


Client: Sei Howe

Flood Risk and SuDS Assessment for the Proposed Development at 22B Harley Road, London.

September 2023

Canterbury Office
Unit 6 & 7
Barham Business Park
Elham Valley Road
Barham
Canterbury
Kent
CT4 6DQ

London Office
Unit 52.11
Woolyard
52 Bermondsey Street
London
SE1 3UD

Tel 01227 833855
www.herringtonconsulting.co.uk

This report has been prepared by Herrington Consulting Ltd in accordance with the instructions of their client, **Sei Howe**, for their sole and specific use. Any other persons who use any information contained herein do so at their own risk.

Project Reference: 3788

Client: Sei Howe

Flood Risk and SuDS Assessment for the Proposed Development at 22B Harley Road, London.

Contents Amendment Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date
1	0	Draft report issued by email	01 August 2023
2	1	Minor changes to scheme drawings. Final report issued by email	27 September 2023

This page is left intentionally blank

Document Verification

Issue	Revision	Date:	01 August 2023	
1	0	Author(s):	JA	HA
		Checked By:	TV	EC
Issue	**Revision**	**Date:**	**27 September 2023**	
2	1	Author(s):	JA	HA
		Checked By:	TV	EC

This page is left intentionally blank

Contents Page

This page is left intentionally blank

1 Scope of Appraisal

Herrington Consulting has been commissioned by **Sei Howe** to prepare a Flood Risk and Sustainable Drainage Assessment for the proposed development at **22B Harley Road, London, NW3 3BN.**

A Flood Risk Assessment (FRA) appraises the risk of flooding to development at a site-specific scale and recommends appropriate mitigation measures to reduce the impact of flooding to both the site and the surrounding area. New development has the potential to increase the risk of flooding to neighbouring sites and properties through increased surface water runoff and as such, an assessment of the proposed site drainage can help to accurately quantify the runoff rates, flow pathways and the potential for infiltration at the site. This assessment considers the practicality of incorporating Sustainable Drainage Systems (SuDS) into the scheme design, with the aim of reducing the risk of flooding by actively managing surface water runoff.

This report has been prepared to supplement a full planning application and has been prepared in accordance with the requirements of both national and local planning policy. To ensure that due account is taken of industry best practice, reference has also been made to CIRIA Report C753 'The SuDS Manual' and any relevant local planning policy guidance. The surface water management strategy included within this report is not intended to constitute a detailed drainage design.

2 Background Information

2.1 Site Location and Existing Use

The site is located at Ordnance Survey (OS) coordinates 526964, 184051, off Harley Road in London. The site covers an area of approximately 326m² and currently comprises a dwelling within the rear garden of 22 Harley Street. The location of the site, in relation to the surrounding area, is shown in Figure 2.1 below.

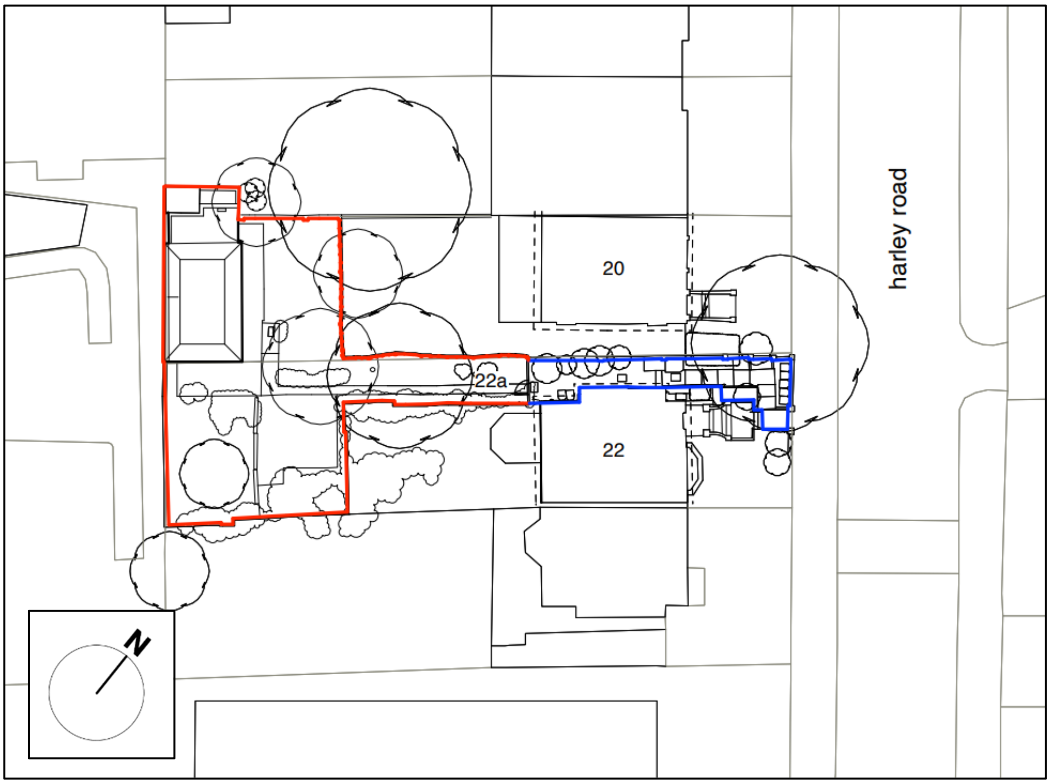


Figure 2.1 – Location map (contains Ordnance Survey data © Crown copyright and database right 2023).

