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FLOOD RISK ASSESSMENT AND SURFACE WATER DRAINAGE STRATEGY

St Michael's Convent, Ham Common, Richmond

Prepared for: Beechcroft Developments
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Appendices

1.0 Introduction

1.1 This Flood Risk Assessment and Surface Water Drainage Strategy has been prepared by Glanville Consultants on behalf of Beechcroft Developments Ltd in support of two planning applications for the re-development for residential purposes of St Michael's Convent, Ham Common, Richmond.

1.2 The combined applications seek permission for a total of 28no. new retirement dwellings achieved through a combination of conversion and new build. 26no. of these dwellings would achieve access via Ham Common, while two would achieve access from Martingales Close. This report has been prepared to accompany both applications and treats both proposed developments as a single site as there is no physical distinction between the two.

1.3 The purpose of this document is to assess the existing level of flood risk to the site(s) and their surroundings within the context of the development proposals and to outline the principles of the surface water drainage strategies.

1.4 This appraisal has been prepared in accordance with the National Planning Policy Framework (NPPF), dated March 2012, and the Planning Practice Guidance (PPG) to the NPPF, dated March 2014.

1.5 This assessment has been undertaken with reference to information provided and/or published by the following bodies:

- Ordnance Survey;
- British Geological Survey;
- London Borough of Richmond upon Thames Council; and
- Environment Agency.

2.0 Site Description and Proposed Development

Site Description

2.1 The development site is located at St Michael's Convent, Richmond, Ham Common, Greater London. A site location plan is provided in Appendix A. The approximate centre of the site is located at Ordnance Survey National Grid reference TQ 17704 72228. The site area is approximately 1.69ha.

2.2 The site is located within the suburban district of Ham in south-west London, approximately 1 mile south of Richmond and 2 miles north of Kingston upon Thames. The site is bounded by residential properties to the north, Martingales Close with residential properties beyond to the east, Ham Common to the south and Ham Avenue to the west.

2.3 There three existing access points into the site, two off Ham Common and one off Martingales Close.

2.4 The site consists of two existing listed buildings, a walled garden and an orchard. A car park is located south of the site with entrance from Ham Common.

2.5 The existing site is largely permeable, with the existing buildings and a parking area at the southern end of the site to the front of the main house as the only existing impermeable areas. The existing impermeable area of the site is approximately 0.21ha, which is 12% of the site area.

Topographical Survey

2.6 A topographical survey of the site was undertaken by Callidus Surveys in September 2013 and is included in Appendix B for reference. The site is generally flat, with a slight fall from the southwest corner of the site to the northeast corner of the site.

Existing Watercourses

2.7 The closest significant watercourse is The River Thames located approximately 1km east of the site. 1.11km northwest of the site there is a 10 acre lake connected to the River Thames via a lock. Furthermore there is a small unnamed lake located approximately 200m southwest of the site.

Geological Characteristics

2.8 Geological maps published by the British Geological Survey (BGS) indicate that the site is underlain by bedrock geology of London Clay Formation consisting of clay and silt. A superficial geology of Kempton Park Gravel Formation consisting of sand and gravel is indicated to exist within the site. BGS online mapping is included in Appendix C for reference.

2.9 A preliminary intrusive site investigation was undertaken in November 2015 by Southern Testing. The results of this investigation broadly confirm the geological mapping information. The soils as found consisted:

- From ground level to 0.2-0.5m below ground level (bgl): Made ground topsoils.
- Below to 0.8-1.2mbgl: Silty clay.
- Below to 3.0-4.0mbgl: Sand/gravel (the Kempton Park Gravel Formation).
- Below: Clay (London Clay Formation).

Hydrogeology and Groundwater Vulnerability

2.10 The intrusive site investigation undertaken in November 2015 encountered groundwater on site at levels between 2.42mbgl and 3.05mbgl. This is within the Kempton Park Gravel Formation. At the time of year the investigation was undertaken groundwater is expected to be somewhere between its seasonally high and seasonally low extents.

2.11 Groundwater is expected to flow east towards the River Thames.

2.12 The Kempton Park Gravel Formation is designated as a Secondary A Aquifer and classed as a Minor Aquifer of High Vulnerability. The London Clay Formation does not have an aquifer designation.

2.13 The EA publishes on its website indicative Source Protection Zones (SPZs) for groundwater sources such as wells, boreholes and springs used for public drinking water supply. The zones define areas where a range of human activities may damage / pollute groundwater. The site is not within a Source Protection Zone.

Existing Surface and Foul Water Drainage

2.14 The incumbent drainage undertaker is Thames Water. From a review of Thames Water Asset Location plans (provided at Appendix D) there is a surface water sewer following the path of Martingales Close and Ham Common.

2.15 No public foul water sewers are located within the site boundary. From a review of Thames Water Asset Location plans (provided at Appendix D) there is a foul water sewer following the path of Martingales Close and Ham Common.

2.16 Information from the current site occupier indicates that drainage from the Old House, the original building, is combined foul and surface water drainage discharging to the public foul sewer in Ham Common near the junction with Martingales Close. Drainage from the newer site buildings is in separate foul and surface water sewers discharging to the public foul and surface water sewers in a similar location near the main gates.

<u>Proposed Development</u>

2.17 The site is split in to two distinct portions and as such, two separate planning applications have been submitted. However there is no variation in flood risk between the two sites, so this report will consider the proposed development in total. An illustrative site layout is provided in Appendix E.

Planning Application 1: Southern Portion - Accessed from Ham Common

2.18 It is proposed that the southern portion of the site would accommodate 26 retirement dwellings (two one bed dwellings, 23 two-bed dwellings, and one four bed dwelling).

Planning Application 2: Northern Portion - Accessed from Martingales Close

2.19 It is proposed that the northern portion of the site would accommodate two retirement dwellings, both of which would be four-bed dwellings.

2.20 Following the development, the impermeable area will increase to approximately 0.55ha, 33% of the site area.

3.0 Planning Policy and Guidance

3.1 Set out below is a summary of national and local planning policy and guidance relating to flood risk and surface water management that are relevant to the development proposals.

