tackling climate change through promoting higher environmental standards Water and surface water flooding

We will make Camden a water efficient Borough and minimise the potential for surface water flooding by: …

i) requiring development to avoid harm to the water environment, water quality or drainage systems and prevents or mitigates local surface water and downstream flooding, …

DP22 – Promoting sustainable design and construction

The Council will require development to incorporate sustainable design and construction measures. Schemes must:...

b) incorporate green or brown roofs and green walls wherever suitable.

…

The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as: …

g) limiting run-off;

h) reducing water consumption;…

DP23 – Water

The Council will require developments to reduce their water consumption, the pressure on the combined sewer network and the risk of flooding by:

a) incorporating water efficient features and equipment and capturing, retaining and re-using surface water and grey water on-site;

b) limiting the amount and rate of run-off and waste water entering the combined storm water and sewer network through the methods outlined in part a) and other sustainable urban drainage methods to reduce the risk of flooding;

c) reducing the pressure placed on the combined storm water and sewer network from foul water and surface water run-off and ensuring developments in the areas identified by the North London Strategic Flood Risk Assessment and shown on Map 2 as being at risk of surface water flooding are designed to cope with the potential flooding;

d) ensuring that developments are assessed for upstream and downstream groundwater flood risks in areas where historic underground streams are known to have been present; and

d) encouraging the provision of attractive and efficient water features.

2.0 BASELINE CONDITIONS

2.1 This section considers the baseline conditions in and around the site with particular reference to flood risk.

Site topography

2.2 The area of the site is approximately 0.2 hectares in total.

2.3 The topography of the site slopes from west to east with a fall of around one metre. Although, the site is predominantly occupied by buildings.

Site Geology

2.4 Data from the British Geological Survey (BGS) relating to the site's geology are provided in Appendix B (contains BGS materials © NERC [2015]). The superficial geology is identified as the Lynch Hill Gravel Member. The bedrock geology of the site is identified as being London Clay.

Existing surface water system

2.5 The development site is currently fully paved and occupied by buildings and some circulation space at street level. The buried services survey in Appendix A identifies a private drain connecting to the public sewerage system on Grays Inn Road.

2.6 It is assumed that a connection to the public sewer network on Mount Pleasant also exists although this has not been defined by the buried services survey. An inspection chamber appears to exist along the northern edge of the basement near to a number of toilets. It is considered likely that all foul and surface water from around half of the site discharges to the public sewerage system on Mount Pleasant.

Definition of the flood hazard

2.7 The EA Flood Map is provided within the Floodinsight report (see Appendix C), which details the risk of flooding from various sources.

Tidal/Fluvial flood risk

2.8 With reference to Section 1 of the FloodInsight report (the EA flood maps), the development site may be described as being within Flood Zone 1 (i.e. less than 0.1% (i.e. 1 in 1000 year) Annual Exceedance Probability (AEP) of flooding from rivers).

2.9 Section 2 of the Floodinsight report identifies that the EA Risk of Flooding from Rivers and Sea flood rating for the site is considered to be Very Low**.**

Historic Flood Events

2.10 Section 3 of the Floodinsight report identifies that no historic flood event records are available for this site within recent years.

Pluvial flood risk

2.11 Section 4 of the Floodinsight report identifies that the majority of the site has a Negligible risk of pluvial flooding.

Surface Water features

2.12 Section 5 of the Floodinsight report indicates that there are no surface water features on or close to the site.

Groundwater Flood Risk

2.13 Section 6 of the Floodinsight report identifies that the site has the potential for groundwater flooding to occur below ground level.

2.14 Section 7 of the Floodinsight report identifies that this potential for groundwater flooding is likely to originate from superficial deposits. However, since the site is currently developed and that the basement will remain unchanged, the risk of flooding from groundwater is considered to be Low.

Reservoir Flood Risk

2.15 Section 8 of the Floodinsight report identifies that the site is not at risk from flooding from canal breaks or reservoir failure.

Sewer Flood Risk

2.16 Thames Water has advised that the site is not located within an area considered to be at risk from sewer flooding (see Appendix D).

Strategic Flood Risk Assessment

2.17 The site is assessed as part of the SFRA. No particular measures to mitigate the risk of fluvial flooding (or other sources of flooding) have been identified by that document at this site.

2.18 The SFRA notes that the Fleet Sewer runs along Grays Inn Road and then onto Hatton Garden. The alignment of the sewer is at a distance from the development and can be seen on the Thames Water asset records in Appendix D.

Surface Water Management Plan

2.19 The site is assessed as part of the SWMP. No particular measures to mitigate the risk of fluvial flooding (or other sources of flooding) have been identified by that document at this site.

2.20 The development site is located within a Critical Drainage area (Group3_003) as indicated on Figure 3.1 of the SWMP[3].

Flood risk considerations for the development site

2.21 From the information within this section, it may be concluded that the site is currently at risk from the following sources:

i. A **Low** risk from extreme Fluvial flooding (i.e. less than 1% AEP in any given year).

ii. A **Low** risk from Pluvial flooding on site

iii. A **Low** risk of groundwater flooding due to an extended extreme flood event.

iv. A **Negligible** risk of flooding from sewer and reservoir failure sources.

3.0 MANAGEMENT OF FLOOD RISK

Site Vulnerability

3.1 With reference to Table 2 of the Technical Guidance to the NPPF, the vulnerability classification of the existing site is “Less Vulnerable” due to the office uses. The vulnerability classification of the proposed development will remain as “Less Vulnerable”, which is acceptable within Flood Zone 1.

Flood risk mitigation measures

3.2 As there is a low risk of flooding to the site from all sources of flooding, no flood control mitigation measures are considered necessary. However, as described above, surface water runoff should be managed and controlled to meet the requirements of the LLFA. Compliance with these requirements is explored in the next chapter.

4.0 MANAGEMENT OF SURFACE WATER

Design Philosophy

4.1 The design of the surface water network serving the development site will comply with planning policy and the requirements of the LLFA with reference to the DEFRA guidance. However, the development proposals will not include amendments to the existing surface water system draining the site since the area of roof space and hardstanding will remain the same as existing. Roof downpipes will connect into existing downpipes above ground level, all surfacing at ground level will remain in-situ, as will all below ground drainage pipework.

4.2 Sustainable Drainage systems (SuDS) selected by this strategy for use within the development should be designed in accordance with the CIRIA document C697 “The SuDS Manual”. An assessment of SuDS suitable for use within the development proposals are included below.

Surface Water management strategy

4.3 A table detailing all SuDS measures to be considered for use within the development is provided in Appendix E, this has been based upon Table 5.2 of The SuDS Manual. Those SuDS components that are proposed for use at the development site are marked in blue. Additional components that are also considered suitable for the site but not proposed, are identified in green.

4.4 Below is a brief assessment of the parameters used for the selection of appropriate SuDS as shown in Appendix E.

Soils

4.5 Soils are defined as being permeable since the strata at the development site is identified as being Boyn Hill Gravels overlying London Clay (see Appendix B). However, analysis of local boreholes to the site suggest that the London Clay horizon is within a metre or so of the basement level. For this reason the Soils parameter is assessed as being “Impermeable”.

Area draining to a single SuDS component

4.6 The area of the site is approximately 0.2 hectare, therefore this parameter is assessed to be “0-2 ha”.

Minimum depth to water table

4.7 By inspection of local boreholes, the London Clay horizon is close to the Basement level. It is expected that perched groundwater will exist within the superficial gravel layer above the London Clay bedrock. Therefore this parameter is considered to be “0-1m”

Site Slope and Available Head

4.8 The site is fairly flat, therefore the Site Slope parameter is considered to be “0-5%” and the Available Head parameter is “0-1m”.

Available Space

4.9 The site is in a congested urban area. The Available Space parameter is considered to be “Low”.

Suitable SuDS Components

4.10 Using the SuDs selection criteria, the following SuDS measures are considered suitable for inclusion at the development site:

i. Subsurface Storage

ii. Pocket wetland

iii. Green roof

iv. Rainwater harvesting

v. Permeable Pavement

4.11 A brief commentary relating to each SuDS component selected for use on the site is provided below.

Sub-surface storage

4.12 The provision of below-ground attenuation storage within the basement of the existing buildings may be possible upstream of the final manhole from the site.

Pocket wetland

4.13 Due to the significant limitations of space at ground level, landscaped features such as pocket wetlands are not considered suitable for this development. Additionally, planted features at ground level would have a limited depth of planting due to the basement structure beneath.

4.14 However, containerised landscaping at ground level would be considered suitable for the site. Although this would not contribute to surface water management for extreme rainfall events, it would provide some effective rainwater re-use for regular rainfall events.

Green Roofs

4.15 The development proposes to construct additional floor levels onto a number of existing buildings within the site, which provides opportunities to install green roofs in replacement of the impermeable flat and pitched roof surfaces which are currently used on the site.

4.16 Green roofs are commonly designed to retain provide interception storage by retaining the first 5 mm or more of a design rainfall event. In order to design a green roof for drainage purposes, the area of green roof is assumed to store 5mm of any rainfall event, and then discharge rainwater at a much slower rate than would be expected from a hard surfaced roof. For the purposes of this report, the green roof is to be specified as having a 100mm substrate depth. CIRIA document C644 "Building Greener" [4] provides guidance on the specification of green roofs.

Rainwater Harvesting

4.17 Where it would not be possible to install green roofs, rainwater harvesting was considered during the design process. Re-use of rainwater within new parts of the building was not considered to be acceptable on economic grounds, partially because the storage tank for the collected rainwater could not be inserted below ground (due to the basement and the building foundations) and would therefore take up lettable space, but also because a separate non-potable water distribution network would be required for discrete areas of the building.

Permeable paving

4.18 Permeable paving will have limited applicability within the development proposals since none of the external ground floor surfaces are proposed to be altered. Additionally, it is unlikely that any existing sub-base would have the necessary material specification to allow permeable paving to be drained adequately, nor is there likely to be sufficient depth beneath the existing surfaces to provide adequate storage.

Proposed drainage strategy

4.19 In order to mitigate flood risk to the site and those downstream of the site, SuDS, such as green roofs, will be proposed to control surface water at source reducing the volume and flow rates from certain areas of the development site.

4.20 In order to reduce runoff to meet the London Plan's mandatory standard, a flow control device and attenuation storage is proposed within the basement upstream of the final manhole.

4.21 By implementing these measures the hydraulic load placed upon the local public sewerage system, which locally is wholly combined, will be reduced.

Calculation of runoff rates

Pre-development rates

4.22 In order to calculate the reduction in surface water runoff by installing green roofs, an assessment of the pre-development runoff rates needs to be made. With reference to the Thames Water asset records and the buried services survey data, the current mode of drainage from the site has been assumed to be via two discrete discharge points, which splits the site into two catchments. The assumed mode of drainage is as shown in Figure 1 below.

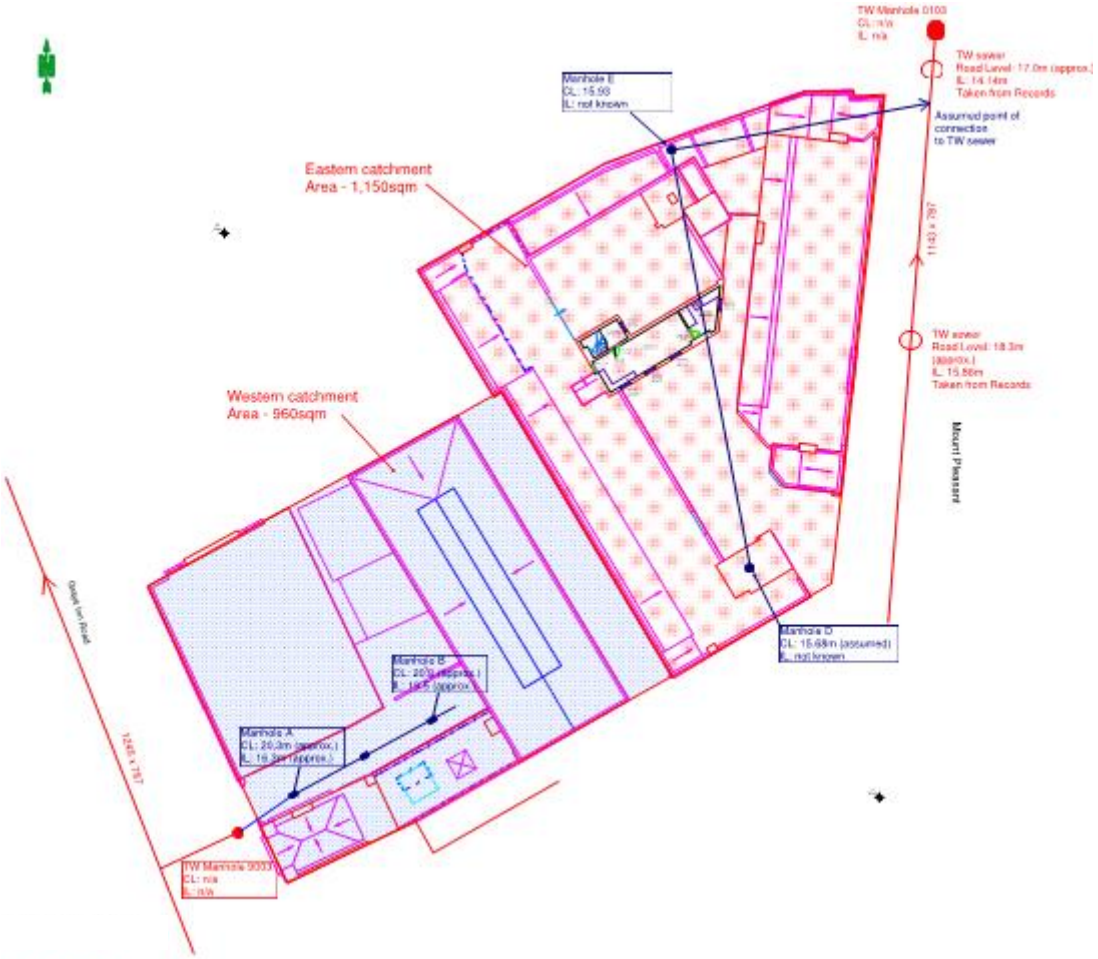

Figure 4.1: Panther House drainage system (existing)

4.23 With reference to the areas indicated on Figure 1, a hydraulic model of the pre-development situation has been built to estimate the run-off rates for a range of storm events. The methodology for this process and the model outputs are provided in Appendix F. The pre-development peak flow rates for a range of storm events are provided in Table 4.1 below.

Sub-Catchment	Area (m^2)	1 in 1 year Peak Run-off rate (l/s)	1 in 30 year Peak Run-off rate (l/s)	1 in 100 year Peak Run-off rate (l/s)
		Critical event	Critical event	Critical event
West	960	12.7	29.6	37.1
		15min Winter	15min Winter	15min Winter
East	1,150	18.3	37.7	43.7
		15min Summer	15min Summer	15min Summer
Total	**2,210**	**31.0**	**67.3**	**80.8**

Table 4.1: Pre-development peak run-off rates

Post-development rates

4.24 Source control of rainfall runoff from roof areas will be provided by new green roofs within the site. The location and extent of the green roofs are provided on the drainage strategy plan within Appendix G.

4.25 A hydraulic model of the proposed drainage system following completion of the development is provided in Appendix F. The post-development peak flow rates for a range of storm events are provided in Table 4.2 below.

Sub-Catchment	Area (m^2)	1 in 1 year Peak Run-off rate (l/s)	1 in 30 year Peak Run-off rate (l/s)	1 in 100 year Peak Run-off rate (l/s)
West	570	4.0	8.9	15.8
		15min Winter	15min Winter	15min Winter
East	1,540	9.9	9.9	11.4
		15min Winter	15min Summer	15min Winter
Total	**2,210**	**13.9**	**18.8**	**27.2**
Peak flow reduction		**55%**	**72%**	**66%**

Table 4.2: Post-development peak run-off rates

4.26 The hydraulic modelling confirms that the peak runoff rates for all storms events up to 1 in 100 year return period can be reduced more than 50% of the pre-development peak runoff rate.

4.27 The hydraulic modelling confirms that the proposed networks will prevent flooding occurring during all 1 in 30 year storm events.

4.28 The hydraulic modelling confirms that the proposed networks will prevent flooding occurring during all 1 in 100 year (plus 30% climate change) storm events.

4.29 The detailed design of the new development will ensure that surface water adequately drains away from entrances to the building.

Calculation of runoff volumes

Pre-development volumes

4.30 Hydraulic calculations for the pre-development discharge volume from the site are provided in Appendix E and reproduced in Table 4.2 below.

	1 in 100 year 360 minute Discharge Volume (m^3)
Western side	48.123
Eastern side	60.001
Total	108.124

Table 4.2: Pre-development runoff volumes during a 1 in 100 year 360 minute event

Post-development volumes

Discharge volumes from the proposed development

4.31 Results from the hydraulic modelling are presented within Appendix F; discharge volumes are stated in Table 4.4 below.

	1 in 100 year 360 minute Discharge Volume (m^3)
Western side	19.406
Eastern side	81.335
Total	100.741
Reduction	14%

Table 4.4: Post-development runoff volumes during a 1 in 100 year 360 minute event

4.32 The discharge volumes from the site following development will reduce by 14%, when compared to the pre-development condition. This reduction will be due to the beneficial effects of the green roof for rainwater retention.