2.2 Proposed Development

The development proposals comprise the demolition of the existing dwelling (22b) and the erection of a new, two-storey, 3-bedroom dwelling. The proposed dwelling will have a larger footprint and be positioned behind both 20 and 22 Harley Street.

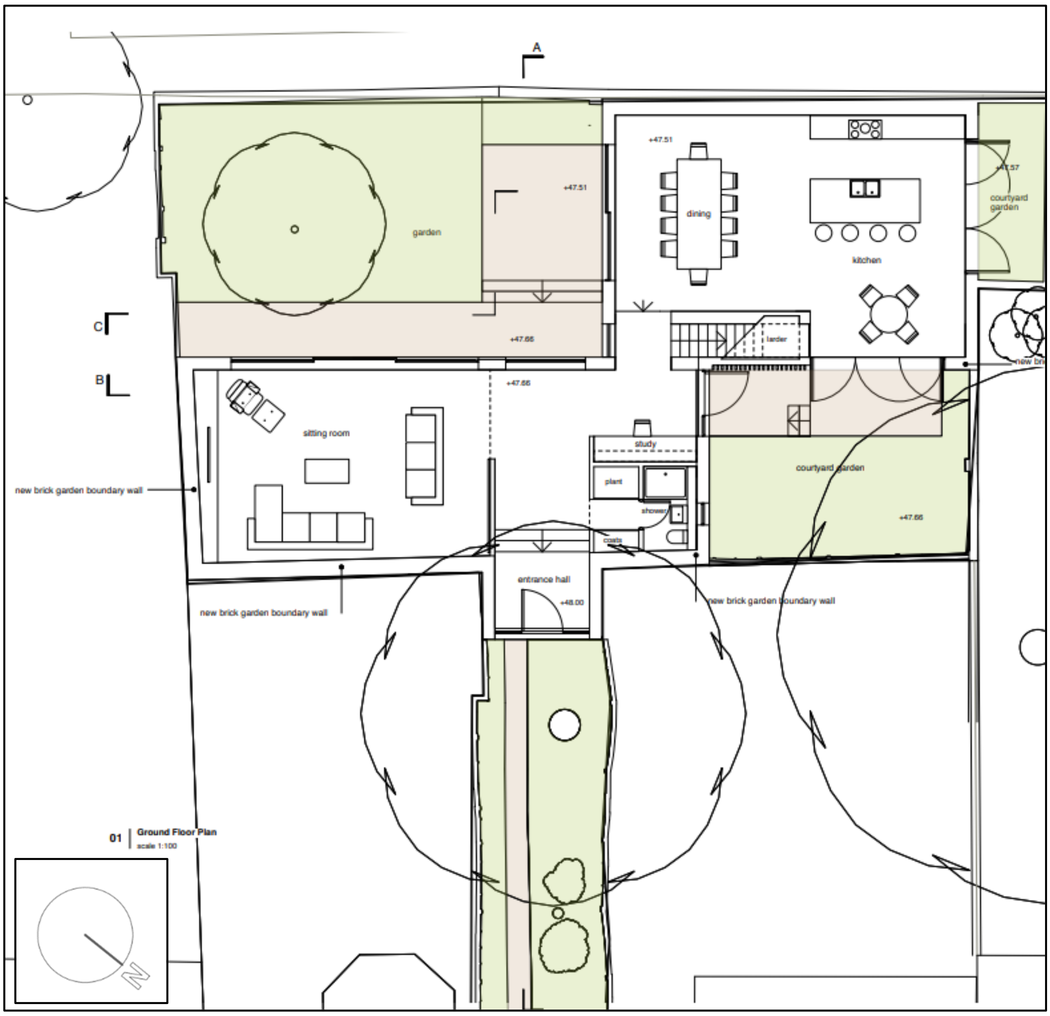


Figure 2.2 – Proposed site plan.

Further drawings of the proposed scheme are included in Appendix A.1 of this report.

2.3 Planning Policy and Context

Local Planning Authorities (LPA) are encouraged to take a risk-based approach to proposals for development in or affecting flood risk areas through the application of the Sequential Test. The objectives of this test are to steer new development away from high-risk areas towards those areas at lower risk of flooding. However, in some locations where developable land is in short supply there can be an overriding need to build in areas that are at risk of flooding. In such circumstances the application of the Sequential Test is used to ensure that the lower risk sites are developed before the higher risk ones.

As mentioned in Section 2.2, the proposed development involves the demolition of the existing dwelling and the construction of a replacement dwelling. Given the nature of the development, it is not possible for the replacement dwelling to be located elsewhere and therefore it is considered there is evidence that the Sequential Test can be passed.

According to the NPPF, if it is not possible, consistent with wider sustainability objectives, for the development to be located in areas at lower risk, the Exception Test may have to be applied. The application of the Exception Test will depend on the type and nature of the development, in line with the Flood Risk vulnerability classification set out in the NPPG. In this case, the site is located within Flood Zone 1, as identified by the EA's 'Flood Map for Planning' (Figure 2.3), therefore, the Exception Test is also passed.