National

3.2 At a national level, the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG) to the NPPF ensure flood risk is taken into account at all stages of the planning process, to avoid inappropriate development in areas at risk of flooding and to direct development towards areas at lowest flood risk. The NPPF retains a risk based approach to the planning process and defines four Flood Zones to be used as the basis for applying the sequential test to consider a development in terms of Flood Risk Vulnerability Classifications, which define the type of development that is considered appropriate within each zone.

3.3 The NPPF establishes the Flood Zones as the starting point for assessment with the overarching aim to steer new development to areas with the lowest probability of flooding. The Flood Zones are defined as follows:

- Flood Zone 1 (Low Probability) comprises land assess as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

- Flood Zone 2 (Medium Probability) comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.

- Flood Zone 3a (High Probability) comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

- Flood Zone 3b (The Functional Floodplain) compromises land where water has to flow or be stored in times of flood.

Local Policy and Guidance

London Borough of Richmond upon Thames (LBRuT) Local Plan

3.4 The adopted London Borough of Richmond Local Plan is part of the development plan. For the purposes of this report reference has been made to the Strategic Flood Risk Assessment (SFRA) for the LBRuT (2012).

LBRuT Strategic Flood Risk Assessment, Level 1, March 2016

3.5 This SFRA was produced by LBRuT Council as part of the evidence base for the emerging local plan. The SFRA includes flood maps covering the entire borough as well as maps showing the topography and geology of the area. The SFRA summarises the main causes of flooding in the district and key historic incidents.

3.6 The SFRA indicates that surface water flooding within the district is an important issue. These flooding events where typically as a result of blocked gullies, sewers flooding, made worse by the steep slope topography of the area.

3.7 The SFRA provides a reference and policy document to advise and inform developers of their obligations under the NPPF. The maps and accompanying report and guidance provide a sound framework enabling consistent and sustainable choices to be made when making future planning decisions.

4.0 Sources of Potential Flooding

4.1 Flood risk to the site is considered from all likely sources of flooding, as defined in the NPPF and the Planning Practice Guidance to the NPPF. These include tidal, fluvial, surface water, groundwater, sewer and from artificial sources (reservoir). The following paragraphs consider flood risk to the site from all of these sources.

Tidal

4.2 The River Thames is influenced by the tide up to Teddington Lock which is 1.2 km, from site. A map showing tidal breach flooding risk provided in the SFRA shows the site to be at low risk. Therefore, tidal flooding is not an issue that would prevent the development of the site for its intended end use.

Fluvial

4.3 The EA publishes flood zone mapping on its website which shows the extent of modelled fluvial flood events. The flood zone mapping indicates that the site is located entirely within Flood Zone 1, which is land at the lowest risk of fluvial flooding. As such, the development is not considered to be at risk of fluvial flooding.

Surface Water

4.4 The EA publishes mapping on its website which indicates the predicted risk of surface water flooding in the event that rainwater does not drain away through normal drainage systems or soak into the ground. The mapping indicates that the majority of the site is at very low risk of surface water flooding, with some areas along the northern boundary of the site at low risk. An extract from the EA's surface water flood map is included within Appendix F.

4.5 There are no significantly higher areas in the local area which might generate exceedance flows that could enter the site.

4.6 Therefore the risk of surface water flooding to the site is considered to be low.

Groundwater

4.7 The Level 1 LBRuT SFRA Susceptibility to Groundwater Flooding Map for the borough indicates there is a potential for groundwater flooding to occur at the surface. An extract of the Susceptibility to Groundwater Flooding Map is included in Appendix G. The potential risk of flooding is due to groundwater being present at relatively shallow depths in the superficial Kempton Park Gravel layer.

4.8 Historical flooding data shows that although there have been several groundwater flood events recorded in the Borough, there have been no reported events at or in close proximity to the site. Furthermore, topographical mapping shows that the site is 6m-8m above river level and comparison of the SFRA's topographical and historic flood incident mapping shows that the recorded groundwater flood events have occurred in areas with lower elevations. This suggests that although there are elevated groundwater levels in the superficial aquifer in prolonged periods of wet weather, groundwater does not rise above the site ground level. Extracts from the SFRA's historical flooding map and topography survey are shown in Appendix H.

4.9 Therefore it is reasonable to conclude that the risk of groundwater flooding is low and is not an issue that would prevent the development of the site for its intended end use.

4.10 A basement level is currently not proposed at the site.

Sewer

4.11 Thames Water Sewer Records indicate there are surface water sewers running within Martingales Close and Ham Common along the sites northern, eastern and southern boundaries.

4.12 The Level 1 LBRuT SFRA historical flooding records for the district provide no reported information of sewer flooding incidents within the site or surrounding area.

4.13 Therefore it is reasonable to conclude that the risk of sewer flooding is low and is not an issue that would prevent the development of the site for its intended use.

Reservoir

4.14 The EA publishes indicative mapping on its website which shows the maximum extent of reservoir flooding in the unlikely event that a reservoir should fail. The mapping indicates that the site is not located within a reservoir flood risk area. Therefore, reservoir flooding is not considered to be an issue which would prevent the development of the site for its intended end use.

Summary

4.15 The site is considered to be at low risk from all sources of flooding examined.

5.0 Flood Risk Assessment

5.1 The NPPF encourages a sequential, risk based approach to determine the suitability of land for development. This document advises that the development of sites within Flood Zone 1 should be given preference where available. Table 3 of the Planning Practice Guidance to the NPPF advises that all land uses are appropriate in Flood Zone 1.

5.2 As the site is within Flood Zone 1, it is considered suitable for all forms of development. Development at the site satisfies the sequential approach of the NPPF by locating development in the lowest flood risk zone.

Consideration for Flood Risk Mitigation Measures

5.3 Given that the site is located within Flood Zone 1, the lowest risk flood zone, flood compensation or resilience measures will not be required to mitigate against the risk of fluvial flooding.