Structural integrity

4.33 The life expectancy of the drainage system components will be designed to match the life expectancy of the development. Adequate and practicable access to all drainage system components will be made available to appropriate persons and their equipment.

4.34 Maintenance requirements for SuDS features are provided in Appendix H. The proposed drainage network, including the SuDS features, will be maintained by a private maintenance company employed by the landowner.

4.35 The materials specified for the drainage system will be of a suitable nature and quality for their intended use.

Designing for maintenance considerations

4.36 No pumping equipment will be required as part of the proposed development proposals.

5.0 COMPLIANCE WITH DEFRA REQUIREMENTS

Flood risk outside the development

DEFRA Requirement S1

> *Where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g. the sea or a large estuary) the peak flow control standards (S2 and S3 below) and volume control technical standards (S4 and S6 below) need not apply.*

5.1 The site will not discharge to a surface water body and so Requirement S1 is not applicable.

Control of peak surface water runoff rates

DEFRA Requirement S2

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

5.2 The development is previously developed, therefore Requirement S2 is not applicable.

DEFRA Requirement S3

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

5.3 The development proposals will implement source control measures to retard the runoff response of the site to rainfall events. It will not be practicable to limit the runoff rate to the greenfield runoff rate, as this would require excessively deep green roofs. Instead, the development proposals seek to restrict the peak run-off rate to at least 50% of the pre-development runoff rates for 1 in 1 year, 1 in 30 year and 1 in 100 year return periods events of critical duration in accordance with the Mandatory standard of the London Plan.

5.4 Table 4.2 estimates the reduction in peak flow rate achievable by the development proposals. Although discharging at the greenfield run-off rate is not possible, the peak flow rate will be more than half of the pre-development peak runoff rate and will reduce the risk of flooding from the public sewer system and the load onto the downstream treatment works. The development is therefore compliant with Requirement S3.

Control of the volume of surface water runoff

DEFRA Requirement S4

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

5.5 The development is not greenfield, therefore Requirement S4 is not applicable.

DEFRA Requirement S5

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

5.6 The development proposals will implement source control measures to reduce the volume of runoff from the site during all rainfall events. It will not be practicable to limit total volume to the greenfield runoff rate, as this would require excessively deep green roofs. Instead, the development proposals will reduce the runoff volume to 14% of the pre-development runoff volume predicted during 1 in 100 year return period event of 360 minute duration. The development is therefore compliant with Requirement S5.

DEFRA Requirement S6

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

5.7 The development is compliant with Requirement S5, therefore compliance with Requirement S6 is achieved.

Control of surface water and flood risk within the development

DEFRA Requirement S7

> *The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.*

5.8 The hydraulic modelling results have demonstrated that flooding is not expected to occur during a 1 in 30 year storm event of critical duration. The development is therefore compliant with Requirement S7.

DEFRA Requirement S8

> *The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.*

5.9 The hydraulic modelling results have demonstrated that no flooding is expected to occur during a 1 in 100 year storm event of critical duration. Additionally, the external surface levels will be designed such that neither buildings nor utility plant will be affected. The development is therefore compliant with Requirement S8.

DEFRA Requirement S9

> *The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.*

5.10 The development site is predominantly made up of buildings, so the surface area at ground level is limited. The development will mitigate the risk of flooding to the building through careful design at entrance thresholds. By implementing these measures, the development is considered to be compliant with Requirement S9.

Structural integrity

DEFRA Requirement S10

> *Components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development taking into account the requirement for reasonable levels of maintenance.*

5.11 The life expectancy of the drainage system components will be designed to match the life expectancy of the development. Adequate and practicable access to all drainage system components will be made available to appropriate persons and their equipment. Accordingly, the development is considered to comply with Requirement S10.

5.12 Maintenance requirements for SuDS features are provided in Appendix H. The proposed drainage network, including the SuDS features, will be maintained by a private maintenance company employed by the landowner.

DEFRA Requirement S11

> *The materials, including products, components, fittings or naturally occurring materials, which are specified by the designer must be of a suitable nature and quality for their intended use.*

5.13 The materials specified for the drainage system will be of a suitable nature and quality for their intended use. Accordingly, the development is considered to comply with Requirement S11.

Designing for maintenance considerations

DEFRA Requirement S12

> *Pumping should only be used to facilitate drainage for those parts of the site where it is not reasonably practicable to drain water by gravity.*

5.14 No pumping of surface water is required as part of the development proposals. Therefore, Requirement S12 is complied with.

Construction

DEFRA Requirement S13

> *The mode of construction of any communication with an existing sewer or drainage system must be such that the making of the communication would not be prejudicial to the structural integrity and functionality of the sewerage or drainage system.*

DEFRA Requirement S14

> *Damage to the drainage system resulting from associated construction activities must be minimised and must be rectified before the drainage system is considered to be completed.*

5.15 DEFRA requirements S13 and S14 shall be communicated to the Preferred Contractor during the procurement process for the construction works. Accordingly, DEFRA Requirements S13 and S14 will be complied with.

Compliance with the DEFRA Requirements

5.16 Table 5.1 details how this report complies with the Non-Statutory Technical Standards for Sustainable Drainage Systems published by DEFRA.

DEFRA Require-ment	Subject	Clause ref.	Complies?
S1	Flood Risk outside the development	5.1	n/a
S2	Peak flow control – Greenfield developments	5.2	n/a
S3	Peak flow control - Previously developed sites	5.4	Y
S4	Volume control – Greenfield developments	5.5	n/a
S5	Volume control - Previously developed sites	5.6	N
S6	Volume control – No adverse effect on flood risk	5.7	Y
S7	Flood risk within the development – 1 in 30 year	5.8	Y
S8	Flood risk within the development – 1 in 100 year	5.9	Y
S9	Flood risk within the development - Exceedance	5.10	Y
S10	Structural integrity – Design life of Components	5.11	Y
S11	Structural integrity – Suitability of materials	5.13	Y
S12	Designing for maintenance considerations	5.14	Y
S13	Construction – Communication with a drainage system	5.15	Y
S14	Construction – Damage to the drainage system	5.15	Y

Table 5.1: Compliance with DEFRA requirements

6.0 CONCLUSIONS

6.1 Planning permission is sought for the development of the buildings at Panther House, Grays Inn Road, London. The development proposals require the provision of additional floors onto the existing buildings and some infill development.

6.2 The site is located Flood Zone 1 and is not within 20m of a Main River, however it is within Critical Drainage Area Group3_003 as defined within London Borough of Camden's Surface Water Management Plan, therefore the Environment Agency are considered to be a Statutory Consultee as part of the planning process.

6.3 The risk of flooding from all sources is found to be Low and no mitigation measures are required to reduce the risk further.

6.4 As the development is considered to be "Major" development as defined within the Town and Country Planning (Development Management Procedure) (England) Order 2010, the Lead Local Flood Authority (London Borough of Camden) will be considered to be statutory consultees for the planning process.

6.5 The surface water strategy for the development incorporates the addition of green roofs onto the new roof space and the provision of below ground attenuation. Through the use of hydraulic models it has been demonstrated that the run-off from the site will achieve the Mandatory standard within the Mayor's London Plan by reducing peak runoff rates by 50%. Discharge volumes will be reduced by 14%, both of these measures will reduces the risk of flooding downstream.

6.6 The drainage strategy for the development also complies with LBC's planning policies CS13, DP22 and DP23.

6.7 The drainage strategy also complies with the relevant provision of DEFRA's Non-Statutory Technical Standards for Sustainable Drainage Systems and as such is expected to achieve the specific requirements of the LLFA.

Robert West

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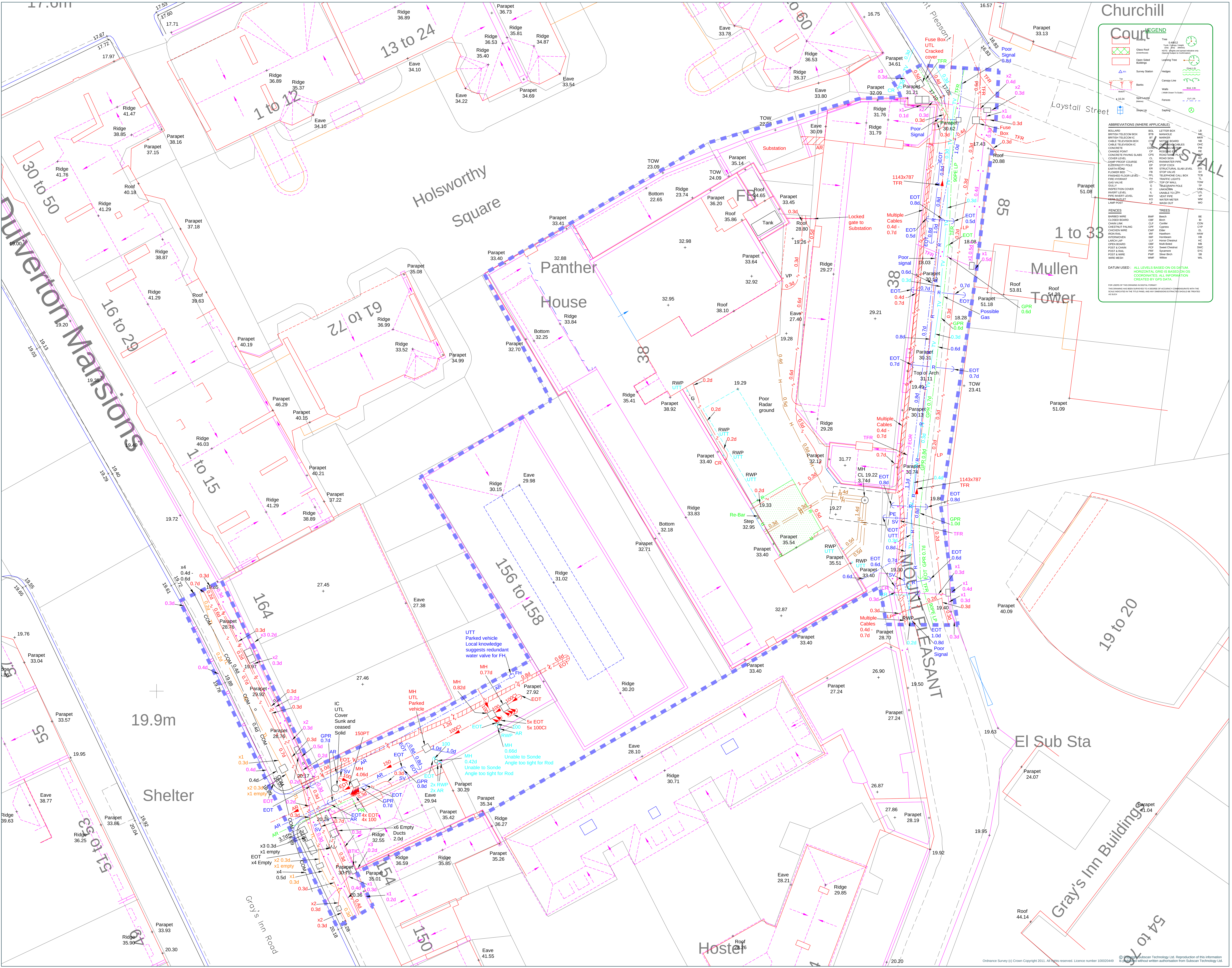
Appendix A – Topographical Survey



NOTES;

Electromagnetic and/or Ground Penetrating Radar techniques have been used to locate/map underground utilities and features on this drawing. Subscan Technology Ltd has made every endeavour to make sure that the information contained within this drawing is accurate and of the highest quality. Subscan Technology Ltd has used any record drawings provided by the client or by the Statutory Utility Providers, at the client's request, at the time of the survey. Any information taken from these drawings (e.g. pipe sizes and position) is not guaranteed. Historic record information is often incomplete and inaccurate and cannot be relied upon.

Subscan Technology Ltd is not liable for any topographical survey that has not been undertaken by us. Any inaccuracies relating to topographical plans/development plans/Ordnance Survey data that we have no control over is the liability of the customer. Where quoted, depth information of underground services/features is stated. Depths are generally within +/- 10% accurate, but cannot be guaranteed. Any depths shown are drains are usually to invert (base of drainage channel) unless otherwise stated.

At Subscan Technology Ltd we use skilled staff and modern, calibrated equipment to perform our surveys. However, the completeness of any underground survey cannot be 100% guaranteed and the results from these types of surveys are not infallible. If the location or depth of services/features is of particular importance to a project then it is strongly advised that discussions are held with Subscan Technology Ltd regarding any possible limitations or anomalies. It is also strongly advised that trial excavations should be undertaken to confirm survey results. We cannot be held responsible for any inaccuracies beyond those that could be reasonably expected by a competent company.

ABBREVIATIONS (Land & Utilities)

AR ASSUMED ROUTE
AV AIR VALVE
BB BELISHA BEACON
BD BACKDROP
Bdl BED LEVEL
BH BOREHOLE
BHch BASEMENT HATCH COVER
Bin LITTER / GRIT SALT BIN
BL BASEMENT LIGHT
Bol BOLLARD
BP BOUNDARY POST
BS BUS STOP
BTIC BRITISH TELECOM CHAMBER
CatL CATENARY LEVEL
CATV CABLE TV COVER
CB CONTROL BOX
CBlt CONVEYOR BELT
CC COAL CHUTE
KO KERB OUTLET
Lby LIFEBOUY
Lck LOCK GATE
Ldr LADDER
LH LAMP HOLE
LP LAMP POST
LV LOW VOLTAGE
MgP MOORING POST
mH METERS HIGH
Mhcy MACHINERY
MH MANHOLE
Mkr MARKER POST
MkrE MARKER POST (ELECTRIC)
MkrG MARKER POST (GAS)
MkrR MARKER POST (RAILWAY)
MkrT MARKER POST (TELECOM)
MkrW MARKER POST (WATER)
MP MILE POST
SiL SIGNAL LOST
SP SIGN POST
SPil SHEET PILING
Spr SPRING
SPt SAMPLING POINT
ST STOP TAP
Sti STILE
Stl STRUCTURE TOP LEVEL
Stp STUMP (TREE)
StP STAND PIPE
StPo STAY POST
StW STAY WIRE
SV STOP VALVE
SVP SOIL VENT PIPE
TBM TEMPORARY BENCH MARK
TCB TELEPHONE CALL BOX
TEL TELECOM CHAMBER COVER
TFR TAKEN FROM RECORDS

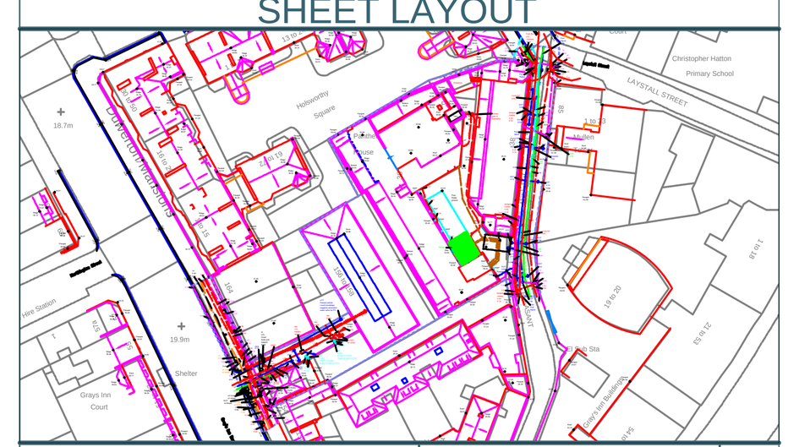
KEY

CCTV / CABLE TELEVISION
COMBINED DRAINAGE
COMMUNICATIONS CABLE
COMPRESSED AIR
DUCTING
EARTH CABLE
ELECTRIC CABLE
END OF TRACE
FOUL DRAINAGE
FUEL PIPE
GAS PIPE
GAUGE LINE
HEATING
OFFSET FILL PIPE
PUMPING MAIN
RADAR AREA ANOMALY
RADAR UTILITY TRACE
SURFACE DRAINAGE
SURVEY BOUNDARY
TELECOM CABLE
TRAFFIC LIGHTS
UNIDENTIFIED
VAPOUR RECOVERY
VENT PIPE
WATER PIPE

A SINGLE LINE INDICATING A UTILITY MAY INDICATE THE PRESENCE OF MULTIPLE SERVICES WITHIN CLOSE PROXIMITY TO EACH OTHER. WHERE A SINGLE LINE TYPE IS SHOWN WE RECOMMEND HAND DIGGING WITHIN 0.5m TO EXPOSE HIDDEN SERVICES.