Notwithstanding this, as the development is situated within a Critical Drainage Area (CDA) as defined by the London Borough of Camden, it will be necessary to submit an FRA as part of the planning process to appraise the risk of flooding from all sources.

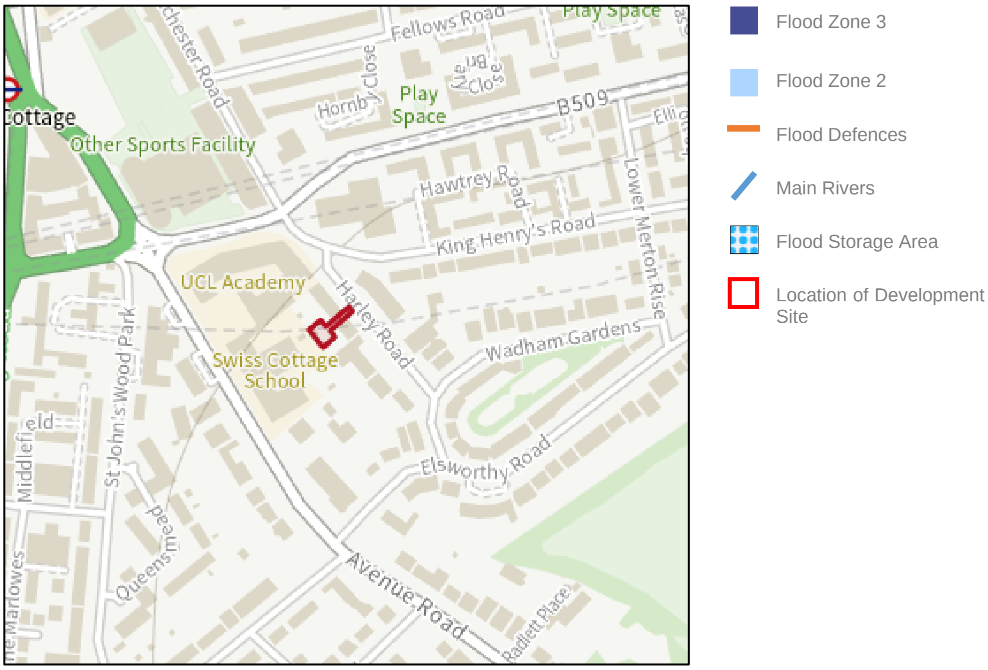


Figure 2.3 – EA's 'Flood Map for Planning' (© Environment Agency).

Section 3.4 of the London Plan also requires all developments to achieve greenfield runoff rates, where possible. If this cannot be achieved, it should be demonstrated how runoff can be minimised, with the expectation that the development can achieve a 50% reduction in the surface water runoff discharged from the site (when compared to the pre-developed conditions).

In addition to the London Borough Camden SFRA, Policy 5.13 of the London Plan (2021) states that proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

1. Rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation).

2. Rainwater infiltration to ground at or close to source.

3. Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens).

4. Rainwater discharge direct to a watercourse (unless not appropriate).

5. Controlled rainwater discharge to a surface water sewer or drain.

6. Controlled rainwater discharge to a combined sewer.

2.4 Site Specific Information

Information from a wide range of sources has been referenced to appraise the true risk of flooding at this location. This section summarises the additional information collected as part of this FRA.

Information contained within the SFRA – The London Borough of Camden Council SFRA (2014) contains detailed mapping showing historic flood records for a wide range of sources. This document has been referenced as part of this site-specific FRA. The SFRA has identified that the site is positioned within a Critical Drainage Area, hence the requirement for an FRA.

Information on localised flooding contained within the SWMP – A Surface Water Management Plan (SWMP) is a study to understand the risk of flooding that arises from local surface water flooding, which is defined by the Flood and Water Management Act 2010 as flooding from surface runoff, groundwater, and ordinary watercourses. Such a document has been prepared for the London Borough of Camden Council (2011) and has therefore been referenced as part of this site-specific FRA.

Information provided by Thames Water – Thames Water has provided the results of an asset location search for the site. The response is included in Appendix A.2.

Site specific topographic surveys – A site-specific topographic survey has been undertaken and inspection of the survey show that the land levels of the site vary between 47.51m and 48.76m Above Ordnance Datum Newlyn (AODN). The land to the rear of 22 Harley Road falls down towards 22B Harley Street, with the proposed dwelling positioned on the lowest part of the site.

Geology – Reference to the British Geological Survey (BGS) map shows that the underlying solid geology in the location of the subject site is London Clay Formation (clay and silt). There are no overlying superficial deposits.

Historic flooding – No information on historic flooding in this area has been provided or revealed through desktop searches.

Existing Flood Risk Management Measures – There are no formal flood defence structures that provide protection to the development site.

2.5 Climate Change

The global climate is constantly changing but it is widely recognised that we are now entering a period of accelerating change. Over the last few decades there have been numerous studies into the impact of potential future changes in the climate and there is now an increasing body of scientific evidence which supports the fact that the global climate is changing as a result of human activity. Past, present, and future emissions of greenhouse gases are expected to cause significant global climate change during this century.

The nature of climate change at a regional level will vary. For the UK, projections of future climate change indicate that more frequent short-duration, high-intensity rainfall, and more frequent periods of long-duration rainfall (of the type responsible for the recent UK flooding), could be expected.