5.4 Although the risk of groundwater flooding at the site surface has been assessed as low as described in Section 4, the geology of the site could permit groundwater flooding in the unlikely event of weather conditions occurring that are significantly more extreme than the design conditions. It is recommended that the garden and orchard areas are kept under observation in wet conditions. Should there be any concern with waterlogging as the groundwater level approaches the site surface level, the potential for a land drainage scheme should be investigated.

5.5 Although the risk of surface water flooding is very low, there is always the potential for localised pooling of surface water run-off in an intense rainfall event. The proposed drainage strategy will provide protection to both existing and proposed properties. It will be designed to ensure that no flooding takes place up to and including the design rainfall event (1 in 100 year return period), with additional capacity within the system to allow for the potential effects of climate change. The proposed surface water drainage strategy is described in Section 6.

5.6 A review of sources of potential flooding in Section 4 of this assessment has also concluded that there is a low risk from all other sources examined.

5.7 Given that the development is located wholly within an area outside of the floodplain and is not located within an EA defined dry island, the site is considered to be fully accessible in times of flooding and no special measures to ensure safe dry access are required.

6.0 Surface Water Drainage

6.1 The PPG recommends that priority should be given to the use of sustainable drainage systems (SuDS) as they are designed to control surface water run-off where it falls and mimic natural drainage as closely as possible. Sustainable drainage systems also provide opportunities for the following:

- Reduce the causes and impacts of flooding;
- Remove pollutants from urban run-off at source; and
- Combine water management with green space with benefits for amenity, recreation and wildlife.

6.2 SuDS encompass a wide range of drainage techniques intended to minimise the rate of discharge, volume and environmental impact of run-off and include:

- Permeable pavements;
- Swales and basins;
- Green roofs and rainwater reuse;
- Infiltration trenches and filter drains; and
- Ponds and wetlands.

6.3 Infiltration based techniques are high up in the hierarchy of techniques available due to the ability for close to source dispersion of surface water. These techniques are considered the closest solution to mimic the natural drainage of undeveloped sites.

6.4 As well as allowing infiltration and attenuation, permeable paving (and other techniques in which surface water run-off percolates through a gravel matrix) also degrades pollutants such as hydrocarbons, which thereby improves the quality of surface water to ground.

6.5 Surface level SuDS features, including swales and basins, are often attractive options because they add amenity and landscape value as well as being a more natural method of managing water than below ground techniques. However at the development site the green areas including the lawn, walled garden and orchard are areas with cultural and historic amenity value and the design for the site emphasises the retention of these features in their existing state. Therefore it will not be suitable to re-landscape these areas to incorporate surface level SuDS features.

6.6 Geocellular storage crates are one of the most efficient ways of providing large volumes of attenuation storage without taking up unacceptable areas of the site above ground. They do not provide any water quality benefits and therefore are not one of the most preferred options in the SuDS hierarchy, but in combination with other SuDS features they can form a vital part of a SuDS management train.

6.7 The Building Regulations part H3 stipulates that rainwater from roofs and paved areas is carried away from surface to discharge to one of the following, listed in order of priority:

a) an adequate soakaway or some other adequate infiltration system; or, where that is not practical;
b) a watercourse; or, where that is not practical
c) a sewer.

Proposed Surface Water Drainage Strategy

6.8 Site Investigation indicates that the site is underlain by bedrock geology of London Clay Formation consisting of clay and silt, and superficial geology of Kempton Park Gravel Formation consisting of sand and gravel, with surface layers of clay and made ground/topsoil. Some infiltration is likely to be feasible within the Kempton Park Gravel Formation, but considering the relatively small depth of this formation, the sometimes silty and clayey composition, and the presence of groundwater within the formation, it is not thought that a sufficient infiltration rate and volume will be achieved to permit a fully infiltration based strategy.

6.9 The surface water drainage will be designed to permit as much infiltration from the site as can be practically achieved. However there will also be a need for an alternative outfall point to discharge surface water run-off from storm events which exceed the infiltration capacity of the site soils.

6.10 Soakage testing to BRE 365 will be required at the detailed design stage to assess the achievable site infiltration rate. For the purpose of the outline design, in order to ensure that a worst case scenario can be accommodated within the site drainage strategy, it will be assumed within this report that no significant infiltration rate can be achieved.

6.11 As stipulated by the Building Regulations part H3, discharge of surface water into a watercourse is the most appropriate solution in the absence of adequate infiltration. However there are no suitable watercourses at the site which could be utilised as the outfall point for surface water discharge.

6.12 Therefore the proposed discharge point will be to the surface water sewer in Ham Common. This is the same as the existing discharge point for surface water run-off from the newer buildings on the site. Betterment will be provided compared to the existing situation by using infiltration and attenuation to restrict the run-off rate to the public sewer. Additionally, betterment will be provided to the adjacent foul water sewer by separating the existing combined drainage from the Old House existing building and redirecting surface water run-off from the foul sewer to the dedicated surface water sewer.

6.13 To offset the increase in impermeable area across the site, attenuation will be provided and discharge will be restricted via a Hydrobrake flow control. Richmond Council follows the Environment Agency guidance in recommending a discharge limit of 2l/s/ha; however the Environment Agency also recognises the practical limitations of very small controls, which are prone to blocking and can cause increased flood risk and an unreasonable maintenance burden. The practical lower limit for a flow control is considered to be 5l/s, and this is the discharge value proposed at the site.

6.14 In February 2016 updated guidance on climate change allowances for flood risk assessment and drainage design was published as part of the PPG. The new guidance states that predicted rainfall intensities should be assessed including both a “central” climate change value and an “upper end” climate change value in order to understand the sensitivity of the site and decide on the appropriate design of the surface water drainage network. The “central” value represents the average climate change prediction for the development and there is a 50% chance that this value will be exceeded. The “upper end” value is a conservative estimate with a 90% chance of not being exceeded.

6.15 For a site with a design life of greater than approximately 50 years (with a proposed end of use date in or beyond the year 2070), the “central” climate change allowance is 20% and the “upper end” allowance is 40%.