ISSUE	DATE	DESCRIPTION

SHEET LAYOUT



CLIENT: MTT Consulting
DWG No: 25957_B
REV.: -

TITLE: Panther House, Grays Inn Road, London (Footpath)

SCALE: 1:100@A0
SURVEYED: TK
DRAWN: TO
DATE: 23/07/15

SURVEY TYPE
TOPOGRAPHICAL ☐
DRAINAGE ☒
UTILITY ☒

SUBSCAN TECHNOLOGY
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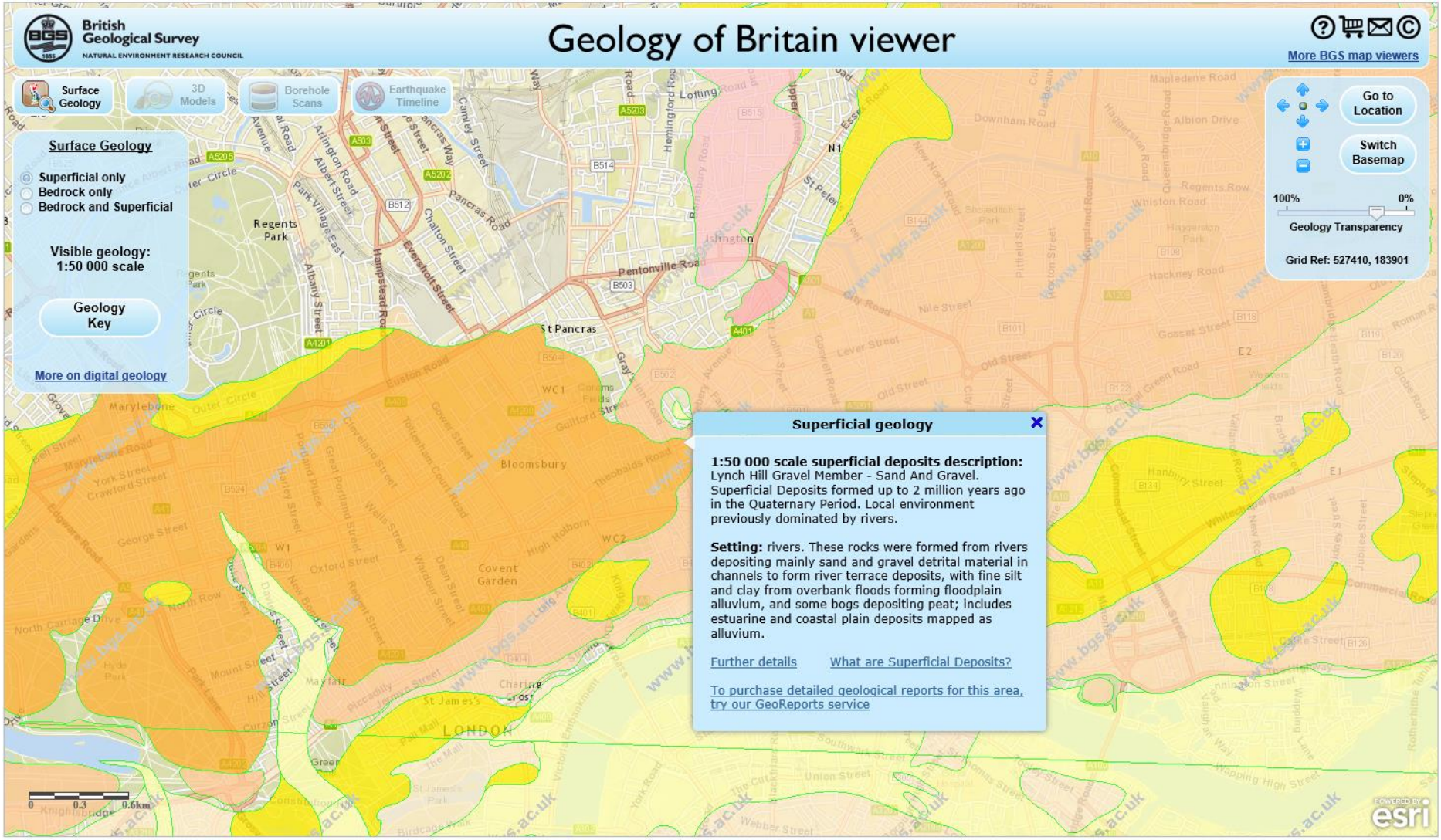
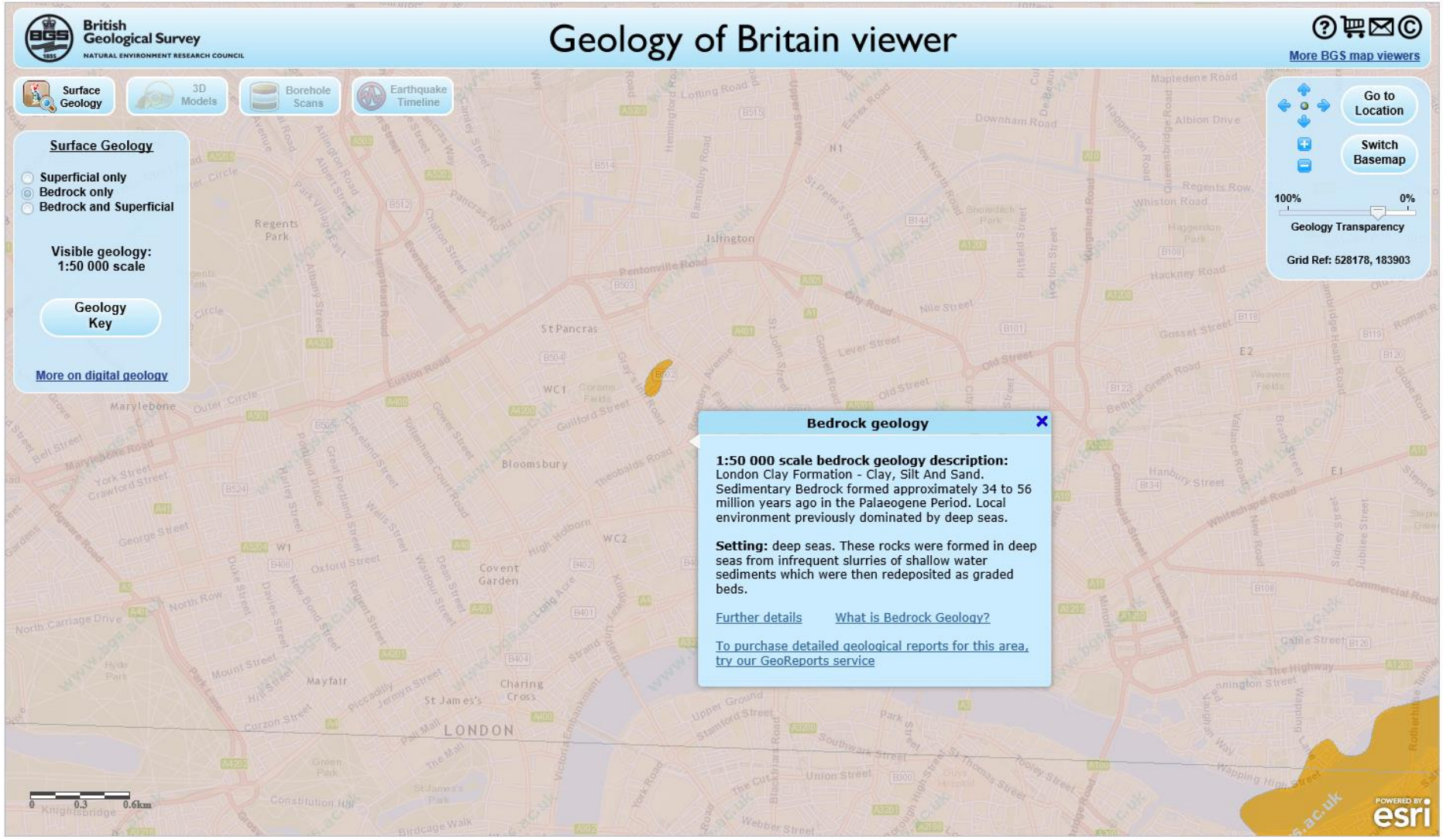
Appendix B – BGS Map



Superficial Deposits at Panther House



Bedrock Deposits at Panther House

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Appendix C – FloodInsight Report

Groundsure Floodinsight

Address:	**PANTHER HOUSE, MOUNT PLEASANT, LONDON, WC1X 0AN**
Date:	**29 Sep 2015**
Reference:	**GS-2470323**
Client:	**ROBERT WEST CONSULTING LIMITED**

NW N NE

W E

SW S SE

Aerial Photograph Capture date:	20-Apr-2013
Grid Reference:	531005,182061
Site Size:	0.22ha

Contents Page

Overview of Findings

For further details on each dataset, please refer to each individual section in the main report as listed.

Section 1: Environment Agency Flood Zones	
1.1 Are there any Enviroment Agency Zone 2 floodplains within 250m of the study site?	No
1.2 Are there any Environment Agency Zone 3 floodplains within 250m of the study site	No
1.3 Are there any Flood Defences within 250m of the study site?	No
1.4 Are there any areas benefiting from Flood Defences within 250m of the study site?	No
1.5 Are there any Proposed Flood Defences within 250m of the study site?	No
1.6 Are there any areas used for Flood Storage within 250m of the study site?	No

Section 2: Risk of Flooding from Rivers and the Sea (RoFRaS)	
2.1 What is the Risk of Flooding from Rivers and the Sea (RoFRaS) Flood Rating for the study site?	Very Low

Section 3: Historic Flood Events	
3.1 Has the site been subject to past flooding as recorded by the Environment Agency?	No

Section 4: JBA Surface Water (Pluvial) Flood	
4.1 Is the site or any area within 50m at risk of Surface Water (Pluvial) Flooding?	Yes

Section 5: Surface Water Features	
5.1 Are there any surface water features within 250m of the study site?	No

Section 6: Groundwater Flooding	
6.1 What is the maximum BGS Groundwater Flooding susceptibility within 50m of the study site?	Potential at Surface
6.2 What is the BGS confidence rating for the Groundwater Flooding susceptibility areas?	High

Section 7: BGS Geological Indicators of historic flooding	
7.1 Are there any geological indicators of historic flooding within 250m of the study site?	Yes

Section 8: JBA Reservoir and Canal Data	
8.1 Is the property located in an area identified as being at potential risk in the event of a reservoir failure?	No
8.2 Is the property located in an area identified as being at potential risk in the event of a canal break?	No

Additional Matters

Riparian ownership

If your land abuts a river, stream or ditch, you may have responsibility to maintain this watercourse, even if Title Deeds show the property boundary to be adjacent to the watercourse. This includes the responsibility for clearing debris and obstructions which may impede the free passage of water and fish, and also includes the responsibilities to accept flood flows through your land, even if these are caused by inadequate capacity downstream. There is no duty in common law for a landowner to improve the drainage capacity of a watercourse. Please contact Groundsure if you need further advice on riparian ownership issues relating to this property.

Sewerage Flooding

Extreme rainfall events may overwhelm sewerage systems and cause local flooding. The water and sewerage companies within the UK are required to maintain 'DG5 – At Risk Registers' which record properties that have flooded from sewers and/or are considered to be at risk of flooding from sewers in the future. If your property is on the 'At Risk' Register, this may be recorded within a standard CON29 Drainage and Water search.

Using this Report

The following report is designed by Environmental Consultants for Environmental Professionals bringing together the most up-to-date market leading environmental data. This report is provided under and subject to the Terms & Conditions agreed between Groundsure and the Client.

Note: Maps

Only certain features are placed on the maps within the report. All features represented on maps found within this search are given an identification number. This number identifies the feature on the mapping and correlates it to the additional information provided below. This identification number precedes all other information and takes the following format -Id: 1, Id: 2, etc. Where numerous features on the same map are in such close proximity that the numbers would obscure each other a letter identifier is used instead to represent the features. (e.g. Three features which overlap may be given the identifier “A” on the map and would be identified separately as features 1A, 3A, 10A on the data tables provided).

Where a feature is reported in the data tables to a distance greater than the map area, it is noted in the data table as “Not Shown”.

All distances given in this report are in Metres (m). Directions are given as compass headings such as N: North, E: East, NE: North East from the nearest point of the study site boundary.

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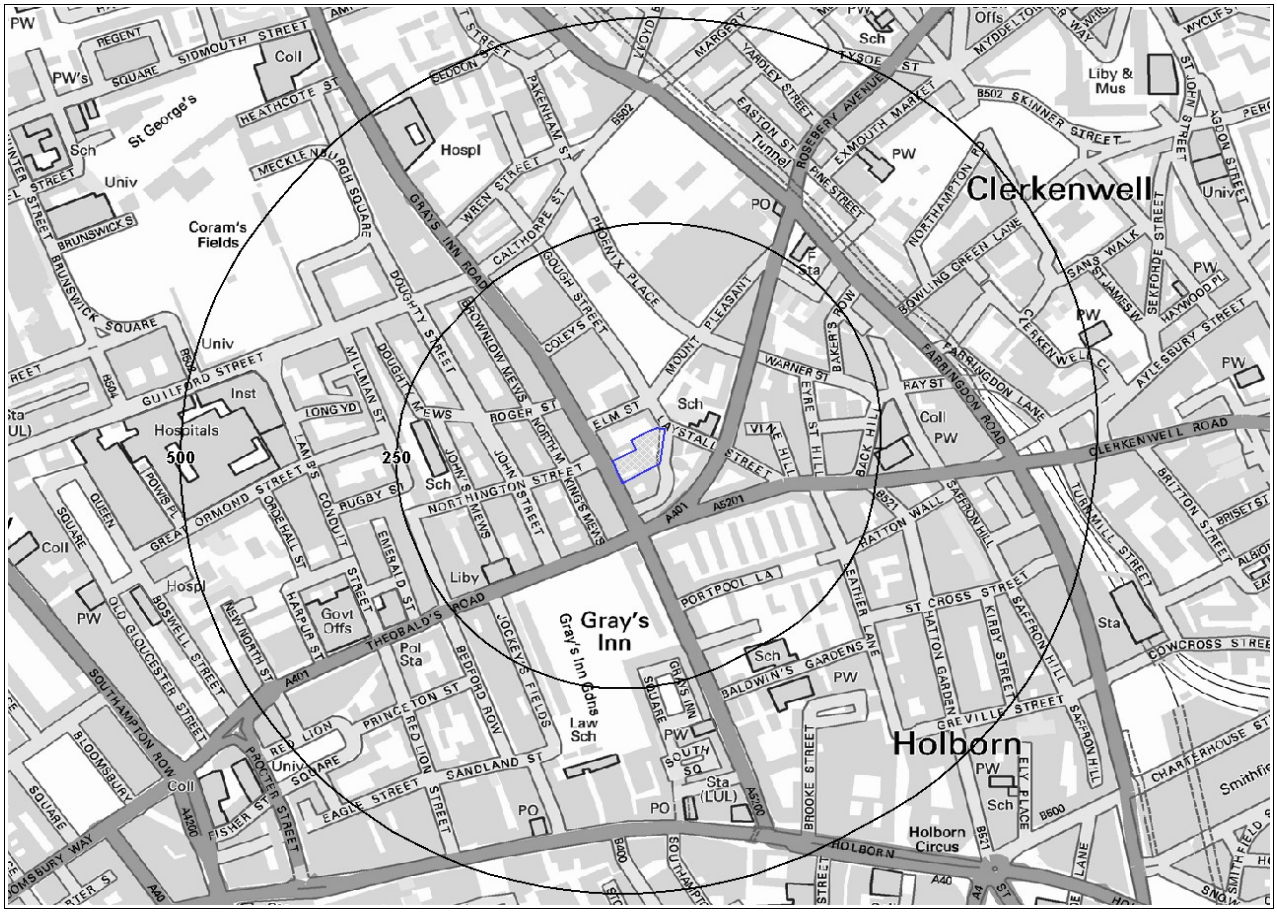
1. Environment Agency Flood Map for Planning (from rivers and the sea)

NW N NE

W E

SW S SE



Environment Agency Flood Map for Planning Legend

- Search Centre
- Search Buffers (m) — 100, 250
- Zone 2 Floodplain
- Zone 3 Floodplain
- Flood Defences
- Area used for Flood Storage
- Proposed Flood Defence Scheme
- Area Benefiting from Flood Defences

Report Reference: GS-2470323
Client Reference: Panther_House

1. Environment Agency Flood Zones

1.1 River and Coastal Zone 2 Flooding

Is the site within 250m of an Environment Agency Zone 2 floodplain? No

Environment Agency Zone 2 floodplains estimate the annual probability of flooding as between 1 in 1000 (0.1%) and 1 in 100 (1%) from rivers and between 1 in 1000 (0.1%) and 1 in 200 (0.5%) from the sea. Any relevant data is represented on Map 1 – Flood Map for Planning:

Database searched and no data found.

1.2 River and Coastal Zone 3 Flooding

Is the site within 250m of an Environment Agency Zone 3 floodplain? No

Zone 3 shows the extent of a river flood with a 1 in 100 (1%) or greater chance of occurring in any year or a sea flood with a 1 in 200 (0.5%) or greater chance of occurring in any year. Any relevant data is represented on Map 1 – Flood Map for Planning.

Database searched and no data found.

1.3 River and Coastal Flood Defences

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

This search consists only of flood defences present in the dataset provided by the Environment Agency. Any relevant data is represented on Map 1 – Flood Map for Planning.

Database searched and no data found.

1.4 Areas benefiting from Flood Defences

Are there any areas benefiting from Flood Defences within 250m of the study site? No

Any relevant data is represented on Map 1 – Flood Map for Planning.