These effects will tend to increase the size of flood zones associated with rivers and the amount of flooding experienced from other inland sources. Consequently, the following section of this report takes into consideration the impacts of climate change and references the most contemporary guidance that is applicable to the development site.

Planning Horizon

To ensure that any recommended mitigation measures are sustainable and effective throughout the lifetime of the development, it is necessary to base the appraisal on climate change predictions that are commensurate with the planning horizon for the proposed development. The NPPF and supporting Planning Practice Guidance Suite state that residential development should be considered for a minimum of 100 years, but that the lifetime of a non-residential development depends on the characteristics of the development. The development that is the subject of this FRA is classified as residential and therefore, a design life of 100 years has been assumed.

Potential Changes in Climate

Recognising that the impact of climate change will vary across the UK, the allowances were updated in May 2022 to show the anticipated changes to peak rainfall across a series of management catchments. The proposed development site is located in the **London Management Catchment**, as defined by the 'Peak Rainfall Allowance' maps, hosted by the Department for Environment, Food and Rural Affairs. Guidance provided by the EA states that this mapping should be used for site-scale applications (e.g. drainage design), in small catchments (less than $5km^2$), or urbanised drainage catchments. For large rural catchments, the peak river flow allowances should be used.

The development site lies within an urbanised drainage catchment and therefore, the Peak Rainfall Allowances for the London Management Catchment should be applied.

For each Management Catchment, a range of climate change allowances are provided for two time epochs and for each epoch, there are two climate change allowances defined. These represent different levels of statistical confidence in the possible scenarios on which they are calculated. The two levels are as follows:

- Central: based on the 50th percentile
- Upper End: based on the 90th percentile

The EA has provided guidance regarding the application of the climate change allowances and how they should be applied in the planning process. The range of allowances for the Management Catchment in which the development site is located are shown in Table 2.1 below.

Management Catchment Name	Annual exceedance probability	Allowance Category	2050s	2070s
London	3.3 %	Central	20%	20%
		Upper End	35%	35%
	1 %	Central	20%	25%
		Upper End	40%	40%

Table 2.1 – Recommended peak rainfall intensity allowances for each epoch for the London Management Catchment.

For a development with a design life of 100 years the Upper End climate change allowance is recommended to assesses whether:

- there is no increase in flood risk elsewhere, and;
- the development will be safe from surface water flooding.

From Table 2.1 above, it can be seen that the recommended climate change allowance for this site is a 40% increase in peak rainfall. Therefore, this increase has been applied to the hydraulic drainage model constructed to inform the surface water management strategy. Where this allowance has been applied the abbreviation “+40%cc” has been used.

3 Potential Sources of Flooding

The main sources of flooding have been assessed as part of this appraisal. The specific issues relating to each one and its impact on this development are discussed below. Table 3.1 at the end of this section summarises the risks associated with each of the sources of flooding.

3.1 Flooding from Main Rivers, Ordinary or Man-Made Watercourses

Inspection of OS mapping identifies that there are no watercourses nearby and the site is not located within an area identified by the EA's 'Flood Map for Planning' as being at risk of flooding from a main river. Consequently, the risk of flooding to the site from rivers is considered to be *low.*

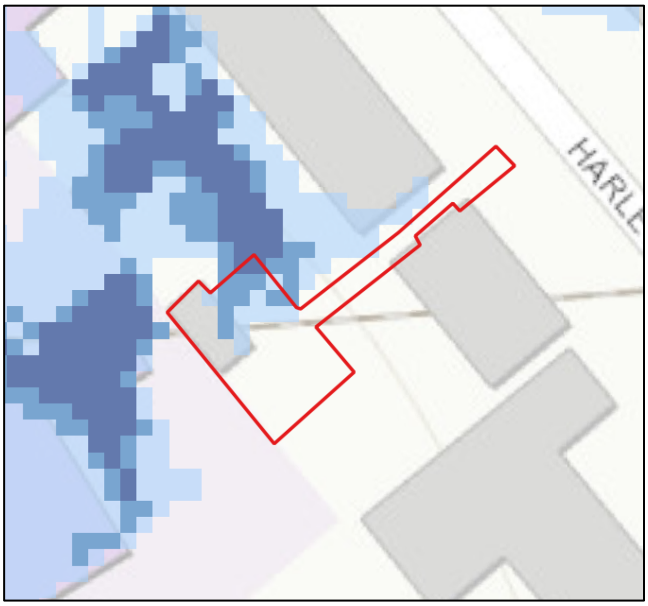
3.2 Flooding from the Sea

The site is located a significant distance inland and is elevated above predicted extreme tide levels. Consequently, the risk of flooding from this source is considered to be *low.*

3.3 Flooding from Surface Water

Surface water, or overland flooding, typically occurs in natural valley bottoms as normally dry areas become covered in flowing water and in low spots where water may pond. This mechanism of flooding can occur almost anywhere but is likely to be of particular concern in any topographical low spot, or where the pathway for runoff is restricted by terrain or man-made obstructions.

The EA's 'Flood Risk from Surface Water' map (Figure 3.1) shows the development site is located in an area classified as having a 'very low' to 'high' risk of surface water flooding. Consequently, the risk of flooding from this source has been appraised in more detail below.