6.16 MicroDrainage WinDes software has been used to evaluate the storage requirements for the site, assuming no significant infiltration rate and a 5l/s discharge. These calculations are given in Appendix J. It can be seen that if a climate change allowance of 20% is included then the storage requirements will be up to 334m^3, while if a climate change allowance of 40% is used then there is a requirement for up to 403m^3 of volume storage. As these values are significantly different it is apparent that the site has a reasonably strong sensitivity to the effects of climate change and therefore the most precautionary value should be adopted.

6.17 The proposed strategy will utilise sustainable drainage techniques in accordance with the guidance described in Ciria C753. All SuDS features will be designed to accommodate surface water flows for all rainfall events up to and including the 1-in-100 year event with a 40% allowance for the potential effects of climate change, without flooding from surface water.

6.18 In the proposed drainage strategy the access, parking areas and hardstanding open space and walkways would be constructed as porous paving with a 500mm deep sub-base. Surface water from roof areas would discharge into the sub-base via distribution tanks and / or perforated pipes as appropriate and surface water from the roads / driveways would discharge under their own footprint.

6.19 Where paving areas are located within root protection zones for important trees, these areas have not been included in the assessment of porous paving, as it is assumed that deep sub-base construction will not be permissible in these areas.

6.20 Furthermore in order to preserve the heritage and conservation properties of the site, in some locations exiting paving is to be preserved. Again these areas have not been included in the assessment of porous paving.

6.21 Once these areas of the site have been eliminated, there is not sufficient paving area available on site to provide the entire required storage volume within the porous paving sub-base. Therefore geocellular storage crates have been included in two locations of the site (in the parking bays to the Martingales Close houses and beneath the landscaped areas near to the site main entrance) in order to supplement the storage provided to the required level. Surface run-off entering these crates will have previously filtered through porous surfacing or sub-base material and therefore will have benefited from the water quality benefits of this SuDS feature.

6.22 The surface water design must permit infiltration as far as may be achievable at the site. It is noted that the site investigation identified an impermeable silty clay layer in the sub-surface, below the made ground/topsoil layer and above the permeable gravel layer. Porous paving, which is the shallowest infiltration-based SuDS feature, would not penetrate this impermeable layer and therefore would not be able to reach the permeable formation to infiltrate.

6.23 Therefore it is proposed to include a number of gravel-filled trenches below the porous paving which will be deep enough to reach the permeable geological layer. These will be constructed as infiltration trenches, but as it is not thought that full infiltration will be achievable, a horizontal conveyance pipe will be included within the trench detail. This will ensure that attenuation storage areas across the site fill equally and act as a single efficient system, and will also provide conveyance to the discharge point for run-off volumes that exceed the infiltration capacity of the site soils. The drainage strategy included in Appendix K shows a typical detail for the proposed trench and how this will work within the ground conditions of the site.

6.24 The proposed geocellular storage crates are a deeper storage feature than the porous paving and will penetrate the permeable gravel layer. Therefore they will be designed to permit infiltration to the ground.

6.25 The drainage strategy drawing shows how the required attenuation storage will be distributed across the site.

6.26 All surface water flows would then be conveyed through the sub-base, using gravel trenches and perforated connector pipes where appropriate, to a piped outfall to the public sewer at the south east corner of the site. The drainage strategy is illustrated on the drawing included in Appendix K.

6.27 Exceedance flows will be directed into the green areas of the site until there is sufficient capacity in the drainage system to collect and discharge these flows. Therefore there will be no increase in flood risk to surrounding areas caused by the increase in exceedance flows from the site.

6.28 Intrusive site investigation to establish the achievable surface water infiltration rate will be required prior to the detailed design stage.

6.29 Permeable paving is identified in the SuDS manual as improving water quality and providing treatment as runoff percolates through the layers of the system. The proposed surface water strategy would therefore provide additional treatment prior to discharge to the sewer and via infiltration into the groundwater. This is considered to provide sufficient water quality treatment to protect the High Vulnerability aquifer given the low contamination nature of run-off from the site.

6.30 All new surface water infrastructures will be designed in accordance with Building Regulations, CIRIA guidance and current best practice where applicable.

6.31 Richmond Borough Council's "Planning Guidance Document – Delivering SuDS in Richmond" includes a checklist of SuDS design information which they request be submitted with a planning application. This checklist has been attached as Appendix L to this report.

Pollution Control

6.32 CIRIA 156 Infiltration Drainage – Manual of Good Practice suggests that surface water runoff from roofs and public / amenity areas are permissible without pollution control measures. Surface water runoff from impermeable lightly trafficked areas such as the parking/driveway areas should be treated with a petrol interceptor or drained through permeable paving before discharge. On this basis all surface waters will be directed to the porous pavements prior to discharge.

SuDS Maintenance and Adoption

6.33 SuDS features within the site including porous paving and associated pipe networks will be maintained by a private management company. It is not anticipated that Thames Water or Richmond Borough Council will adopt any SuDS features proposed.

7.0 Summary and Conclusions

Summary

7.1 This Flood Risk Assessment and Surface Water Drainage Strategy has been prepared by Glanville Consultants on behalf of Beechcroft Developments Ltd in support of two planning applications for the re-development for residential purposes of St Michael's Convent, Ham Common, Richmond. This report has been prepared to accompany both applications and treats both proposed developments as a single site as there is no physical distinction between the two.

7.2 This assessment has been prepared in accordance with the requirements of the NPPF and PPG, and with reference to the London Borough of Richmond upon Thames SFRA.

7.3 The site is located in Flood Zone 1, at the lowest possible risk of flooding from fluvial sources. The report concludes that the site is considered to be at low risk from all sources of flooding including allowance for the potential effects of climate change.

7.4 BGS mapping indicates that the site is underlain by a bedrock geology consisting of London Clay Formation consisting of clay and silt. A superficial geology of Kempton Park Gravel Formation consisting of sand and gravel is present and this is anticipated to have the capability of providing a limited volume of infiltration from the site.