1.5 Areas of Proposed Flood Defences

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

* This illustrates the number of households that move from 'very significant' or 'significant' to 'moderate' or 'low' probability of flood risk bands if the proposed flood scheme is to be implemented.

Any relevant data is represented on Map 1 – Flood Map for Planning.

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.

1.6 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.

Notes on Flood Zone Data:

This data relates solely to flooding from rivers or the sea. The Environment Agency estimate that over 2.5 million properties are at risk of flooding within England and Wales. River flooding occurs when a watercourse cannot cope with the water draining into it from the surrounding land. This can happen, for example, when heavy rain falls on an already waterlogged catchment. Coastal flooding results from a combination of high tides and stormy conditions. If low atmospheric pressure coincides with a high tide, a tidal surge may happen which can cause serious flooding.

The Groundsure Floodinsight Report comments upon whether a property lies in proximity to Environment Agency Zone 2 and Zone 3 floodplains. The Government's Technical Guidance to the National Planning Policy Framework explains how flood risk should be considered at all stages of the planning and development process in order to reduce future damage to property and potential loss of life. The Government looks to planning authorities to ensure that flood risk is properly taken into account in the planning of developments to reduce the risk of flooding and the damage which floods cause.

Flood Zones enable planning authorities to apply the sequential test (see Technical Guidance to the National Planning Policy Framework) for development proposals and prevent inappropriate development.

Technical Guidance to the National Planning Policy Framework defines the flood zones as: -

Zone 1 – little or no risk with an annual probability of flooding from rivers and the sea of less than 0.1%

Zone 2 – low to medium risk with an annual probability of flooding of 0.1-1.0% from rivers and 0.1-0.5% from the sea.

Zone 3 – high risk with an annual probability of flooding of 1.0% or greater from rivers, and 0.5% or greater from the sea.

Flood Zone 3b/Flood Storage Areas - very high risk with the site being used as part of the functional flood plain or as a Flood Storage Area.

The flood zones are the main constraint map underpinning decisions on development and flood risk.

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. For example, defences in urban areas may be built to provide protection against flood events of a size which might occur on average once in one hundred years or less.

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 Programme that show the annual maintenance programme of work scheduled to be carried 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.

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.

This site includes mapping data licensed from Ordnance Survey used for setting the Environment Agency's data in its geographical context. Ordnance Survey retains the copyright of this material and it can not be used for any other purpose.

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.

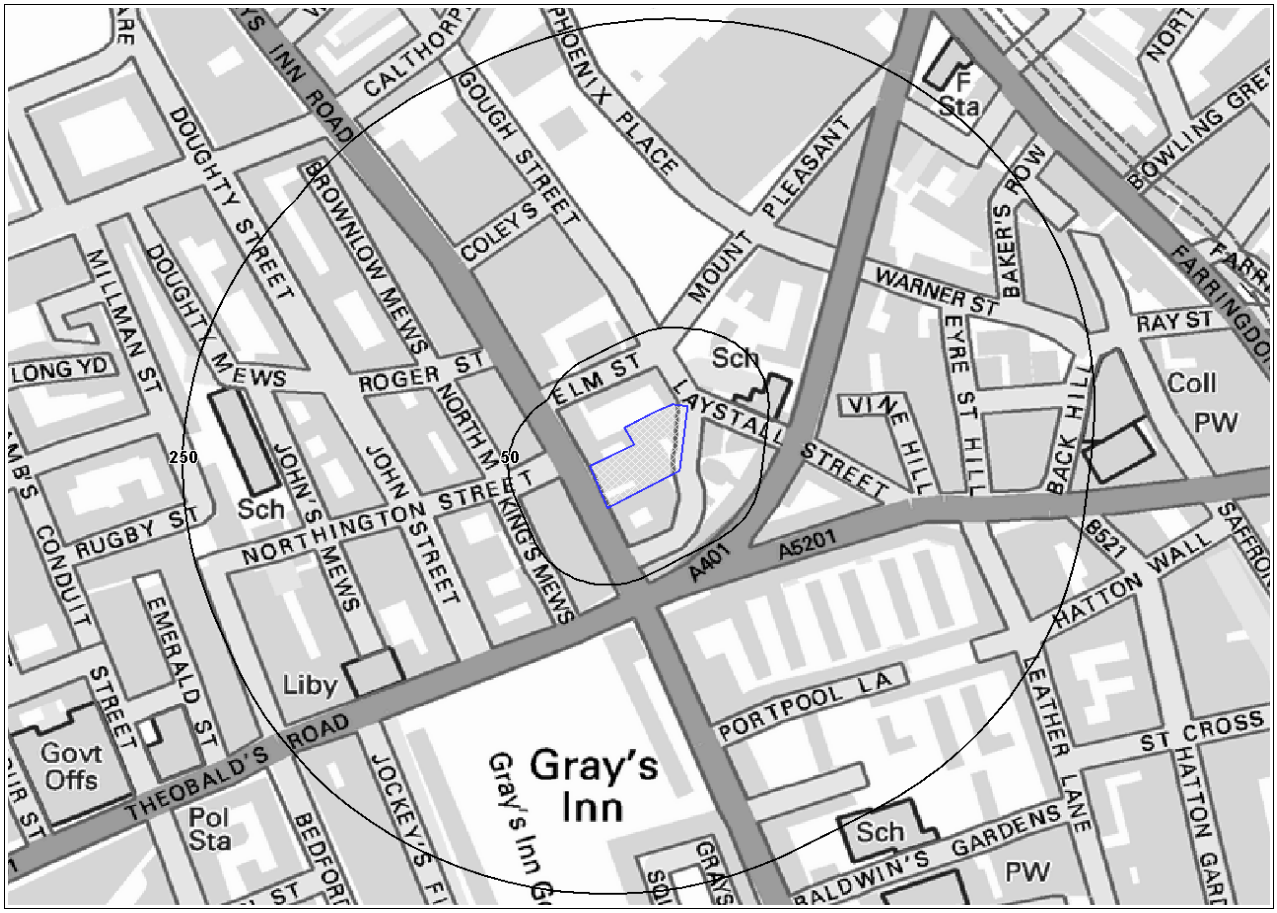
A flood storage area may take the form of a wet or dry reservoir. A wet reservoir is a water storage facility in which storage can be effected by allowing water levels to rise during flood times. A dry reservoir is typically adjacent to a river and comprises an enclosed area that accepts water only at 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.

2. Environment Agency RoFRaS Flooding Map

NW N NE

W E

SW S SE



Environment Agency RoFRaS Flooding legend

Site Outline

100 250 Search Buffers (m)

RoFRaS Rating

- Very Low
- Low
- Medium
- High

2. Environment Agency Risk of Flooding from Rivers and the Sea (RoFRaS)

2.1 Environment Agency Risk of Flooding from Rivers and the Sea (RoFRaS) Flood Rating (River and Coastal)

What is the highest risk of flooding onsite? Very Low

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 probability that the flood defences will overtop or breach by considering their location, type, condition and standard of protection.

RoFRaS data for the study site indicates the property is in an area with a Very Low (less than 1 in 1000) chance of flooding in any given year.

Notes on RoFRaS data:

This information is based on the very latest Environment Agency Risk of Flooding from Rivers and the Sea (RoFRaS) data. This data has been created by dividing the flood plain into 50m squares, or smaller areas where a square if intersected by a river or coastline. These are called impact cells. The method then calculates the likelihood that the centre of each impact cell will start to flood using a number of different flood scenarios.

A number of insurance companies providing cover for flood risk use this data as the basis of 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. The probability estimates for RoFRaS risk bands are as follows:

Very Low – the chance of flooding from rivers or the sea is considered to be less than 1 in 1000 (0.1%) in any given year.

Low – the chance of flooding from rivers or the sea is considered to be less than 1 in 100 (1%) but greater than or equal to 1 in 1000 (0.1%) in any given year.

Medium – the chance of flooding from rivers or the sea is considered to be less than 1 in 30 (3.3%) but greater than 1 in 100 (1%) in any given year.

High – the chance of flooding from rivers or the sea is considered to be greater than or equal to 1 in 30 (3.3%) in any given year.

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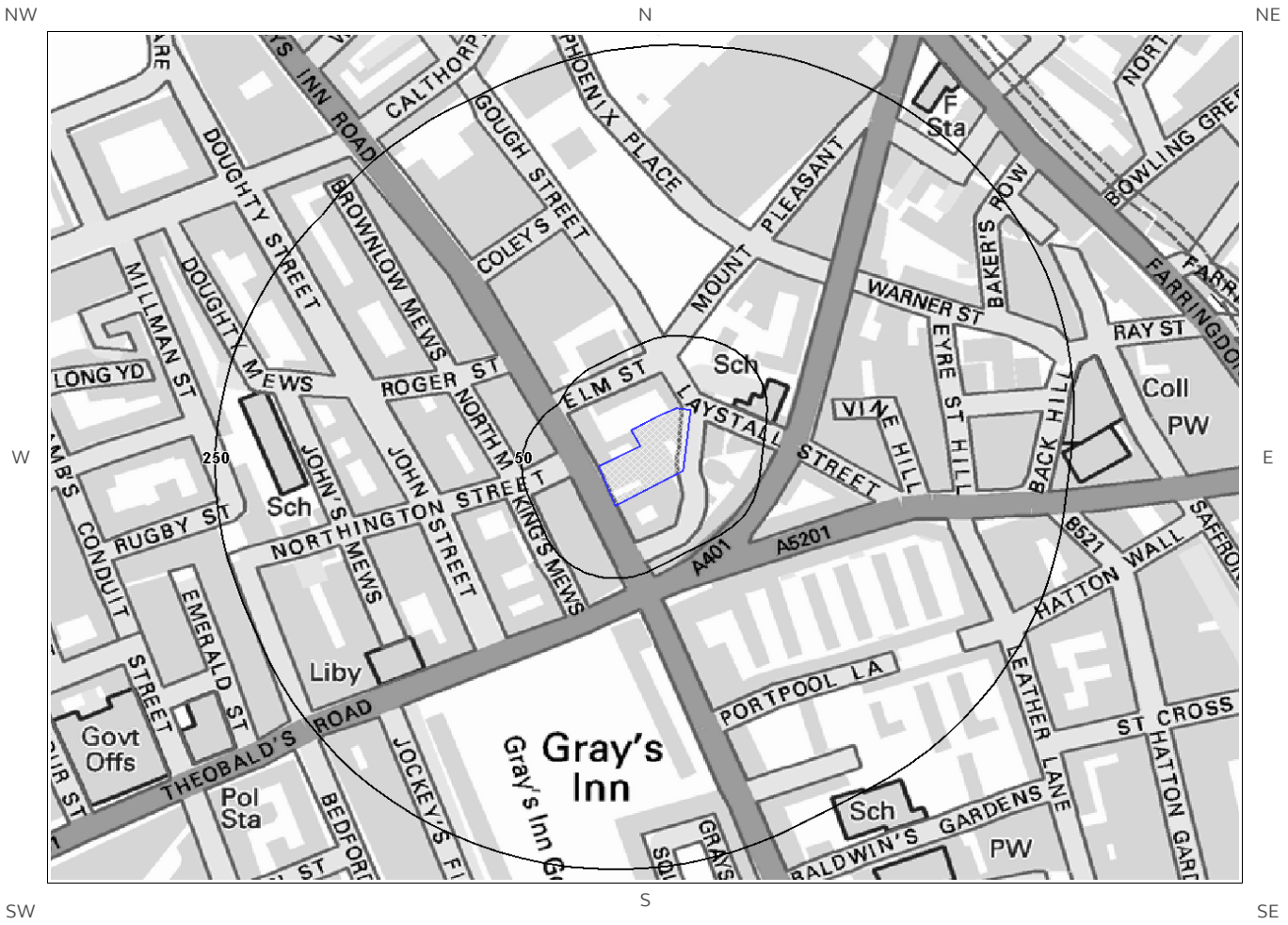
3. Environment Agency Historic Flooding Events Map



Environment Agency Historic Flooding Events legend

Site Outline

125
250
Search Buffers (m)

Historic Flood Events

3. Environment Agency Historic Flooding Events

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.

---

4. JBA Surface Water (Pluvial) Flood Map

JBA Surface Water (Pluvial) Flood Legend

Site Outline

125
250
Search Buffers (m)

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

4. 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 study site? High

Guidance: The site or an area in close proximity has been assessed to be at 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

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	Risk
0.0	On Site	High
0.0	On Site	Low
0.0	On Site	Low to Moderate
0.0	On Site	Low to Moderate
1.0	SE	Significant
3.0	NW	Low
5.0	NW	Significant
7.0	SE	Significant
8.0	SE	Low
10.0	NW	High
10.0	NW	Low
12.0	NW	Low
17.0	SE	Significant
19.0	NW	Low
22.0	SE	High
22.0	SE	Low to Moderate
24.0	NW	Low
24.0	SE	Significant
25.0	SE	Low
26.0	NW	Low

Distance	Direction	Risk
26.0	SE	Low
27.0	SE	Moderate
29.0	SE	Significant
48.0	NE	High

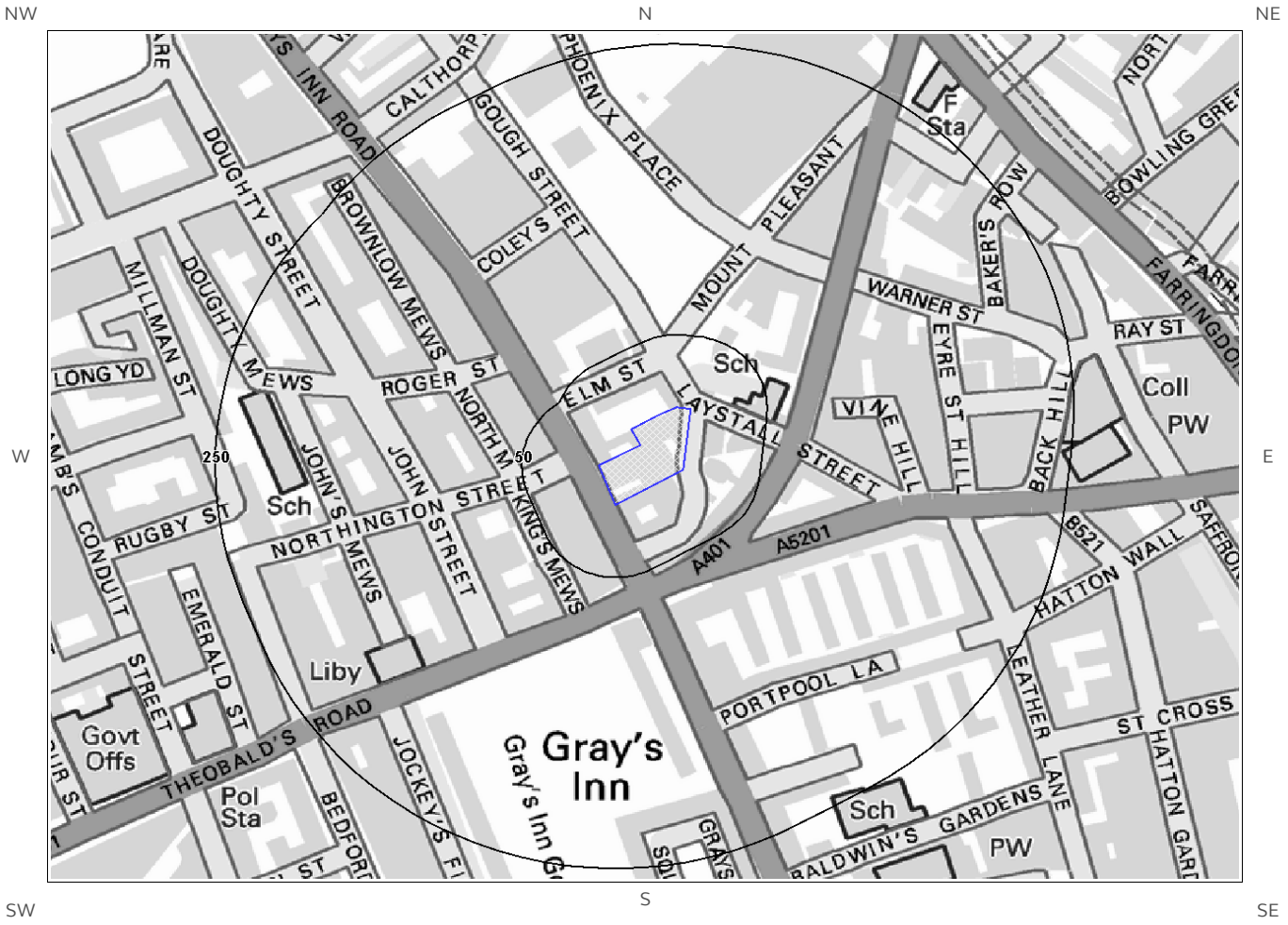
Notes on Surface water (Pluvial) Flooding data:

JBA Consulting 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

5. Surface Water Features map



Surface Water Features legend

Site Outline

Search Buffers (m)

50

250

Surface Water Feature (wider than 5m)