Probability of Flooding

High – Extent of flooding from surface water that has a 3.3% (1 in 30) or greater chance of happening each year.

Medium - Extent of flooding from surface water that has between a 3.3% (1 in 30) and 1% (1 in 100) chance of happening each year.

Low - Extent of flooding from surface water that has between a 1% (1 in 100) and 0.1% (1 in 1000) chance of happening each year.

Location of Development Site

Figure 3.1 – EA's 'Flood Risk from Surface Water' map (© Environment Agency).

The pluvial 'design flood event' is taken as the 1 in 100 year return period event (1% AEP) including a 45% allowance for climate change (refer to Section 4.2). While the EA's mapping does not include an allowance for climate change, the maps do include a modelled scenario whereby a rainfall event is applied which exceeds the design flood event, represented by the 'low' likelihood of occurrence event. This scenario represents the impacts of an extreme pluvial event with a 1 in 1000 year return period. Whilst it is recognised that the 'low' likelihood of occurrence event can be used to *estimate* the impacts of climate change, in some case these results are likely to *significantly* overestimate the risk of flooding at the site which are attributed to climate change.

The EA's mapping also does not take account of local features such as geology, drainage networks or features such as walls. The absence of this information within the modelling can result in the EA mapping further overestimating the risk of flooding in some areas. Nevertheless, in the absence of any other detailed information, the EA's mapping has been used to appraise the risk of flooding from this source.

During the 'low' probability event, the mapping highlights that surface water could accumulate in the northwest part of the site to a maximum depth of 0.60m. Only part of the replacement dwelling is shown to be located in the area that could be subject to flooding.

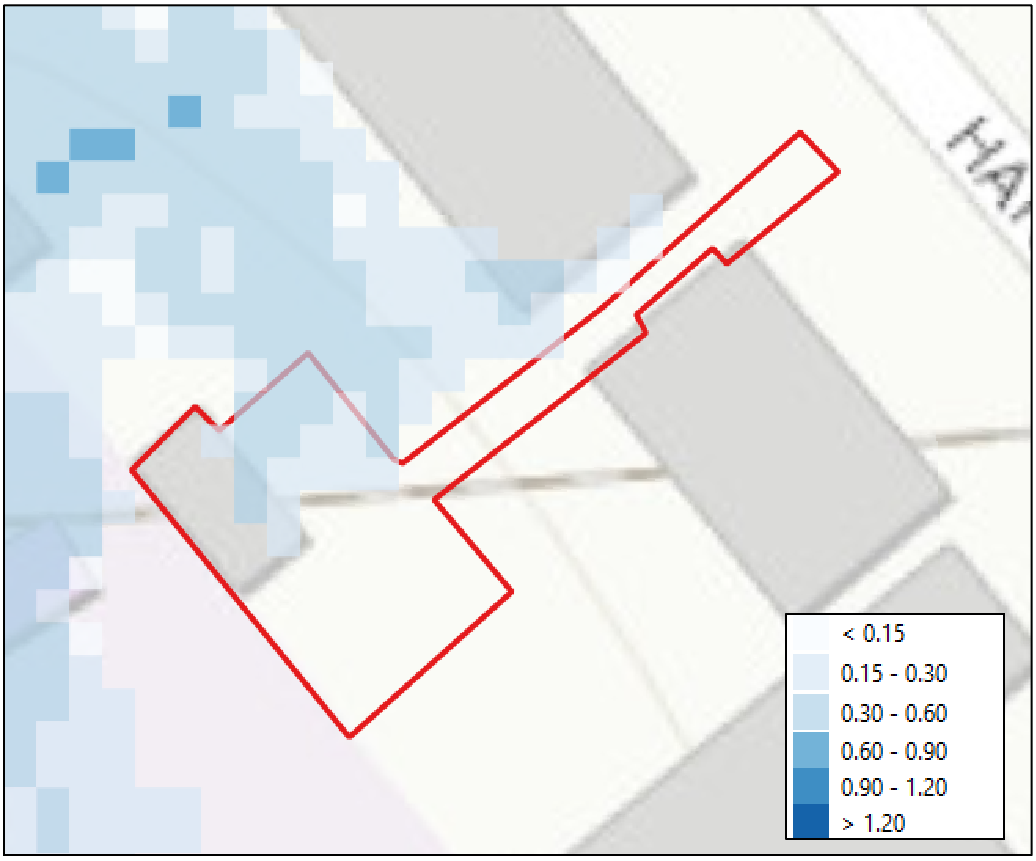


Figure 3.2 - EA's 'Risk of Flooding from Surface Water' Maps showing the maximum flood depth (in metres) during the 'low' likelihood of occurrence scenario (© *Environment Agency).*

To mitigate the impact of floodwater to the replacement dwelling, it is recommended that flood resistance and resilience measures be included (Refer to Section 4.1). These measures will prevent floodwater ingress where possible and manage the impact of floodwater where internal flooding cannot be prevented.

In addition, the proposed development will include SuDS within the scheme design which will be designed to manage rain falling onsite up to and during the design rainfall event. These measures will capture rain falling on the site and therefore could reduce the extent of surface water accumulation in the north west corner of the site by reducing the area contributing.