7.5 The drainage strategy for the site involves a restricted discharge to the public surface water sewer. The design will enable infiltration into the Kempton Park Gravel Formation, but has been designed based on a negligible infiltration rate in order to achieve a conservative design. Attenuation storage will be provided to accommodate surface water flows from the development for the 1-in-100 + 40% climate change storm event without flooding.

7.6 The proposed development will not create an increased risk of flooding from surface water either on the site or to the surrounding area, and will provide betterment to both foul and surface water public sewers by redirecting surface water flows away from the foul sewer and restricting the discharge to the surface water sewer.

Conclusion

7.7 In conclusion, this report has demonstrated that the proposed residential development:

- is in accordance with the National Planning Policy Framework;
- will not be at an unacceptable risk from fluvial flooding;
- will not increase flood risk elsewhere; and
- will employ a surface water drainage strategy based on the principles of sustainable drainage.

The proposals are therefore considered to fully comply with National, Regional and Local planning policy.

Appendices

Appendix A

Site Location Plan

NOTES

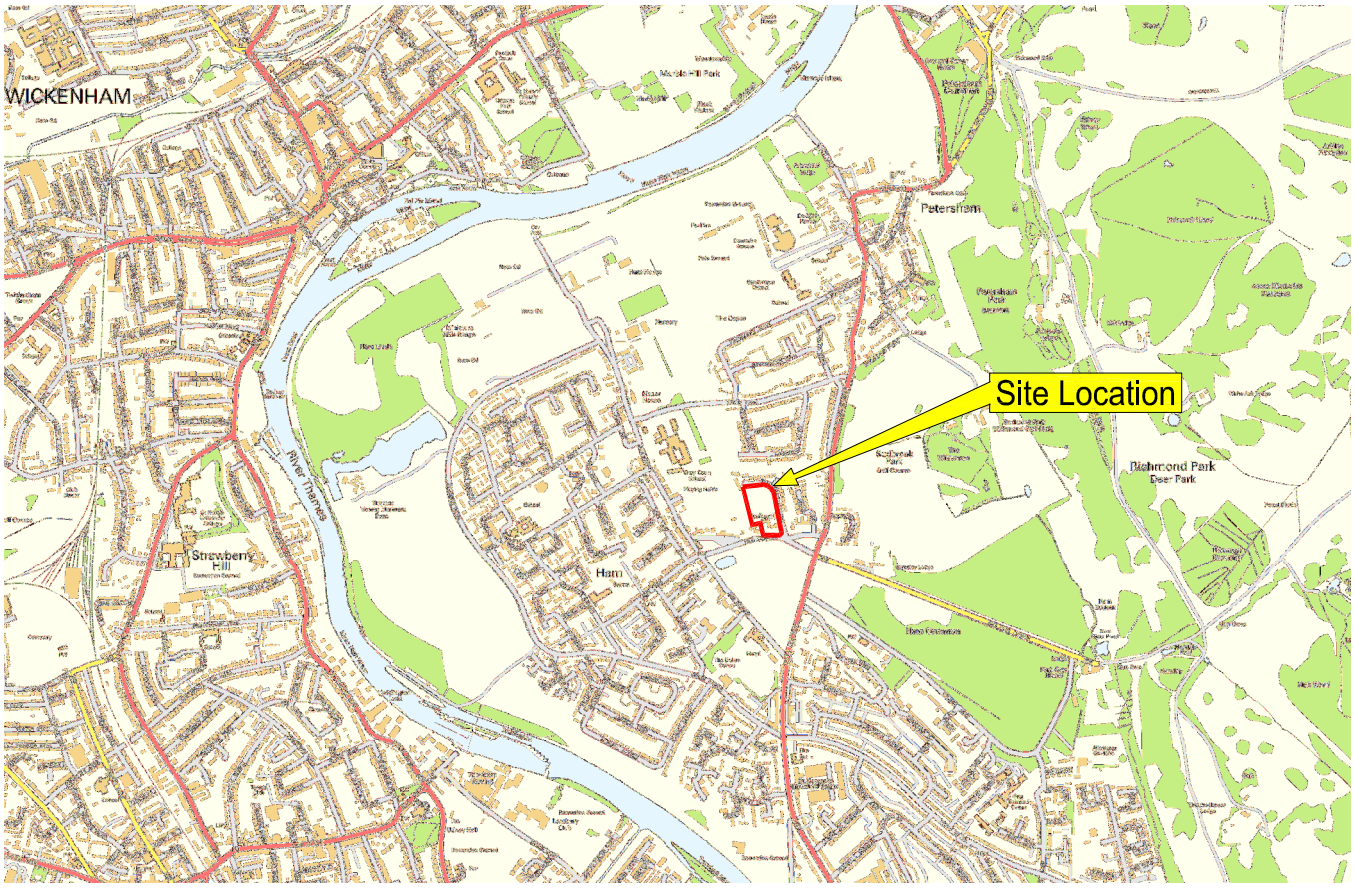
1. This drawing is to be read in conjunction with all relevant documents and specifications.
2. Dimensions not to be scaled.