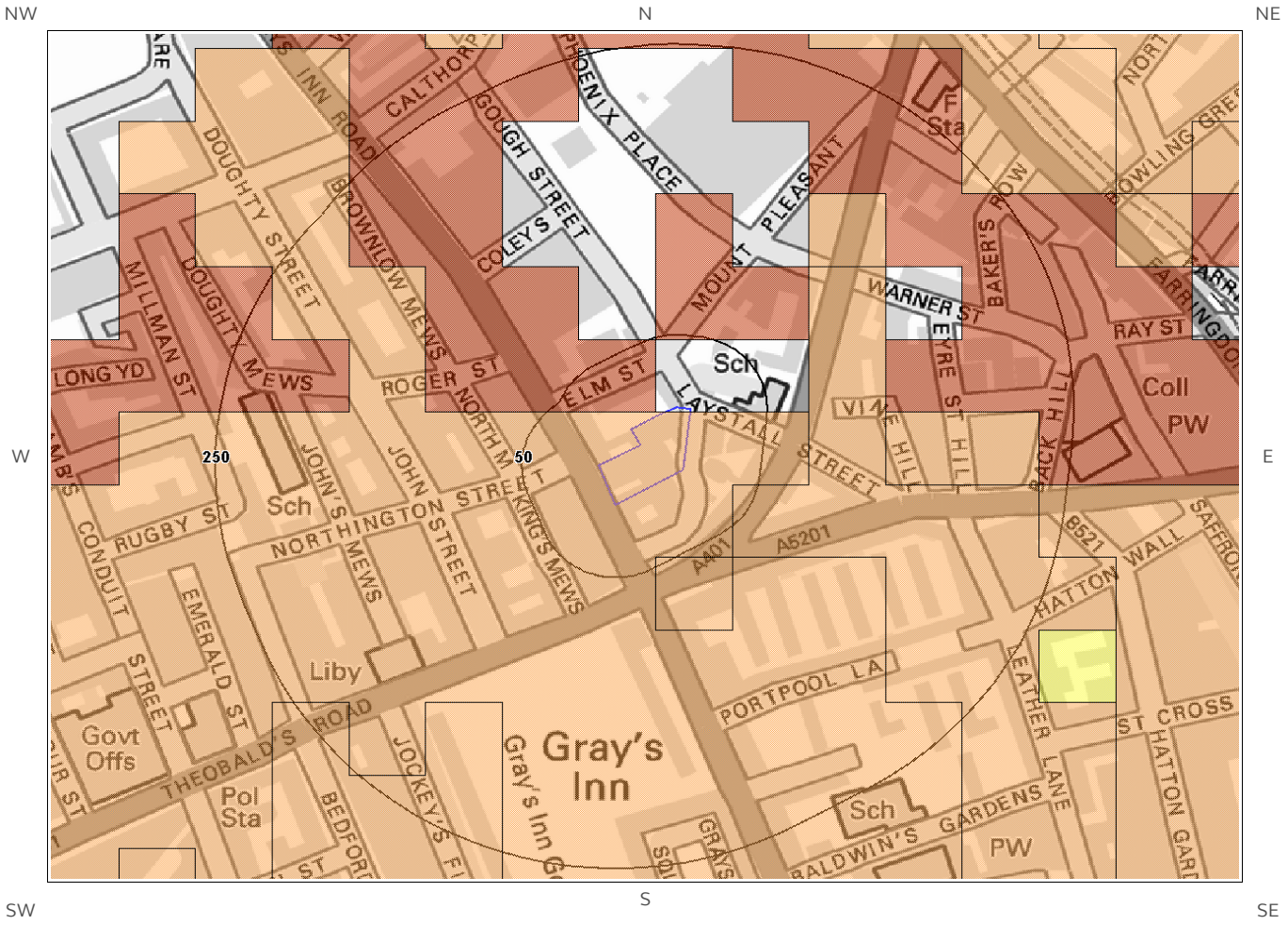
Surface Water Feature (narrower than 5m)

5. Surface Water Features

Are there any surface water features within 250m of the study site? No

Database searched and no data found.

6. BGS Groundwater Flooding Map



BGS Groundwater Flooding legend

Site Outline

50
250
Search Buffers (m)

Limited potential for groundwater flooding to occur

Potential for groundwater flooding of property below ground level

Potential for groundwater flooding to occur at surface

6. Groundwater Flooding

6.1 Groundwater Flooding Susceptibility Areas

Are there any British Geological Survey groundwater flooding susceptibility flood areas within 50m of the boundary of the study site? Yes

What is the highest susceptibility to groundwater flooding in the search area based on the underlying geological conditions? Potential for groundwater flooding at surface

Does this relate to Clearwater Flooding or Superficial Deposits Flooding? Superficial Deposits Flooding

Where potential for groundwater flooding to occur at surface is indicated, this means that given the geological conditions in the area groundwater flooding hazard should be considered in all land-use planning decisions. It is recommended that other relevant information e.g. records of previous incidence of groundwater flooding, rainfall, property type, and land drainage information be investigated in order to establish relative, but not absolute, risk of groundwater flooding.

6.2 Groundwater Flooding Confidence Areas

What is the British Geological Survey confidence rating in this result? High

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.

The confidence rating is on a threefold scale - Low, Moderate and High. This provides a relative indication of the BGS confidence in the accuracy of the susceptibility result for groundwater flooding. This is based on the amount and precision of the information used in the assessment. In areas with a relatively lower level of confidence the susceptibility result should be treated with more caution. In other areas with higher levels of confidence the susceptibility result can be used with more confidence.

Notes on Groundwater Flooding data:

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.

Groundwater flooding may either be associated with shallow unconsolidated sedimentary aquifers which overlie unproductive aquifers (Superficial Deposits Flooding), or with unconfined aquifers (Clearwater Flooding).

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.

7. BGS Geological Indicators of Flooding

Are there any geological indicators of flooding within 250m of the study site? Yes

This dataset identifies the presence of superficial geological deposits which indicate that the site may be, or have been in the past, vulnerable to inland and/or coastal flooding. This assessment does not take account of any man-made factors such as flood protection schemes, and the data behind the report are purely geological.

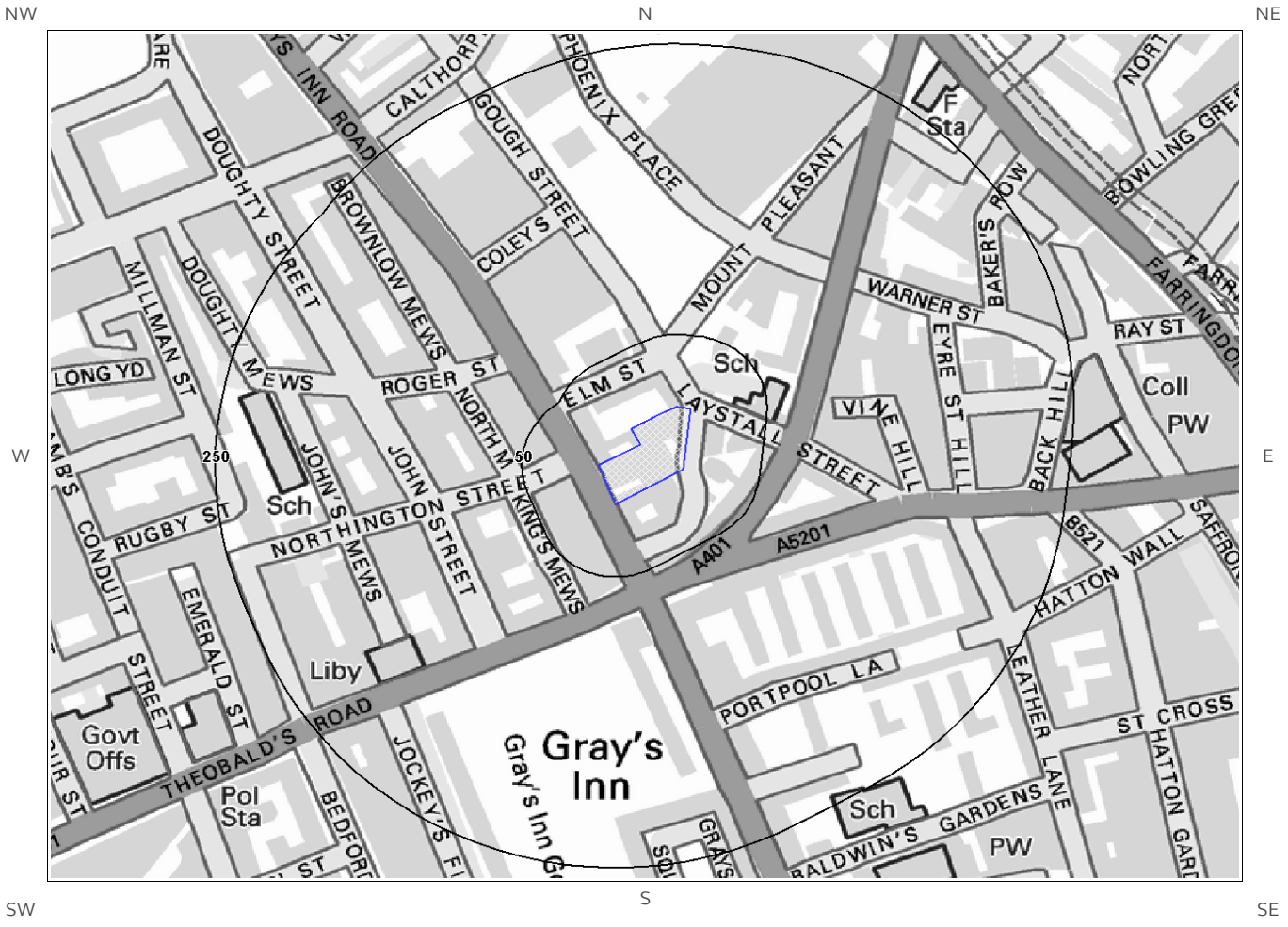
Distance	Direction	Description
57.0	N	Higher flood potential from rivers: the first areas to experience the effects of inland flooding in a river catchment.

Notes on BGS Geological Indicators of Flooding data:

The BGS Geological Indicators of Flooding (GIF) data set is a digital map based on the BGS Digital Geological Map of Great Britain at the 1:50,000 scale (DiGMapGB-50). It was produced by characterising Superficial (Drift) Deposits on DiGMapGB-50 in terms of their likely vulnerability to flooding, either from coastal or inland water flow. These Superficial Deposits are considered 'recent' in geological terms, most having been formed in the later parts of the Quaternary geological period (i.e. within the last few tens of thousands of years). Observations made during recent major inland and coastal flooding events have demonstrated that the erosion and deposition of these recent geological sediments have produced subtle topographical variations, resulting in landforms such as fluvial and coastal floodplains. The mapping of these landforms, in conjunction with the fluvial and/or coastal deposits that underlie them, has in turn determined the extent of previous coastal and inland flooding.

On this basis, the floodplains which are at greatest risk from flooding can be both visualised and defined by Superficial Deposits as depicted on geological maps. These include deposits such as river alluvium and lacustrine (lake) alluvium, as well as the First River Terrace or 'Floodplain terrace' (raised flat areas adjacent to or within floodplains, which represent the level of the floodplain prior to the most recent episode of down-cutting). Older and higher river terraces have been excluded as they lie outside the geologically defined floodplain. Areas at risk from coastal inundation are similarly characterised by a range of estuarine or marine deposits that include, for example, tidal flats.

8. JBA Canal Break map



JBA Canal Break legend

Site Outline

50
250
Search Buffers (m)

Areas at risk from Canal Breach

8. JBA Reservoir and Canal Data

8.1 JBA Reservoir Failure Impact Modelling

Is the property located in an area identified as being at potential risk in the event of a reservoir failure? No

JBA consulting have modelled the flooding impact from 1,700 reservoirs in England and Wales, should there be a catastrophic failure of a reservoir wall or embankment. This data is not displayed on mapping.

Guidance: None required

Notes on Reservoir Failure Impact data:

This dataset identified areas that are most likely to flood following the sudden catastrophic failure of a reservoir and is provided by JBA Consulting. JBA has identified over 1,700 reservoirs that pose a risk to people and property. These maps identify properties that would flood in the unlikely event of the failure of the reservoir's dam or embankment. Empirical methods were used to predict the flow that would result from the failure which was then modelled onto high resolution Digital Terrain Models (DTM) using JBA's advanced 2D hydraulic modelling techniques. The model provides the maximum depth of flooding in each cell of the DTM.

8.2 JBA Canal Break Modelling

Is the property located within 500m of an area identified as being at potential risk in the event of a canal break? No

Database searched and no data found.

Notes on Canal Break modelling data

Canal failure mapping includes two types of failure:

- Breach of raised canal embankments - failure of the embankment due to weaknesses; these are typically caused by erosion or animal burrowing but can also arise from poor maintenance.
- Aqueduct failure - an aqueduct is where the canal passes over infrastructure such as roads, railways and subways, or over other canals and rivers. Failures of these are typically caused by the collapse of the underlying culvert.

A length of over 1,700km of canal covering England, Wales and Scotland was modelled. The canal modelling is restricted to the areas where LIDAR is available as the raised embankments are more defined in the LIDAR than in the Photogrammetry data. Each canal is categorised as part of the Merchant Shipping Notice (MSN 1776 (M)). The majority of the modelled canals are categorised as A, with a few exceptions, which fell under category B.

- Category A: narrow rivers and canals where the depth of water is generally less than 1.5m.
- Category B: wider rivers and canals where the depth of water is generally 1.5m or more and where the significant wave height could not be expected to exceed 0.6m at any time.
- Category C: tidal rivers and estuaries and large, deep lakes and lochs where the significant wave height could not be expected to exceed 1.2m at any time.
- Category D: tidal rivers and estuaries where the significant wave height could not be expected to exceed 2m at any time.

The canal map provides flood extent data only and show flooded areas with a depth greater than 0.1m.

Contact Details

Groundsure Helpline

Telephone: 08444 159 000
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

JBA Risk Management

South Barn
Broughton Hall
Skipton
BD23 3AE
Tel: 01756 799919

Ordnance Survey

Adanac Drive, Southampton
SO16 0AS

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

Local Authority

Authority: London Borough of Camden
Phone: 020 7974 4444
Web: http://www.camden.gov.uk/
Address: Camden Town Hall, Judd Street, London, WC1H 9JE

Getmapping PLC

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

Standard Terms and Conditions

1 Definitions

I**n these terms and conditions unless the context otherwise requires:**
"Beneficiary" means the person or entity for whose benefit the Client has obtained the Services.
"Client" means the party or parties entering into a Contract with Groundsure.
"Commercial" means any building or property which is not Residential.
"Confidential Information" means the contents of this Contract and all information received from the Client as a result of, or in connection with, this Contract other than
(i) information which the Client can prove was rightfully in its possession prior to disclosure by Groundsure and
(ii) any information which is in the public domain (other than by virtue of a breach of this Contract).
"Support Services" means Support Services provided by Groundsure including, without limitation, interpreting third party and in-house environmental data, providing environmental support advice, undertaking environmental audits and assessments, Site investigation, Site monitoring and related items.
"Contract" means the contract between Groundsure and the Client for the provision of the Services, and which shall incorporate these terms and conditions, the Order, and the relevant User Guide.
"Third Party Data Provider" means any third party providing Third Party Content to Groundsure.
"Data Reports" means reports comprising factual data with no accompanying interpretation.
"Fees" has the meaning set out in clause 5.1.
"Groundsure" means Groundsure Limited, a company registered in England and Wales under number 03421028.
"Groundsure Materials" means all materials prepared by Groundsure and provided as part of the Services, including but not limited to Third Party Content, Data Reports, Mapping, and Risk Screening Reports.
"Intellectual Property" means any patent, copyright, design rights, trade or service mark, moral rights, data protection rights, know-how or trade mark in each case whether registered or not and including applications for the same or any other rights of a similar nature anywhere in the world.
"Mapping" means a map, map data or a combination of historical maps of various ages, time periods and scales.
"Order" means an electronic, written or other order form submitted by the Client requesting Services from Groundsure in respect of a specified Site.
"Ordnance Survey" means the Secretary of State for Business, Innovation and Skills, acting through Ordnance Survey, Adanac Drive, Southampton, SO16 0AS, UK.
"Order Website" means the online platform through which Orders may be placed by the Client and accepted by Groundsure.
"Report" means a Risk Screening Report or Data Report for Commercial or Residential property.
"Residential" means any building or property used as or intended to be used as a single dwelling.
"Risk Screening Report" means a risk screening report comprising factual data with an accompanying interpretation by Groundsure.
"Services" means any Report, Mapping and/or Support Services which Groundsure has agreed to provide by accepting an Order pursuant to clause 2.6.
"Site" means the area of land in respect of which the Client has requested Groundsure to provide the Services.
"Third Party Content" means data, database information or other information which is provided to Groundsure by a Third Party Data Provider.
"User Guide" means the user guide, as amended from time to time, available upon request from Groundsure and on the website (www.Groundsure.com) and forming part of this Contract.