Taking the above into consideration, it is concluded that with the inclusion of the above mentioned measures, the risk of flooding from this source is *low.*

3.4 Flooding from Groundwater

Water levels below the ground rise during wet winter months and fall again in the summer as water flows out into rivers. In very wet winters, rising water levels may lead to the flooding of normally dry land, as well as reactivating flow in 'bournes' (streams that only flow for part of the year).

The underlying geology in this area is London Clay Formation, with no overlaying superficial deposits. This geological composition is typically impermeable and not commonly associated with groundwater flooding. This assumption is supported by mapping provided as part of the Defra Groundwater Flood Scoping Study (May 2004) shows that no groundwater flooding events were recorded near the site during the very wet periods of 2000/01 or 2002/03. The mapping also identifies that the site itself is not located within an area where groundwater emergence is predicted. Consequently, given that there are also no records of flooding from groundwater at the site in the past, the risk of flooding from this source is considered to be *low*.

3.5 Flooding from Sewers

In urban areas, rainwater is typically drained into surface water sewers or sewers containing both surface and wastewater known as "combined sewers". Flooding can result when the sewer is overwhelmed by heavy rainfall, becomes blocked, or has inadequate capacity; this will continue until the water drains away.

Inspection of the asset location mapping provided by Thames Water (Figure 3.2) identifies that the sewers in this area are combined sewers.

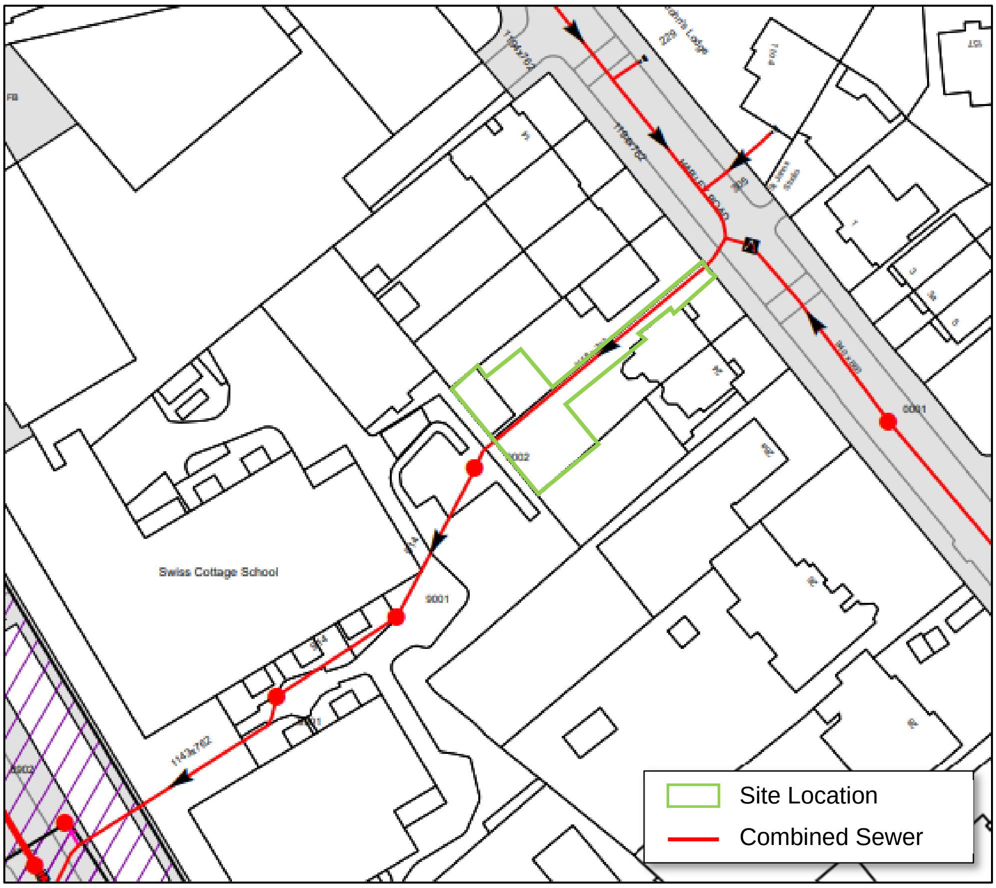


Figure 3.2 – Asset location mapping provided by Thames Water (a full scale copy can be found in Appendix A.2).

The London Borough of Camden SFRA shows that external sewer flooding is concentrated in areas such as South Hampstead and Kilburn in the west of the borough. The SFRA records 18 external flooding incidents in area of South Hampstead. However, this is relatively coarse data and relates to localised incidents within a broad area, with no indication of any historic sewer flooding having occurred on the proposed development site.

Inspection of the asset location data indicates that if water was to exit the sewer network (i.e., as a result of a blockage or following an extreme rainfall event) floodwater would more likely exit the network to the southwest of the site. This conclusion is based upon aerial height data and the asset location mapping which shows that Thames Water manhole '9002' located directly south west of the site has a cover level of 48.22m AODN, with another manhole (number '9001') recorded further south with a cover level of 47.81m AODN.

In regard to the sewer run within Harley Road, LiDAR data shows that Harley Road falls to the east of manhole reference '0001' therefore any floodwater exiting the sewer within Harley Road is likely to flow within the channel of the road towards the lower lying land to the east. Consequently, the risk of flooding from this source is considered to be *low*.