LOCATION

Address: St Michael's Convent
56 Ham Common
Richmond
Surrey
TW10 7JH

Grid reference: TQ 1771872251

N



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Project :	St Michael's Convent, Ham Common, Richmond				
Title :	Site Location Plan				
Project Engineer :	C. Levy	Scale :	N.T.S	Drawing No.	Appendix B
Project Director :	J. Hanlon	Date :	July 2016		Rev -

Appendix B

Topographical Survey

SURVEY CONTROL

THE SURVEY GRID AND LEVELS ARE BASED ON ORDNANCE SURVEY NATIONAL GRID COORDINATES (GPS)

TOPOGRAPHICAL LEGEND

	survey station		banking
	gate		benchmark
ACU	air conditioning unit	LP	lamp post
AV	air vent	MP	marker post
B	bollard	MH	manhole
BB	belisha beacon	MRP	mooring post
BL	basement light	NB	notice board
BS	brick setts	NP	nameplate
BT	british telecom	NVG	navigation beacon
BW	brick wall	P	post
BWF	barbed wire fence	PM	parking meter
CATV	cable TV cover	PB	post box
CBF	close-board fence	PL	pavement light
CCTV	close circuit tv	PRF	post and rail fence
CL	cover level	PSW	pole stay wire
CLF	chain link fence	OHP	overhead powerline
Conc.	concrete	OHT	overhead telephone line
CPF	chestnut paling fence	RE	rodding eye
CPL	canopy line	RFP	reflector post
CPS	concrete paving slabs	RG	road gully
DLF	dilapidated fence	RS	road sign
DK	drop kerb	RTW	retaining wall
DP	down pipe	RWP	rain water pipe
EL	eaves level	SC	stopcock
ELCP	electricity control panel	SCB	scrub
ER	earth rod	SL	sump level
ESS	elec. sub-station	SNP	street name plate
EP	electricity pole	SPU	species unknown
EPY	electricity pylon	SV	stop valve
FB	flower bed	SVP	soil vent pipe
FIG	feeds into ground	SWCP	surface water catch pit
FLT	floodlight	SWIC	surface water IC
FH	fire hydrant	SWS	storm water sewer
FL	floor level	TCB	traffic control box
FP	footpath	TCMH	telecommunication mh
FGP	flagpole	TCP	telephone call box
FWS	foul water sewer	TCSU	traffic control signal unit
G	gully	THL	threshold level
GM	gas marker	TL	traffic light
GP	gas pipe	TLC	traffic light control box
GV	gas valve	TacP	tactile paving
HCL	hedge centreline	TP	telegraph pole
HR	hand rail	UTL	unable to lift
IC	inspection cover	VCS	vehicle control sensor
IL	invert level	VP	vent pipe
IRF	iron railing fence	WL	water level
JB	junction box	WM	water meter
KO	kerb outlet	WMF	wire mesh fence
LB	litter bin	WO	water outlet
LF	lattice fence	WT	water tap

NOTES

SERVICES
WHILST ALL REASONABLE CARE HAS BEEN TAKEN IN LOCATING THE UNDERGROUND SERVICES SHOWN ON THIS PLAN, THE COMPLETENESS OR ACCURACY OF THE INFORMATION CANNOT BE GUARANTEED.

USERS ARE ADVISED TO SATISFY THEMSELVES CONCERNING THE TYPE, SIZE AND ROUTE OF SERVICES BEFORE PROCEEDING WITH GROUND WORK.

TREES
TREE SPREADS ARE AVERAGES UNLESS OTHERWISE INDICATED AND CANOPY SPREADS SHOWN TO SCALE. IF TREE TYPES ARE CRITICAL VERIFICATION BY A SPECIALIST MUST BE UNDERTAKEN.

MULTI-BOLE TREES ARE INDICATED WITH (MB).

0.2 / 6 / 10
Dia of Bole / Dia. of spread / Ht. of Tree

COORDINATE TABLE

STATION	DESC'N	EASTING	NORTHING	LEVEL
S1	PK NAIL	517772.198	172136.385	7.141
S2	HILTI	517767.387	172166.304	6.932
S3	HILTI	517772.230	172173.586	7.075
S4	PK NAIL	517778.760	172176.975	7.201
S5	PK NAIL	517776.208	172186.916	7.284
S6	PK NAIL	517770.591	172206.587	7.243
S7	PK NAIL	517761.030	172231.263	6.910
S9	HILTI	517746.654	172186.639	7.592
S10	HILTI	517763.551	172192.383	7.297
S12	PK NAIL	517720.201	172181.248	7.089
S14	PK NAIL	517718.385	172141.854	7.071
S15	PK NAIL	517788.588	172148.917	7.247
S16	PK NAIL	517782.427	172195.990	7.351
S17	PK NAIL	517747.626	172318.439	6.853
S18	PK NAIL	517653.955	172319.910	6.761
S22	PK NAIL	517707.092	172191.982	7.215
S23	PK NAIL	517700.151	172222.417	7.192
S24	PK NAIL	517677.446	172218.033	7.123
S29	PK NAIL	517676.129	172302.601	6.521
S30	PK NAIL	517695.899	172303.436	6.484
S32	PK NAIL	517701.617	172248.410	6.742
S33	PK NAIL	517726.013	172309.635	6.435
S34	PK NAIL	517747.111	172284.771	6.465
S35	PK NAIL	517750.847	172252.628	8.183

REVISIONS

A. FAR KERB LINE ADDED
04/10/13 JG

callidus
Callidus Surveys
Dalton House
60 Windsor Avenue
London SW19 2RR

Project:

ST MICHAEL'S CONVENT
HAM COMMON
RICHMOND
SURREY, TW10 7JH
SITE PLAN

Client:

GERALD EVE LLP
72 WELBECK STREET
LONDON
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Job No:	13057	Drawing I.D:	PSF
Drawn:	JH	Scale:	1/200
Checked:	JG	Date:	19/09/13

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Appendix C

British Geological Survey Mapping Extracts

KEY

Approximate site boundary

N

NOTES

1. This drawing is to be read in conjunction with all other documents and specifications
2. Dimensions not to be scaled from drawing