2 Scope of Services, terms and conditions, requests for insurance and quotations

2.1 Groundsure agrees to provide the Services in accordance with the Contract.
2.2 Groundsure shall exercise reasonable skill and care in the provision of the Services.
2.3 Subject to clause 7.3 the Client acknowledges that it has not relied on any statement or representation made by or on behalf of Groundsure which is not set out and expressly agreed in writing in the Contract and all such statements and representations are hereby excluded to the fullest extent permitted by law.
2.4 The Client acknowledges that terms and conditions appearing on a Client's order form, printed stationery or other communication, or any terms or conditions implied by custom, practice or course of dealing shall be of no effect, and that this Contract shall prevail over all others in relation to the Order.
2.5 If the Client or Beneficiary requests insurance in conjunction with or as a result of the Services, Groundsure shall use reasonable endeavours to recommend such insurance, but makes no warranty that such insurance shall be available from insurers or that it will be offered on reasonable terms. Any insurance purchased by the Client or Beneficiary shall be subject solely to the terms of the policy issued by insurers and Groundsure will have no liability therefor. In addition you acknowledge and agree that Groundsure does not act as an agent or broker for any insurance providers. The Client should take (and ensure that the Beneficiary takes) independent advice to ensure that the insurance policy requested or offered is suitable for its requirements.
2.6 Groundsure's quotations or proposals are valid for a period of 30 days only unless an alternative period of time is explicitly stipulated by Groundsure. Groundsure reserves the right to withdraw any quotation or proposal at any time before an Order is accepted by Groundsure. Groundsure's acceptance of an Order shall be binding only when made in writing and signed by Groundsure's authorised representative or when accepted through the Order Website.

3 The Client's obligations

3.1The Client shall comply with the terms of this Contract and
(i) procure that the Beneficiary or any third party relying on the Services complies with and acts as if it is bound by the Contract and
(ii) be liable to Groundsure for the acts and omissions of the Beneficiary or any third party relying on the Services as if such acts and omissions were those of the Client.
3.2 The Client shall be solely responsible for ensuring that the Services are appropriate and suitable for its and/or the Beneficiary's needs.
3.3 The Client shall supply to Groundsure as soon as practicable and without charge all requisite information (and the Client warrants that such information is accurate, complete and appropriate), including without limitation any environmental information relating to the Site and shall give such assistance as Groundsure shall reasonably require in the provision of the Services including, without limitation, access to the Site, facilities and equipment.
3.4 Where the Client's approval or decision is required to enable Groundsure to carry out work in order to provide the Services, such approval or decision shall be given or procured in reasonable time and so as not to delay or disrupt the performance of the Services.
3.5 Save as expressly permitted by this Contract the Client shall not, and shall procure that the Beneficiary shall not, re-sell, alter, add to, or amend the Groundsure Materials, or use the Groundsure Materials in a manner for which they were not intended. The Client may make the Groundsure Materials available to a third party who is considering acquiring some or all of, or providing funding in relation to, the Site, but such third party cannot rely on the same unless expressly permitted under clause 4.
3.6 The Client is responsible for maintaining the confidentiality of its user name and password if using the Order Website and the Client acknowledges that Groundsure accepts no liability of any kind for any loss or damage suffered by the Client as a consequence of using the Order Website.

4 Reliance

4.1The Client acknowledges that the Services provided by Groundsure consist of the presentation and analysis of Third Party Content and other content and that information obtained from a Third Party Data Provider cannot be guaranteed or warranted by Groundsure to be reliable.
4.2 In respect of Data Reports, Mapping and Risk Screening Reports, the following classes of person and no other are entitled to rely on their contents;
(i) the Beneficiary,
(ii) the Beneficiary's professional advisers, (iii) any person providing funding to the Beneficiary in relation to the Site (whether directly or as part of a lending syndicate),
(iv) the first purchaser or first tenant of the Site, and
(v) the professional advisers and lenders of the first purchaser or tenant of the Site.
4.3 In respect of Support Services, only the Client, Beneficiary and parties expressly named in a Report and no other parties are entitled to rely on its contents.
4.4 Save as set out in clauses 4.2 and 4.3 and unless otherwise expressly agreed in writing, no other person or entity of any kind is entitled to rely on any Services or Report issued or provided by Groundsure. Any party considering such Reports and Services does so at their own risk.

5 Fees and Disbursements

5.1Groundsure shall charge and the Client shall pay fees at the rate and frequency specified in the written proposal, Order Website or Order acknowledgement form, plus (in the case of Support Services) all proper disbursements incurred by Groundsure. The Client shall in addition pay all value added tax or other tax payable on such fees and disbursements in relation to the provision of the Services (together "Fees").
5.2 The Client shall pay all outstanding Fees to Groundsure in full without deduction, counterclaim or set off within 30 days of the date of Groundsure's invoice or such other period as may be agreed in writing between Groundsure and the Client ("Payment Date"). Interest on late payments will accrue on a daily basis from the Payment Date until the date of payment (whether before or after judgment) at the rate of 8% per annum.
5.3 The Client shall be deemed to have agreed the amount of any invoice unless an objection is made in writing within 28 days of the date of the invoice. As soon as reasonably practicable after being notified of an objection, without prejudice to clause 5.2 a member of Groundsure's management team will contact the Client and the parties shall then use all reasonable endeavours to resolve the dispute within 15 days.

6 Intellectual Property and Confidentiality

6.1 Subject to
(i) full payment of all relevant Fees and
(ii) compliance with this Contract, the Client is granted (and is permitted to sub-licence to the Beneficiary) a royalty-free, worldwide, non-assignable and (save to the extent set out in this Contract) non-transferable licence to make use of the Groundsure Materials.
6.2 All Intellectual Property in the Groundsure Materials are and shall remain owned by Groundsure or Groundsure's licensors (including without limitation the Third Party Data Providers) the Client acknowledges, and shall procure

acknowledgement by the Beneficiary of, such ownership. Nothing in this Contract purports to transfer or assign any rights to the Client or the Beneficiary in respect of such Intellectual Property.
6.3 Third Party Data Providers may enforce any breach of clauses 6.1 and 6.2 against the Client or Beneficiary.
6.4 The Client shall, and shall procure that any recipients of the Groundsure Materials shall:

(i) not remove, suppress or modify any trade mark, copyright or other proprietary marking belonging to Groundsure or any third party from the Services;

(ii) use the information obtained as part of the Services in respect of the subject Site only, and shall not store or reuse any information obtained as part of the Services provided in respect of adjacent or nearby sites;

(iii) not create any product or report which is derived directly or indirectly from the Services (save that those acting in a professional capacity to the Beneficiary may provide advice based upon the Services);

(iv) not combine the Services with or incorporate such Services into any other information data or service;

(v) not reformat or otherwise change (whether by modification, addition or enhancement), the Services (save that those acting for the Beneficiary in a professional capacity shall not be in breach of this clause 6.4(v) where such reformatting is in the normal course of providing advice based upon the Services);

(vi) where a Report and/or Mapping contains material belonging to Ordnance Survey, acknowledge and agree that such content is protected by Crown Copyright and shall not use such content for any purpose outside of receiving the Services; and

(vii) not copy in whole or in part by any means any map prints or run-on copies containing content belonging to Ordnance Survey (other than that contained within Ordnance Survey's OS Street Map) without first being in possession of a valid Paper Map Copying Licence from Ordnance Survey,

6.5 Notwithstanding clause 6.4, the Client may make reasonable use of the Groundsure Materials in order to advise the Beneficiary in a professional capacity. However, Groundsure shall have no liability in respect of any advice, opinion or report given or provided to Beneficiaries by the Client.
6.6 The Client shall procure that any person to whom the Services are made available shall notify Groundsure of any request or requirement to disclose, publish or disseminate any information contained in the Services in accordance with the Freedom of Information Act 2000, the Environmental Information Regulations 2004 or any associated legislation or regulations in force from time to time.

7.Liability: Particular Attention Should Be Paid To This Clause

7.1 This Clause 7 sets out the entire liability of Groundsure, including any liability for the acts or omissions of its employees, agents, consultants, subcontractors and Third Party Content, in respect of:

(i) any breach of contract, including any deliberate breach of the Contract by Groundsure or its employees, agents or subcontractors;

(ii) any use made of the Reports, Services, Materials or any part of them; and

(iii) any representation, statement or tortious act or omission (including negligence) arising under or in connection with the Contract.

7.2 All warranties, conditions and other terms implied by statute or common law are, to the fullest extent permitted by law, excluded from the Contract.
7.3 Nothing in the Contract limits or excludes the liability of the Supplier for death or personal injury resulting from negligence, or for any damage or liability incurred by the Client or Beneficiary as a result of fraud or fraudulent misrepresentation.
7.4 Groundsure shall not be liable for

(i) loss of profits;
(ii) loss of business;
(iii) depletion of goodwill and/or similar losses;
(iv) loss of anticipated savings;
(v) loss of goods;
(vi) loss of contract;
(vii) loss of use;
(viii) loss or corruption of data or information;
(ix) business interruption;
(x) any kind of special, indirect, consequential or pure economic loss, costs, damages, charges or expenses;
(xi) loss or damage that arise as a result of the use of all or part of the Groundsure Materials in breach of the Contract;
(xii) loss or damage arising as a result of any error, omission or inaccuracy in any part of the Groundsure Materials where such error, omission or inaccuracy is caused by any Third Party Content or any reasonable interpretation of Third Party Content;
(xiii) loss or damage to a computer, software, modem, telephone or other property; and
(xiv) loss or damage caused by a delay or loss of use of Groundsure's internet ordering service.

7.5 Groundsure's total liability in relation to or under the Contract shall be limited to £10 million for any claim or claims.
7.6 Groundsure shall procure that the Beneficiary shall be bound by limitations and exclusions of liability in favour of Groundsure which accord with those detailed in clauses 7.4 and 7.5 (subject to clause 7.3) in respect of all claims which the Beneficiary may bring against Groundsure in relation to the Services or other matters arising pursuant to the Contract.

8 Groundsure's right to suspend or terminate

8.1 If Groundsure reasonably believes that the Client or Beneficiary has not provided the information or assistance required to enable the proper provision of the Services, Groundsure shall be entitled to suspend all further performance of the Services until such time as any such deficiency has been made good.
8.2 Groundsure shall be entitled to terminate the Contract immediately on written notice in the event that:

(i) the Client fails to pay any sum due to Groundsure within 30 days of the Payment Date; or

(ii) the Client (being an individual) has a bankruptcy order made against him or (being a company) shall enter into liquidation whether compulsory or voluntary or have an administration order made against it or if a receiver shall be appointed over the whole or any part of its property assets or undertaking or if the Client is struck off the Register of Companies or dissolved; or

(iii) the Client being a company is unable to pay its debts within the meaning of Section 123 of the Insolvency Act 1986 or being an individual appears unable to pay his debts within the meaning of Section 268 of the Insolvency Act 1986 or if the Client shall enter into a composition or arrangement with the Client's creditors or shall suffer distress or execution to be levied on his goods; or

(iv) the Client or the Beneficiary breaches any term of the Contract (including, but not limited to, the obligations in clause 4) which is incapable of remedy or if remediable, is not remedied within five days of notice of the breach.

9. Client's Right to Terminate and Suspend

9.1 Subject to clause 10.1, the Client may at any time upon written notice terminate or suspend the provision of all or any of the Services.
9.2 In any event, where the Client is a consumer (and not a business) he/she hereby expressly acknowledges and agrees that:

(i) the supply of Services under this Contract (and therefore the performance of this Contract) commences immediately upon Groundsure's acceptance of the Order; and

(ii) the Reports and/or Mapping provided under this Contract are

(a) supplied to the Client's specification(s) and in any event
(b) by their nature cannot be returned.

10 Consequences of Withdrawal, Termination or Suspension

10.1 Upon termination of the Contract:

(i) Groundsure shall take steps to bring to an end the Services in an orderly manner, vacate any Site with all reasonable speed and shall deliver to the Client and/or Beneficiary any property of the Client and/or Beneficiary in Groundsure's possession or control; and

(ii) the Client shall pay to Groundsure all and any Fees payable in respect of the performance of the Services up to the date of termination or suspension. In respect of any Support Services provided, the Client shall also pay Groundsure any additional costs incurred in relation to the termination or suspension of the Contract.

11 Anti-Bribery

11.1 The Client warrants that it shall:

(i) comply with all applicable laws, statutes and regulations relating to anti-bribery and anti-corruption including but not limited to the Bribery Act 2010;

(ii) comply with such of Groundsure's anti-bribery and anti-corruption policies as are notified to the Client from time to time; and

(iii) promptly report to Groundsure any request or demand for any undue financial or other advantage of any kind received by or on behalf of the Client in connection with the performance of this Contract.

11.2 Breach of this Clause 11 shall be deemed a material breach of this Contract.

12 General

12.1 The Mapping contained in the Services is protected by Crown copyright and must not be used for any purpose other than as part of the Services or as specifically provided in the Contract.
12.2 The Client shall be permitted to make one copy only of each Report or Mapping Order. Thereafter the Client shall be entitled to make unlimited copies of the Report or Mapping Order only in accordance with an Ordnance Survey paper map copy license available through Groundsure.
12.3 Groundsure reserves the right to amend or vary this Contract. No amendment or variation to this Contract shall be valid unless signed by an authorised representative of Groundsure.
12.4 No failure on the part of Groundsure to exercise, and no delay in exercising, any right, power or provision under this Contract shall operate as a waiver thereof.
12.5 Save as expressly provided in this Contract, no person other than the persons set out therein shall have any right under the Contract (Rights of Third Parties) Act 1999 to enforce any terms of the Contract.
12.6 The Secretary of State for Business, Innovation and Skills ("BIS") or BIS' successor body, as the case may be, acting through Ordnance Survey may enforce a breach of clause 6.4(vi) and clause 6.4(vii) of these terms and conditions against the Client in accordance with the provisions of the Contracts (Rights of Third Parties) Act 1999.
12.7 Groundsure shall not be liable to the Client if the provision of the Services is delayed or prevented by one or more of the following circumstances:

(i) the Client or Beneficiary's failure to provide facilities, access or information;
(ii) fire, storm, flood, tempest or epidemic;
(iii) Acts of God or the public enemy;
(iv) riot, civil commotion or war;
(v) strikes, labour disputes or industrial action;
(vi) acts or regulations of any governmental or other agency;
(vii) suspension or delay of services at public registries by Third Party Data Providers;
(viii) changes in law; or
(ix) any other reason beyond Groundsure's reasonable control.

In the event that Groundsure is prevented from performing the Services (or any part thereof) in accordance with this clause 12.6 for a period of not less than 30 days then Groundsure shall be entitled to terminate this Contract immediately on written notice to the Client.

12.8 Any notice provided shall be in writing and shall be deemed to be properly given if delivered by hand or sent by first class post, facsimile or by email to the address, facsimile number or email address of the relevant party as may have been notified by each party to the other for such purpose or in the absence of such notification the last known address.

12.9 Such notice shall be deemed to have been received on the day of delivery if delivered by hand, facsimile or email (save to the extent such day is not a working day where it shall be deemed to have been delivered on the next working day) and on the second working day after the day of posting if sent by first class post.

12.10 The Contract constitutes the entire agreement between the parties and shall supersede all previous arrangements between the parties relating to the subject matter hereof.

12.11 Each of the provisions of the Contract is severable and distinct from the others and if one or more provisions is or should become invalid, illegal or unenforceable, the validity and enforceability of the remaining provisions shall not in any way be tainted or impaired.

12.12 This Contract shall be governed by and construed in accordance with English law and any proceedings arising out of or connected with this Contract shall be subject to the exclusive jurisdiction of the English courts.

12.13 Groundsure is an executive member of the Council of Property Search Organisation (CoPSO) and has signed up to the Search Code administered by the Property Codes Compliance Board (PCCB). All Risk Screening Reports shall be supplied in accordance with the provisions of the Search Code.

12.14 If the Client or Beneficiary has a complaint about the Services, written notice should be given to the Compliance Officer at Groundsure who will respond in a timely manner.

12.15 The Client agrees that it shall, and shall procure that each Beneficiary shall, treat in confidence all Confidential Information and shall not, and shall procure that each Beneficiary shall not (i) disclose any Confidential Information to any third party other than in accordance with the terms of this Contract; and (ii) use Confidential Information for a purpose other than the exercise of its rights and obligations under this Contract. Subject to clause 6.6, nothing shall prevent the Client or any Beneficiary from disclosing Confidential Information to the extent
required by law

Rail
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Appendix D – Thames Water information

Asset Location Search

Subscan Technology Ltd
Unit 8Hayfield Lane
FINNINGLEY
DONCASTER
DN9 3FL

Search address supplied Panther House
Grays Inn Road
London

Your reference N/A

Our reference ALS/ALS Standard/2015_3092930

Search date 10 July 2015

You are now able to order your Asset Location Search requests online by visiting
www.thameswater-propertysearches.co.uk

Asset Location Search

Search address supplied: Panther House, Grays Inn Road, London,

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0845 070 9148, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Asset Location Search

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an ‘as constructed’ record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and

pressure test to be carried out for a fee.