Whilst the risk of flooding from sewers is concluded to be low, it is noted that the Thames Water sewer passes beneath the location of the replacement dwelling. It will be necessary to contact Thames Water to discuss the location of any development within 3m of the sewer and to obtain a build over agreement or to discuss diverting the sewer.

3.6 Flooding from Reservoirs, Canals and Other Artificial Sources

Non-natural or artificial sources of flooding can include reservoirs, canals, and lakes, where water is retained above natural ground level. In addition, operational and redundant industrial processes including mining, quarrying, sand and/or gravel extraction, may also increase the depth of floodwater in areas adjacent to these features.

The potential effects of flood risk management infrastructure and other structures also needs to be considered. For example, reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure.

Inspection of the OS mapping for the area shows that there are no artificial sources of flooding within close proximity to the site. In addition, the EA's 'Flood Risk from Reservoirs' map shows that the site is not within an area considered to be at risk of flooding from reservoirs. Consequently, the risk of flooding is considered to be *low*.

3.7 Summary of Flood Risk

A summary of the overall risk of flooding from each source is provided in Table 3.1 below.

Source of Flooding	Initial Level of Risk	Appraisal method applied at the initial flood risk assessment stage
Rivers, Ordinary and Man-Made Watercourses	Low	OS mapping and the EA's 'Flood Map for Planning'
Sea	Low	OS mapping and the EA's 'Flood Map for Planning'
Surface Water	Low with the inclusion of Flood Resistance and Resilience Measures	EA's 'Flood Risk from Surface Water' map, and historic records contained within the SFRA.
Groundwater	Low	BGS Geology of Britain Mapping, Defra Groundwater Flood Scoping Study and mapping contained within the SFRA.
Sewers	Low	Aerial height data, OS mapping, site-specific, asset location data provided by Thames Water and historic sewer records contained within the SFRA
Reservoirs, Canals and Other Artificial Sources	Low	OS mapping and EA's 'Flood Risk from Reservoirs' map

Table 3.1 – Summary of flood sources and risks.

From the analysis above, it can be seen that **the risk of flooding to the site from all sources is low**, provided that flood resistance and resilience measures are included in the design of the replacement dwelling. Furthermore, to ensure that the development meets the requirements of the NPPF, the following sections of the report recommends further mitigation measures, where appropriate, to ensure the risk of flooding offsite does not increase as a result of the proposals.

4 Flood Mitigation Measures

The key objectives of flood risk mitigation are:

- to reduce the risk of the development being flooded.
- to ensure continued operation and safety during flood events.
- to ensure that the flood risk downstream of the site is not increased by increased runoff.
- to ensure that the development does not have an adverse impact on flood risk elsewhere.

The following section of this report examines ways in which the risk of flooding at the development site can be mitigated.

Mitigation Measure	Appropriate	Comment
Careful location of development within site boundaries (i.e., Sequential Approach)	✓	The Sequential Approach has been applied internally by locating the most vulnerable elements (i.e. sleeping accommodation) on the upper floor.
Land raising	x	The mitigation measures are not considered necessary or practical to include within the proposed development.
Compensatory floodplain storage	x	
Flood defences	x	
Alterations/ improvements to channels and hydraulic structures	x	
Raising floor levels	x	
Flood resistance & resilience	✓	Refer to Section 4.1
Flood warning	✓	Refer to Section 4.2
Surface water management	✓	Refer to Sections 5 and 6

Table 4.1 – Appropriateness of mitigation measures.

4.1 Flood Resistance and Resilience

Flood Resistance or 'dry proofing', where flood water is prevented from entering the building. For example, using flood barriers across doorways and airbricks, or raising floor levels. These measures are considered appropriate for 'more vulnerable' development where recovery from internal flooding is not considered to be practical.

Flood Resilience or 'wet proofing', accepts that flood water will enter the building and allows for this situation through careful internal design for example raising electrical sockets and fitting tiled floors. The finishes and services are such that the building can quickly be returned to use after the flood. Such measures are generally only considered appropriate for some 'less vulnerable' uses and where the use of an existing building is to be changed and it can be demonstrated that no other measure is practicable.

It has been demonstrated that the proposed development could be subject to flooding following an extreme rainfall event, as such flood resistance and resilience measures should be included, to help manage the possible impacts of flooding.

Typical examples of flood resilience measures which may be appropriate for the development site include (but are not limited to) the following:

- Bringing the electrical supply in at first floor.
- Placing boilers and meter cupboards on the first floor.
- Water-resistant plaster/tiles on the walls of the ground floor.
- Solid stone or concrete floors with no voids underneath.
- Covers for doors and airbricks.
- Non-return valves on new plumbing works.
- Avoidance of studwork partitions on the ground floor.

Details of flood resilience and flood resistance construction techniques can be found in the document '*Improving the Flood Performance of New Buildings; Flood Resilient Construction'*, which can be downloaded from www.gov.uk.