Bedrock Geology

London Clay Formation - Clay and Silt

Superficial Deposits

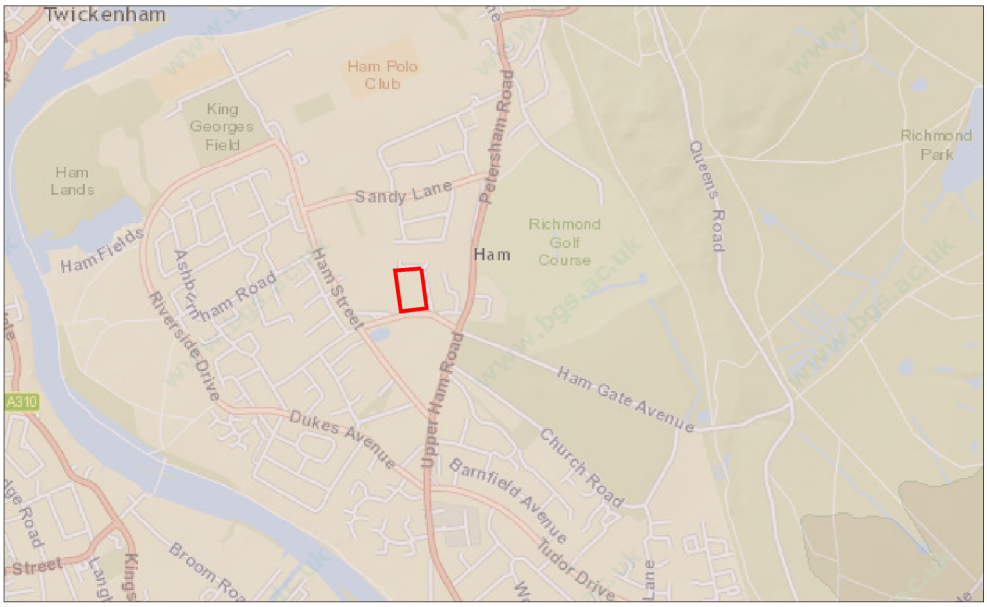
Kempton Park Gravel Formation - Sand and Gravel

Black Park Gravel Member - Sand and Gravel

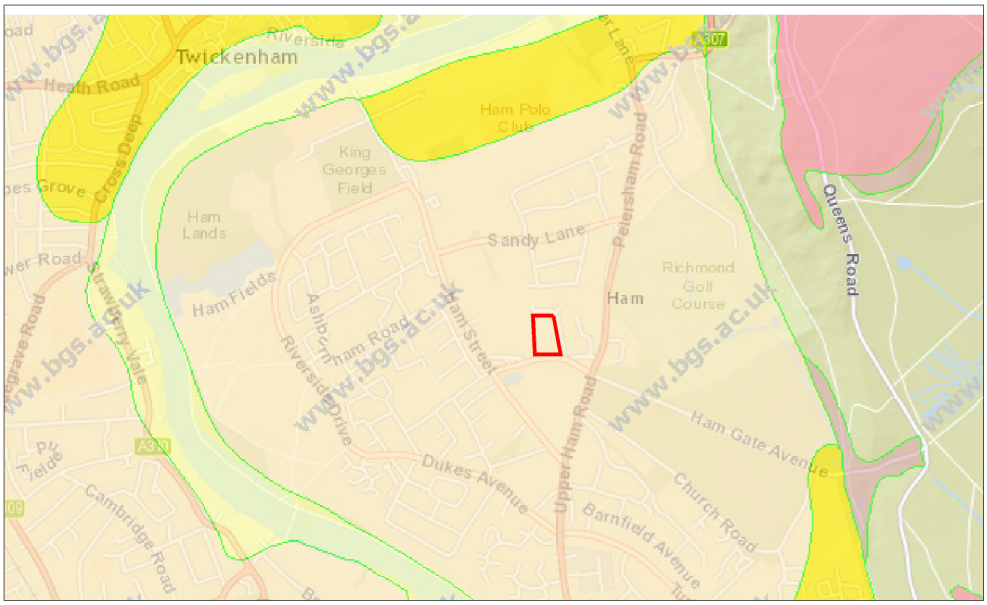
Langley Silt Member - Clay and Silt

Alluvium - Clay, Silty, Peaty, Sandy

Bedrock Geology



Superficial Deposits



Glanville

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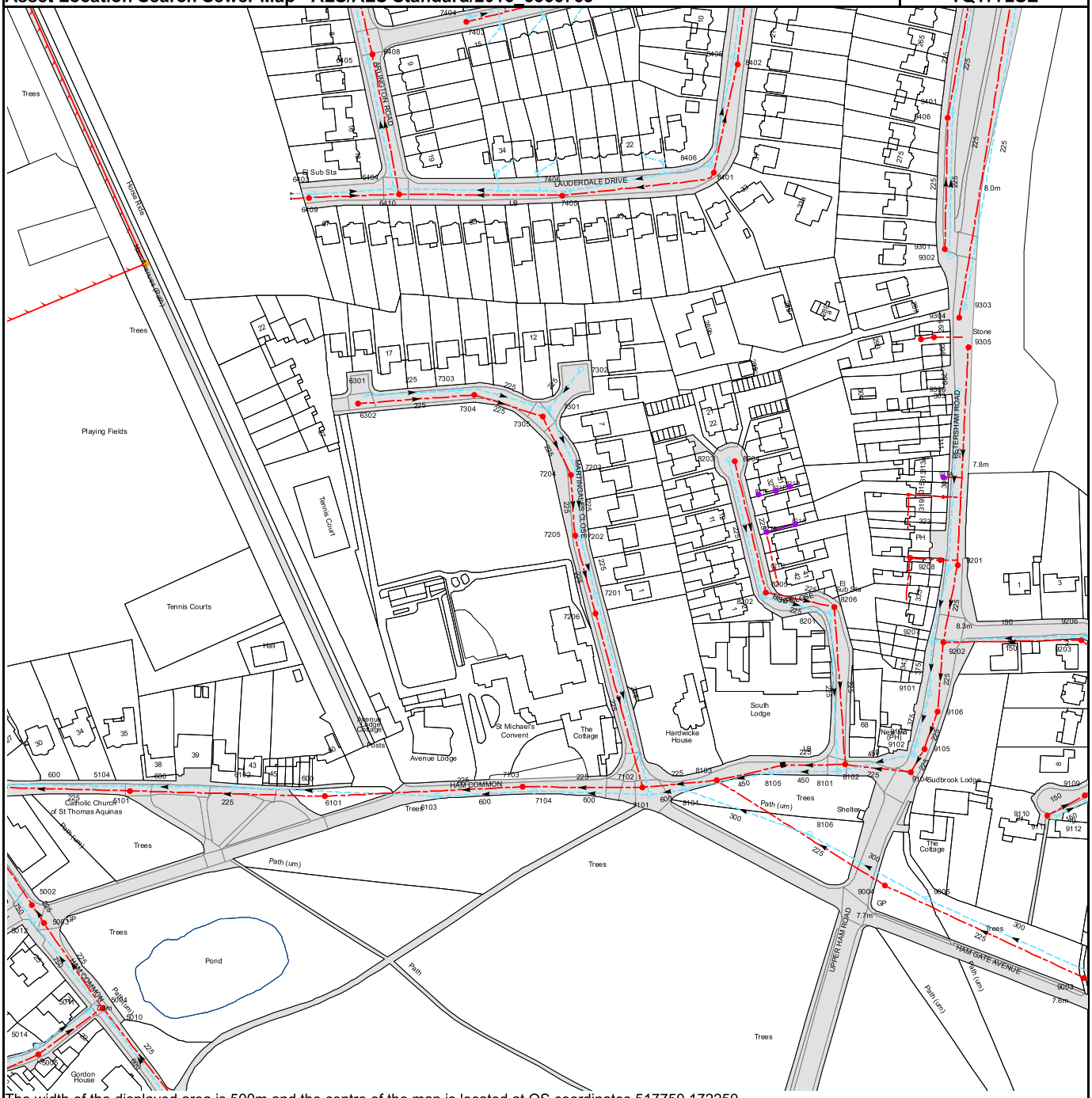
Project :	St Michaels Convent, Ham Common, Richmond				
Title :	British Geological Survey Mapping Extract				
Project Engineer :	C. Levy	Scale :	NTS	Drawing No. Appendix C	Rev P1
Project Director :	J. Hanlon	Date :	July 2016		