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Asset Location Search

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0845 850 2777
Email: developer.services@thameswater.co.uk

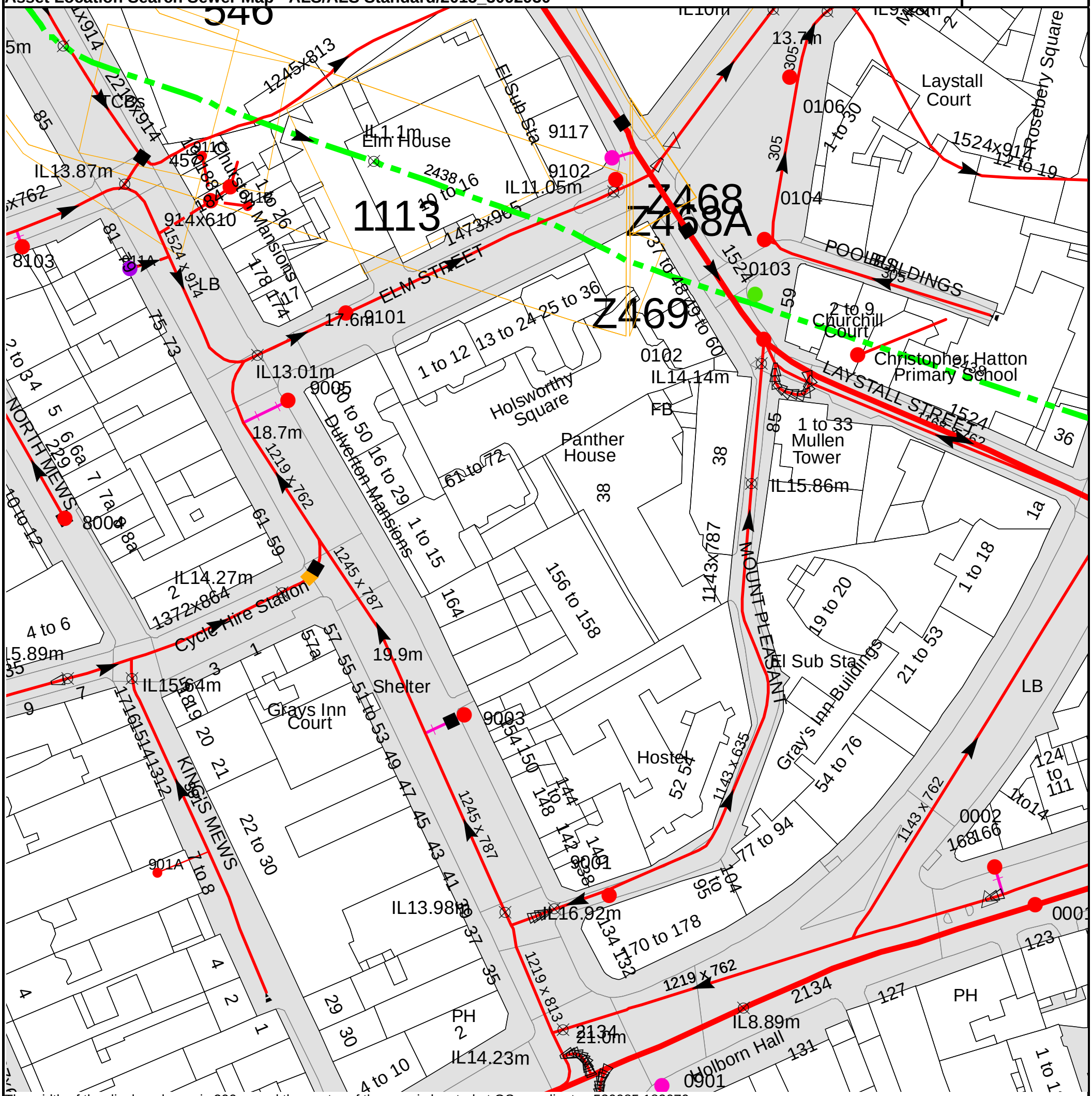
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0845 850 2777
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2015_3092930



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 530985,182070

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
01FF	n/a	n/a
0102	16.54	n/a
9101	17.7	12.69
0103	n/a	n/a
911A	n/a	n/a
8103	n/a	n/a
0104	15.27	10.6
911B	n/a	n/a
91CF	n/a	n/a
91CD	n/a	n/a
9102	15.39	n/a
9117	n/a	n/a
911C	n/a	n/a
0106	14.04	9.59
901A	n/a	n/a
9005	n/a	n/a
9003	n/a	n/a
9001	20.62	n/a
0901	n/a	n/a
0002	n/a	n/a
0001	n/a	8.87
8004	20.05	16.3

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.

2) All measurements on the plans are metric.

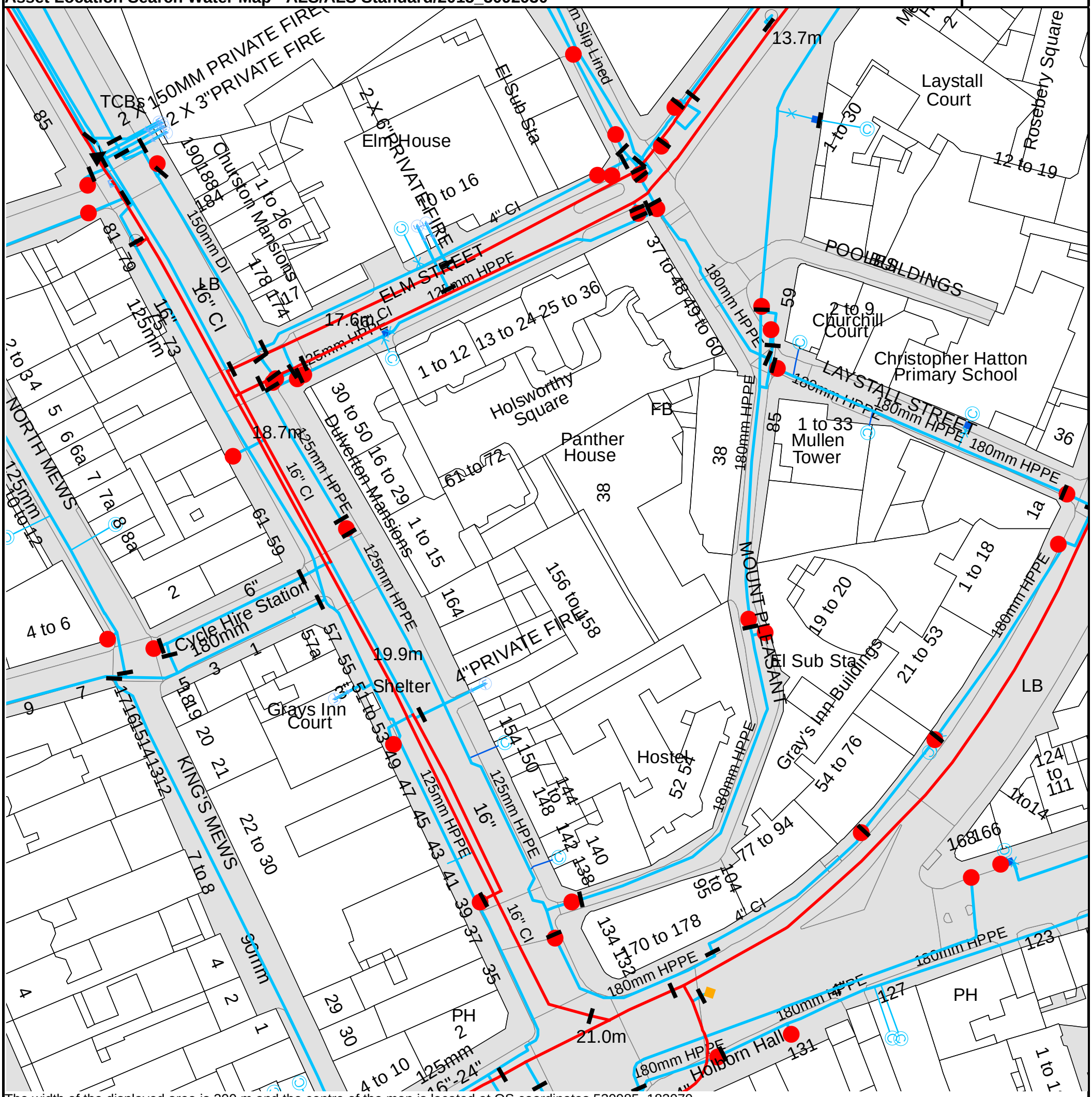
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

5) 'na' or '0' on a manhole level indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Asset Location Search Water Map - ALS/ALS Standard/2015_3092930



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 530985, 182070.

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

ALS Water Map Key

Water Pipes (Operated & Maintained by Thames Water)

4"

Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

16"

Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

3" SUPPLY

Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.

3" FIRE

Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

3" METERED

Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to him at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**	**Cheque**
Call **0845 070 9148** quoting your invoice number starting CBA or ADS.	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

Search Code

IMPORTANT CONSUMER PROTECTION INFORMATION

This search has been produced by Thames Water Property Searches, Clearwater Court, Vastern Road, Reading RG1 8DB, which is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom
- sets out minimum standards which firms compiling and selling search reports have to meet
- promotes the best practise and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.

By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports
- act with integrity and carry out work with due skill, care and diligence
- at all times maintain adequate and appropriate insurance to protect consumers
- conduct business in an honest, fair and professional manner
- handle complaints speedily and fairly
- ensure that products and services comply with industry registration rules and standards and relevant laws
- monitor their compliance with the Code

Complaints

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award compensation of up to £5,000 to you if he finds that you have suffered actual loss as a result of your search provider failing to keep to the Code.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs Contact Details

The Property Ombudsman scheme
Milford House
43-55 Milford Street
Salisbury
Wiltshire SP1 2BP
Tel: 01722 333306
Fax: 01722 332296
Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk

PLEASE ASK YOUR SEARCH PROVIDER IF YOU WOULD LIKE A COPY OF THE SEARCH CODE

Sewer Flooding
History Enquiry

Robert West Consulting

Search address supplied	Panther Securities Plc Panther House 38 Mount Pleasant London WC1X 0AN
Your reference	Panther House
Our reference	SFH/SFH Standard/2015_3161322
Received date	**6 October 2015**
Search date	**6 October 2015**

Thames Water Utilities Ltd

Property Searches
PO Box 3189
Slough SL1 4WW

DX 151280 Slough 13

T 0118 925 1504
E searches@thameswater.co.uk
I www.thameswater-propertysearches.co.uk

Registered in England and Wales
No. 2366661, Registered office
Clearwater Court, Vastern Road
Reading RG1 8DB

Sewer Flooding

History Enquiry

Search address supplied: Panther Securities Plc,Panther House,38,Mount Pleasant,London,WC1X 0AN

This search is recommended to check for any sewer flooding in a specific address or area

TWUL, trading as Property Searches, are responsible in respect of the following:-

(i) any negligent or incorrect entry in the records searched;

(ii) any negligent or incorrect interpretation of the records searched;

(iii) and any negligent or incorrect recording of that interpretation in the search report

(iv) compensation payments

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Reading RG1 8DB

Sewer Flooding

History Enquiry

History of Sewer Flooding

Is the requested address or area at risk of flooding due to overloaded public sewers?

The flooding records held by Thames Water indicate that there have been no incidents of flooding in the requested area as a result of surcharging public sewers.

For your guidance:

- A sewer is “overloaded” when the flow from a storm is unable to pass through it due to a permanent problem (e.g. flat gradient, small diameter). Flooding as a result of temporary problems such as blockages, siltation, collapses and equipment or operational failures are excluded.
- “Internal flooding” from public sewers is defined as flooding, which enters a building or passes below a suspended floor. For reporting purposes, buildings are restricted to those normally occupied and used for residential, public, commercial, business or industrial purposes.
- “At Risk” properties are those that the water company is required to include in the Regulatory Register that is presented annually to the Director General of Water Services. These are defined as properties that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system more frequently than the relevant reference period (either once or twice in ten years) as determined by the Company’s reporting procedure.
- Flooding as a result of storm events proven to be exceptional and beyond the reference period of one in ten years are not included on the At Risk Register.
- Properties may be at risk of flooding but not included on the Register where flooding incidents have not been reported to the Company.
- Public Sewers are defined as those for which the Company holds statutory responsibility under the Water Industry Act 1991.
- It should be noted that flooding can occur from private sewers and drains which are not the responsibility of the Company. This report excludes flooding from private sewers and drains and the Company makes no comment upon this matter.
- For further information please contact Thames Water on Tel: 0800 316 9800 or website www.thameswater.co.uk

Thames Water Utilities Ltd

Property Searches
PO Box 3189
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I www.thameswater-propertysearches.co.uk

Robert West

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Appendix E – SuDS Hierarchy

SUDS Group	Technique	Soils		Area draining to a single SuDS component		Minimum depth to water table		Site Slope		Available Head		Available Space	
		Impermeable	Permeable	0 - 2ha	> 2ha	0 - 1m	> 1m	0 - 5%	> 5%	0 - 1m	1 - 2m	Low	High
Retention	Retention Pond	**Y**	Y[1]	**Y**	Y[5]	**Y**	Y	**Y**	Y	**Y**	Y	**N**	Y
	Subsurface Storage	**Y**	Y	**Y**	Y[5]	**Y**	Y	**Y**	Y	**Y**	Y	**Y**	Y
Wetland	Shallow Wetland	**Y**[2]	Y[4]	**Y**[4]	Y[6]	**Y**[2]	Y[2]	**Y**	N	**Y**	Y	**N**	Y
	Extended detention wetland	**Y**[2]	Y[4]	**Y**[4]	Y[6]	**Y**[2]	Y[2]	**Y**	N	**Y**	Y	**N**	Y
	Pond/wetland	**Y**[2]	Y[4]	**Y**[4]	Y[6]	**Y**[2]	Y[2]	**Y**	N	**Y**	Y	**N**	Y
	Pocket wetland	**Y**[2]	Y[4]	**Y**[4]	N	**Y**[2]	Y[2]	**Y**	N	**Y**	Y	**Y**	Y
	Submerged gravel wetland	**Y**[2]	Y[4]	**Y**[4]	Y[6]	**Y**[2]	Y[2]	**Y**	N	**Y**	Y	**N**	Y
	Wetland channel	**Y**[2]	Y[4]	**Y**[4]	Y[6]	**Y**[2]	Y[2]	**Y**	N	**Y**	Y	**N**	Y
Infiltration	Infiltration trench	**N**	Y	**Y**	N	**N**	Y	**Y**	Y	**Y**	N	**Y**	Y
	Infiltration basin	**N**	Y	**Y**	Y[5]	**N**	Y	**Y**	Y	**Y**	N	**N**	Y
	Soakaway	**N**	Y	**Y**	N	**N**	Y	**Y**	Y	**Y**	N	**Y**	Y
Filtration	Surface sand filter	**Y**	Y	**Y**	Y[5]	**N**	Y	**Y**	N	**N**	Y	**N**	Y
	Sub-surface sand filter	**Y**	Y	**Y**	N	**N**	Y	**Y**	N	**N**	Y	**Y**	Y
	Perimeter sand filter	**Y**	Y	**Y**	N	**N**	Y	**Y**	N	**Y**	Y	**Y**	Y
	Bioretention/filter strips	**Y**	Y	**Y**	N	**N**	Y	**Y**	N	**Y**	Y	**N**	Y
	Filter trench	**Y**	Y[1]	**Y**	N	**N**	Y	**Y**	N	**Y**	Y	**Y**	Y
Detention	Detention Basin	**Y**	Y[1]	**Y**	Y[5]	**N**	Y	**Y**	Y	**N**	Y	**N**	Y
Open channels	Conveyance Swale	**Y**	Y	**Y**	N	**N**	Y	**Y**	N[3]	**Y**	N	**N**	Y
	Enhanced dry swale	**Y**	Y	**Y**	N	**N**	Y	**Y**	N[3]	**Y**	N	**N**	Y
	Enhanced wet swale	**Y**[2]	Y[4]	**Y**	N	**Y**	Y	**Y**	N[3]	**Y**	N	**N**	Y
Source Control	Green roof	**Y**	Y	**Y**	N	**Y**	Y	**Y**	Y	**Y**	Y	**Y**	Y
	Rainwater harvesting	**Y**	Y	**Y**	N	**Y**	Y	**Y**	Y	**Y**			
	Permeable Pavement	**Y**	Y	**Y**	Y	**Y**	Y	**Y**	N	**Y**	Y	**Y**	Y

NOTES:
Y = Yes ; N = No
Y[1] - Yes, with liner
Y[2] - Yes, with surface baseflow
N[3] - No, unless follows contours
Y[4] - Yes, with liner and constant surface baseflow, or high ground water table
Y[5] - Yes, possible, but not recommended (implies appropriate management train not in place)
Y[6] - Yes, where high flows are diverted around SUDS components

Robert West

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Appendix F – Hydraulic modelling calculations

Robert West

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Pre-development network discharge rates (West Area)

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.450	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	100	Min Design Depth for Optimisation (m)	0.800
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	0.80
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

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	15.000	0.200	75.0	0.048	5.00	0.0	0.600	o	150	
1.001	10.000	0.088	113.6	0.048	0.00	0.0	0.600	o	150	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	73.27	5.22	19.400	0.048	0.0	0.0	0.0	1.16	20.5	9.5
1.001	72.17	5.39	16.300	0.096	0.0	0.0	0.0	0.94	16.6«	18.8

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
A	20.300	0.900	Open Manhole	1200	1.000	19.400	150				
B	20.000	3.700	Open Manhole	1200	1.001	16.300	150	1.000	19.200	150	2900
TW1	20.000	3.788	Open Manhole	0		OUTFALL		1.001	16.212	150	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	A	20.300	19.400	0.750	Open Manhole	1200
1.001	o	150	B	20.000	16.300	3.550	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	15.000	75.0	B	20.000	19.200	0.650	Open Manhole	1200
1.001	10.000	113.6	TW1	20.000	16.212	3.638	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001	TW1	20.000	16.212	16.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.950	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.950
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.450		

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 * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.450
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	A	15 minute 1 year Winter I+0%	1	20.300	19.463	-0.087	0.000	0.36
1.001	B	15 minute 1 year Winter I+0%	1	20.000	16.409	-0.041	0.000	0.86

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	A	0.066	3.253	6.9	OK
1.001	B	0.118	6.507	12.8	OK

30 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 * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.450
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	A	15 minute 30 year Winter I+0%	1	20.300	19.512	-0.038	0.000	0.89
1.001	B	15 minute 30 year Winter I+0%	1	20.000	16.846	0.396	0.000	2.30

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	A	0.121	7.965	17.0	OK
1.001	B	0.612	15.928	34.1	SURCHARGED

100 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 * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.450
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	A	15 minute 100 year Winter I+0%	1	20.300	19.605	0.055	0.000	1.14
1.001	B	15 minute 100 year Winter I+0%	1	20.000	17.119	0.669	0.000	2.91

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	A	0.226	10.362	21.5	SURCHARGED
1.001	B	0.921	20.729	43.1	SURCHARGED

Robert West

Rail
Buildings
Infrastructure
Transport & Environment

Pre-development network discharge rates (East Area)

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.450	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	0.800
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	0.80
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.950		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

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	30.000	0.200	150.0	0.060	5.00	0.0	0.600	o	150	
1.001	20.000	0.133	150.4	0.055	0.00	0.0	0.600	o	150	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.61	14.680	0.060	0.0	0.0	0.0	0.82	14.5	10.3
1.001	50.00	6.02	14.070	0.115	0.0	0.0	0.0	0.82	14.4«	19.7

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Essex CM13 1NH

Date 04/11/2015 11:50 | Designed by Paul
File Pre-dev east_041115.mdx | Checked by
XP Solutions | Network 2015.1

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
D	15.680	1.000	Open Manhole	1200	1.000	14.680	150				
E	15.530	1.460	Open Manhole	1200	1.001	14.070	150	1.000	14.480	150	410
TW	17.000	3.063	Open Manhole	0		OUTFALL		1.001	13.937	150	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	D	15.680	14.680	0.850	Open Manhole	1200
1.001	o	150	E	15.530	14.070	1.310	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	30.000	150.0	E	15.530	14.480	0.900	Open Manhole	1200
1.001	20.000	150.4	TW	17.000	13.937	2.913	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001	TW	17.000	13.937	13.900	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.950	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.950
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.450		

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 * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.442
Region	England and Wales	Cv (Summer)	0.950
M5-60 (mm)	20.800	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	D	15 minute 1 year Summer I+0%	1	15.680	14.781	-0.049	0.000	0.78
1.001	E	15 minute 1 year Summer I+0%	1	15.530	14.328	0.108	0.000	1.35

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	D	0.109	4.754	10.9	OK
1.001	E	0.287	9.110	18.3	SURCHARGED

30 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 * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.442
Region	England and Wales	Cv (Summer)	0.950
M5-60 (mm)	20.800	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	D	15 minute 30 year Summer I+0%	1	15.680	15.545	0.715	0.000	1.55
1.001	E	15 minute 30 year Summer I+0%	1	15.530	15.145	0.925	0.000	2.77

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	D	0.973	11.680	21.5	FLOOD RISK
1.001	E	1.719	22.388	37.7	SURCHARGED

100 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 * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.442
Region	England and Wales	Cv (Summer)	0.950
M5-60 (mm)	20.800	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	D	15 minute 100 year Summer I+0%	1	15.680	15.682	0.852	2.450	1.90
1.001	E	15 minute 100 year Summer I+0%	1	15.530	15.502	1.282	0.000	3.22

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	D	3.571	15.199	26.4	FLOOD
1.001	E	2.123	29.132	43.7	FLOOD RISK

Robert West

Rail
Buildings
Infrastructure
Transport & Environment

Post-development network discharge rates (West Area)

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.450	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	100	Min Design Depth for Optimisation (m)	0.800
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	0.80
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

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	15.000	0.200	75.0	0.027	5.00	0.0	0.600	o	100	
1.001	10.000	0.088	113.6	0.030	0.00	0.0	0.600	o	150	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	56.60	5.28	19.400	0.027	0.0	0.0	0.0	0.89	7.0	4.1
1.001	55.74	5.46	16.300	0.057	0.0	0.0	0.0	0.94	16.6	8.6

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XP Solutions | Network 2015.1

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
A	20.300	0.900	Open Manhole	1200	1.000	19.400	100				
B	20.000	3.700	Open Manhole	1200	1.001	16.300	150	1.000	19.200	100	2850
TW1	20.000	3.788	Open Manhole	0		OUTFALL		1.001	16.212	150	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	100	A	20.300	19.400	0.800	Open Manhole	1200
1.001	o	150	B	20.000	16.300	3.550	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	15.000	75.0	B	20.000	19.200	0.700	Open Manhole	1200
1.001	10.000	113.6	TW1	20.000	16.212	3.638	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001	TW1	20.000	16.212	16.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.950	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.950
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.450		

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 * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.441
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.900	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	A	15 minute 1 year Winter I+0%	1	20.300	19.457	-0.043	0.000	0.60
1.001	B	15 minute 1 year Winter I+0%	1	20.000	16.354	-0.096	0.000	0.27

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	A	0.059	1.885	4.0	OK
1.001	B	0.055	2.159	4.0	OK

30 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 * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.441
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.900	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	A	15 minute 30 year Winter I+0%	1	20.300	19.657	0.157	0.000	1.33
1.001	B	15 minute 30 year Winter I+0%	1	20.000	16.384	-0.066	0.000	0.60

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	A	0.285	4.673	8.9	SURCHARGED
1.001	B	0.089	6.262	8.9	OK

100 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 * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.441
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.900	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	A	15 minute 100 year Winter I+30%	1	20.300	20.134	0.634	0.000	2.04
1.001	B	15 minute 100 year Winter I+30%	1	20.000	16.457	0.007	0.000	1.07

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	A	0.824	7.895	13.6	FLOOD RISK
1.001	B	0.172	11.038	15.8	SURCHARGED

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Post-development network discharge rates (East Area)

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.700	Minimum Backdrop Height (m)	0.200
Ratio R	0.439	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	100	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

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	30.000	0.200	150.0	0.052	5.00	0.0	0.600	o	150	
1.001	20.000	0.133	150.4	0.104	0.00	0.0	0.600	o	150	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	72.45	5.61	14.680	0.052	0.0	0.0	0.0	0.82	14.5	10.2
1.001	70.13	6.02	14.070	0.156	0.0	0.0	0.0	0.82	14.4«	29.6

19 Lonsdale Avenue
Hutton
Essex CM13 1NH

Date 04/11/2015 12:58 | Designed by Paul
File Post-dev east_041115.mdx | Checked by
XP Solutions | Network 2015.1

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
D	15.680	1.000	Open Manhole	1200	1.000	14.680	150				
E	15.530	1.460	Open Manhole	1200	1.001	14.070	150	1.000	14.480	150	410
TW	17.000	3.063	Open Manhole	0		OUTFALL		1.001	13.937	150	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	D	15.680	14.680	0.850	Open Manhole	1200
1.001	o	150	E	15.530	14.070	1.310	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	30.000	150.0	E	15.530	14.480	0.900	Open Manhole	1200
1.001	20.000	150.4	TW	17.000	13.937	2.913	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001	TW	17.000	13.937	13.600	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.700	Storm Duration (mins)	30
Ratio R	0.439		

Online Controls for Storm

Hydro-Brake Optimum® Manhole: E, DS/PN: 1.001, Volume (m³): 2.2

Unit Reference	MD-SHE-0145-1000-1000-1000
Design Head (m)	1.000
Design Flow (l/s)	10.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	145
Invert Level (m)	14.070
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	10.0
Flush-Flo™	0.304	9.9
Kick-Flo®	0.672	8.3
Mean Flow over Head Range	-	8.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.2	1.200	10.9	3.000	16.8	7.000	25.2
0.200	9.6	1.400	11.7	3.500	18.1	7.500	26.0
0.300	9.9	1.600	12.4	4.000	19.3	8.000	26.9
0.400	9.8	1.800	13.2	4.500	20.4	8.500	27.7
0.500	9.6	2.000	13.8	5.000	21.4	9.000	28.4
0.600	9.1	2.200	14.5	5.500	22.4	9.500	29.2
0.800	9.0	2.400	15.1	6.000	23.4		
1.000	10.0	2.600	15.7	6.500	24.3		

Storage Structures for Storm

Tank or Pond Manhole: D, DS/PN: 1.000

Invert Level (m) 14.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	40.0	0.700	0.0	1.400	0.0	2.100	0.0
0.100	40.0	0.800	0.0	1.500	0.0	2.200	0.0
0.200	40.0	0.900	0.0	1.600	0.0	2.300	0.0
0.300	40.0	1.000	0.0	1.700	0.0	2.400	0.0
0.400	40.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	0.0	1.200	0.0	1.900	0.0		
0.600	0.0	1.300	0.0	2.000	0.0		

Tank or Pond Manhole: E, DS/PN: 1.001

Invert Level (m) 14.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	50.0	0.700	0.0	1.400	0.0	2.100	0.0
0.100	50.0	0.800	0.0	1.500	0.0	2.200	0.0
0.200	50.0	0.900	0.0	1.600	0.0	2.300	0.0
0.300	50.0	1.000	0.0	1.700	0.0	2.400	0.0
0.400	50.0	1.100	0.0	1.800	0.0	2.500	0.0
0.500	0.0	1.200	0.0	1.900	0.0		
0.600	0.0	1.300	0.0	2.000	0.0		

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 * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.441
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.900	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	D	15 minute 1 year Winter I+0%	1	15.680	14.739	-0.091	0.000	0.33
1.001	E	15 minute 1 year Winter I+0%	1	15.530	14.336	0.116	0.000	0.73

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	D	1.625	3.659	4.6	OK
1.001	E	2.114	10.946	9.9	SURCHARGED

30 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 * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.441
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.900	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	D	15 minute 30 year Winter I+0%	1	15.680	14.792	-0.038	0.000	0.89
1.001	E	15 minute 30 year Winter I+0%	1	15.530	14.581	0.361	0.000	0.73

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	D	3.786	8.990	12.4	OK
1.001	E	14.701	26.968	9.9	SURCHARGED

100 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 * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.441
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.900	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	D	15 minute 100 year Winter I+30%	1	15.680	14.976	0.146	0.000	1.00
1.001	E	30 minute 100 year Winter I+30%	1	15.530	15.449	1.229	0.000	0.84

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	D	11.380	15.202	13.9	SURCHARGED
1.001	E	23.729	31.919	11.4	FLOOD RISK

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Pre-development discharge volume (West Area)

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

« - Indicates pipe capacity < flow

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	15.000	0.200	75.0	0.048	5.00	0.0	0.600	o	100	
1.001	10.000	0.088	113.6	0.048	0.00	0.0	0.600	o	150	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	72.86	5.28	19.400	0.048	0.0	0.0	0.0	0.89	7.0«	9.5
1.001	71.78	5.46	16.300	0.096	0.0	0.0	0.0	0.94	16.6«	18.7

Summary Wizard of Discharge Volume Test I+0% for Storm

Simulation Criteria

Volumetric Runoff Coeff	0.950	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000

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

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

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	A	Discharge Volume Test I+0%	1	20.300	19.445	-0.055	0.000	0.42
1.001	B	Discharge Volume Test I+0%	1	20.000	16.364	-0.086	0.000	0.38

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	A	0.046	24.057	2.8	OK
1.001	B	0.067	48.123	5.6	OK

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Pre-development discharge volume (East Area)

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

« - Indicates pipe capacity < flow

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	30.000	0.200	150.0	0.060	5.00	0.0	0.600	o	150	
1.001	20.000	0.133	150.4	0.055	0.00	0.0	0.600	o	150	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.61	14.680	0.060	0.0	0.0	0.0	0.82	14.5	10.3
1.001	50.00	6.02	14.070	0.115	0.0	0.0	0.0	0.82	14.4«	19.7

Summary Wizard of Discharge Volume Test I+0% for Storm

Simulation Criteria

Volumetric Runoff Coeff	0.950	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000

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

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

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	D	Discharge Volume Test I+0%	1	15.680	14.731	-0.099	0.000	0.25
1.001	E	Discharge Volume Test I+0%	1	15.530	14.145	-0.075	0.000	0.50

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	D	0.052	30.075	3.5	OK
1.001	E	0.079	57.634	6.7	OK

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Post-development discharge volume (West Area)

STORM SEWER DESIGN by the Modified Rational Method

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	15.000	0.200	75.0	0.027	5.00	0.0	0.600	o	100	
1.001	10.000	0.088	113.6	0.030	0.00	0.0	0.600	o	150	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	56.60	5.28	19.400	0.027	0.0	0.0	0.0	0.89	7.0	4.1
1.001	55.74	5.46	16.300	0.057	0.0	0.0	0.0	0.94	16.6	8.6

Summary Wizard of Discharge Volume Test I+0% for Storm

Simulation Criteria

Volumetric Runoff Coeff	0.950	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000

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

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

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	A	Discharge Volume Test I+0%	1	20.300	19.433	-0.067	0.000	0.24
1.001	B	Discharge Volume Test I+0%	1	20.000	16.339	-0.111	0.000	0.15

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	A	0.032	13.530	1.6	OK
1.001	B	0.038	19.406	2.3	OK

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Post-development discharge volume (East Area)

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

« - Indicates pipe capacity < flow

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	30.000	0.200	150.0	0.052	5.00	0.0	0.600	o	150	
1.001	20.000	0.133	150.4	0.104	0.00	0.0	0.600	o	150	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	72.45	5.61	14.680	0.052	0.0	0.0	0.0	0.82	14.5	10.2
1.001	70.13	6.02	14.070	0.156	0.0	0.0	0.0	0.82	14.4«	29.6

Summary Wizard of Discharge Volume Test I+0% for Storm

Simulation Criteria

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

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

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

PN	US/MH Name	Event	Storm Rank	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	D	Discharge Volume Test I+0%	1	15.680	14.728	-0.102	0.000	0.23
1.001	E	Discharge Volume Test I+0%	1	15.530	14.243	0.023	0.000	0.69

PN	US/MH Name	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
1.000	D	1.174	27.117	3.1	OK
1.001	E	0.190	81.335	9.4	SURCHARGED

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Appendix G – Proposed Drainage Strategy

Eastern catchment
Area - 1,640sqm

Below ground attenuation storage
40m² x 0.4m deep = 16m³

MH E

1.001

MH TW

New manhole containing flow control device, limiting outflows to 10 l/s at 1.0m head

1.000

Western catchment
Area - 570sqm

Green Roof - 130sqm

Roof Plant

MH TW1

1.001

1.000

MH B

MH A

MH D

Below ground attenuation storage
50m² x 0.4m deep = 20m³

Key:

Green Roof

Drainage network

Attenuation Storage

7F

N

KEY

1 M

5 M

Project: Panther House
Title: Proposed drainage strategy
Prepared By: PBT - Robert West Ltd
Date: November 2015

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Appendix H – Maintenance Schedule

Maintenance Requirements for SuDS features at Panther House

Item	SuDS Feature	Maintenance Action	Maintenance Description	Frequency of Maintenance	Responsibility
1	Green Roof	Litter removal	Collect litter from accessible roof areas. Inspect roof outlets and remove dead plants.	Six Monthly [1]	Landowner
		Inspection	Inspect plant growth and remove any undesirable growth.	Annually	Landowner
2	Below-ground Attenuation	Inspections	Inspect silt traps and note rate of sediment accumulation within tank	Annually	Landowner
			Check attenuation tank to ensure emptying is occurring	Annually	Landowner
		Maintenance Operations	Clearing of gutters/slot drains	Annually	Landowner

[1] Frequency of maintenance may be dependent on the type of product selected during the detailed design stage. Refer to the Manufacturer's Technical Guide.

References

[1] Maps.environment-agency.gov.uk, (2015). *Environment Agency - What's in your backyard?*. [online] Available at: http://maps.environment-agency.gov.uk/wiyby/wiybyController?value=WC1X+0AN&lang=_e&ep=map&topic=floodmap&layerGroups=default&scale=9&textonly=off&submit.x=0&submit.y=0 [Accessed 10 Sep. 2015].

[2] Gov.uk, (2015). *Flood risk assessment: local planning authorities - Detailed guidance - GOV.UK*. [online] Available at: https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities [Accessed 10 Sep. 2015].

[3] Camden.gov.uk, (2015). *Camden Council: Our role as a lead local flood authority*. [online] Available at: https://www.camden.gov.uk/ccm/content/environment/green/climate-change/camdens-role-as-a-lead-local-flood-authority/ [Accessed 11 Sep. 2015].

[4] Newton, J. (2007). *Building greener*. London: CIRIA.