Appendix D

Thames Water Records

Asset Location Search Sewer Map - ALS/ALS Standard/2016_3366763 | TQ1772SE



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 517750,172250

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

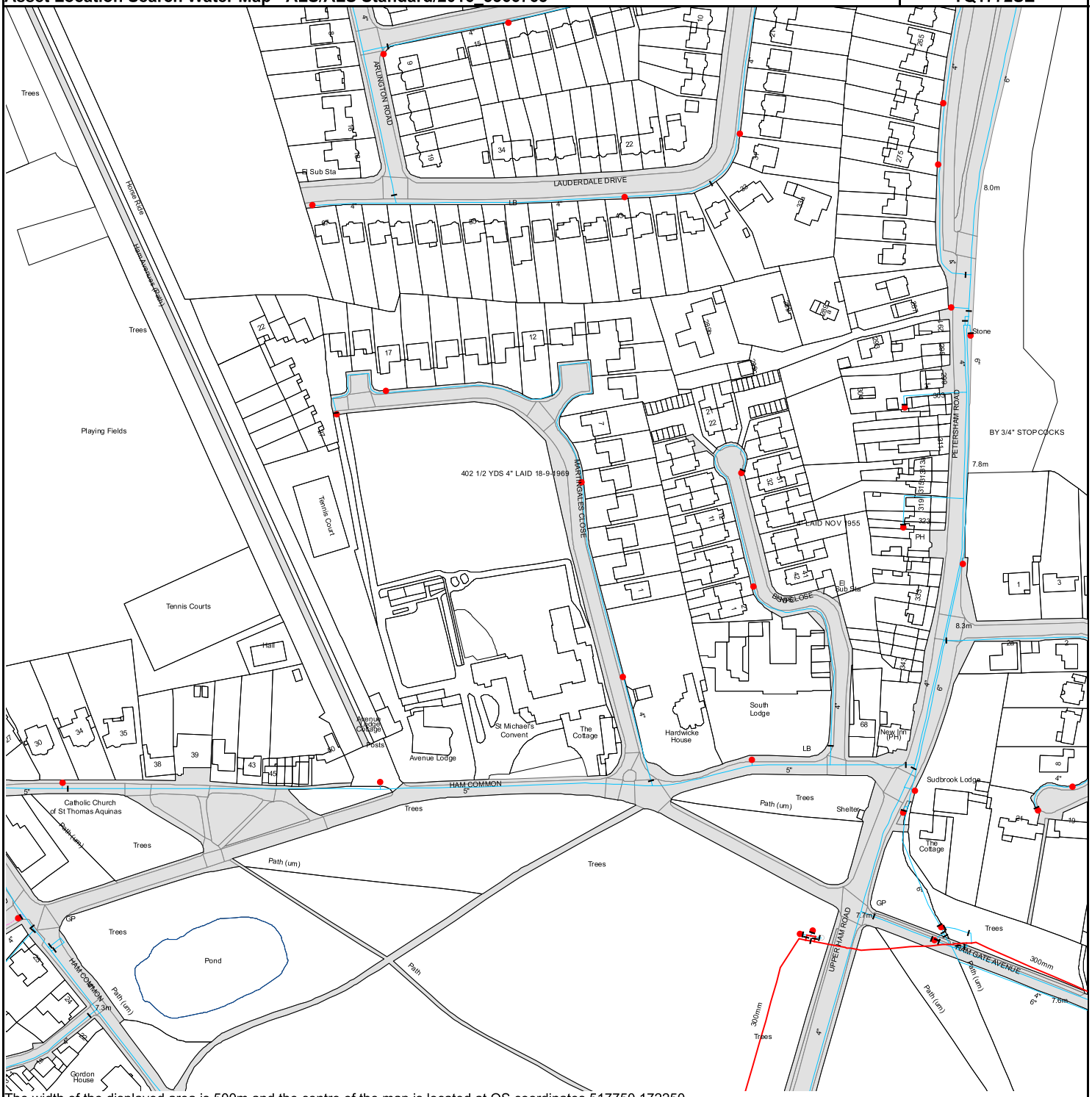
Abandoned Sewer

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/2016_3366763

TQ1772SE



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 517750,172250

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.