A Code of Practice (CoP) for Property Flood Resilience (PFR) has been put in place to provide a standardised approach for the delivery and management of PFR. Further information on the CoP and guidance on how to make a property more flood resilient can be accessed, and downloaded, from the Construction Industry Research and Information Association (CIRIA) Website:

https://www.ciria.org/Resources/Free_publications/CoP_for_PFR_resource.aspx

4.2 Flood Warnings

It has been identified that the proposed development could be subject to flooding following an extreme rainfall event. As such, it is recommended that residents sign up to the Met Office Weather Warnings, which could provide a forewarning of weather conditions which could result in flooding on site:

www.metoffice.gov.uk/weather/uk/uk_forecast_warnings.html

5 Existing Drainage

5.1 Existing Surface Water Drainage

Thames Water has provided sewer mapping as part of their asset location data for the site and surrounding area. An extract of this mapping is presented in Figure 3.2 and shows the location of public sewers in close proximity to the site. The asset location search shows only a combined sewer network near the site. The combined sewer sits directly beneath Harley Road to the east of the site and connects to a combined trunk sewer on Avenue Road (parallel to Harley Road, west of the site) continuing between 20 and 22 Harley Road. This large combined sewer pipe (with dimensions of approximately 0.7m x 1.1m) crosses the site and lies beneath the proposed development area. A build-over agreement from Thames Water will therefore be required.

The nearest manhole is located adjacent to the site rear, with an invert level 3.75m below the surface. The existing site drainage has not been surveyed and it is currently unknown how the existing building at the site currently drains. However, it is assumed to drain at an unrestricted rate into the public combined sewer.

The current rate of discharge has been calculated for a range of rainfall events with varying return periods and these rates are outlined in Table 6.1. These hydrological calculations have been undertaken using the Modified Rational Method and synthetic rainfall data derived using the variables obtained from the Flood Estimation Handbook (FEH) online web service. Greenfield runoff rates for the entire site have also been calculated using the FEH methodology and are outlined in Table 5.1 below.

Return Period (years)	Greenfield runoff rates (l/s)	Peak brownfield runoff rates from the existing site (l/s)
2	0.2	2.6
30	0.4	8.2
100	0.5	10.9

Table 5.1 – Summary of peak runoff rates for the existing site.

6 Sustainable Drainage Assessment

6.1 Site Characteristics

The important characteristics of the site, which have the potential to influence the surface water drainage strategy, are summarised in Table 6.1 below.

Site Characteristic	**Development Site**	
Total area of site	~326 m^2	
Current site condition	Developed (brownfield)	
Greenfield runoff rates (based on the FEH methodology)	1:1 yr = 0.1 l/s Qbar = 0.2 l/s 1:30 yr = 0.4 l/s 1:100 yr = 0.5 l/s	
Infiltration	Assumed negligible due to London Clay bedrock geology	
Current surface water discharge method	Assumed to drain into public combined sewer	
Is there a watercourse nearby?	No	
Impermeable area	**Existing** **~ 132 m^2**	**Proposed** **~ 174 m^2**

Table 6.1 – Site characteristics affecting rainfall runoff.

Based on Table 6.1 above, it is evident that the development proposals will increase the total impermeable area across the site. As a result, the rate at which the surface water runoff is discharged from the site is likely to increase. Consequently, measures will need to be put in place to ensure that the impact of this additional surface water runoff is appropriately managed.

Furthermore, the potential use of SuDS within the proposed development will be considered to assess the practicality of better replicating greenfield behaviour, in accordance with Local Planning Policy.

6.2 Opportunities to Discharge Surface Water Runoff

Policy SI 13 of the London Plan (2021) summaries a hierarchy of options for discharging surface water runoff from developments. Policy SI 13 favours managing surface water runoff at source, by either storing it for later **re-use** or allowing it to **infiltrate** into the ground. If this option is not viable, the next option of preference is for the runoff to be discharged into a **watercourse.** Only if neither of these options are possible, the water should be conducted into a **public sewer** system, with a connection into a surface water sewer being preferred over the discharge into either a combined or foul sewer.

The following opportunities for managing the surface water runoff discharged from the development site are listed in order of preference:

Water Re-Use – Water re-use systems should ideally be considered to reduce the reliance on the demand for potable water. However, such systems can rarely manage 100% of the surface water runoff discharged from a development, as this requires the yield from the building and hardstanding area to balance perfectly with the demand from the proposed development. Consequently, whilst rainwater recycling systems can be considered for inclusion within the scheme, an alternative solution for attenuating storm water will still be required.

Infiltration – The soil and underlying geology at this location has been analysed using the BGS mapping. The geology of the site is made up of London Clay Formation bedrock, with no overlying superficial deposits. Clay is commonly associated with very low infiltration rates. Furthermore, there is insufficient space on the site to comply with Building Regulations, which require a 5m easement from structures to any infiltration feature. As a result, infiltration SuDS are not considered to be a viable solution for managing surface water runoff discharged from the proposed development.

Discharge to Watercourses – There are no watercourses located within close proximity to the site, which show onward connectivity to a main river, the sea, or any other large surface water body. As a result, there is no opportunity to discharge surface water runoff from the development to an existing watercourse.

Discharge to Public Sewer System – With no alternative preferred options available, the existing connection into the public combined sewer system presents a viable solution for managing the surface water runoff discharged from the development.

6.3 Constraints and Further Considerations

The key constraints that are relevant to this development are listed below:

- There is limited open space to incorporate SuDS that require very large areas of land, such as wetlands and large infiltration basins.
- Due to the poor infiltration rate and limited space, it will not be possible to reduce or maintain the volume of surface water runoff discharged from the development site.
- If additional surface water runoff is to be discharged into the public sewer system, or if a new connection is required, it will be necessary to gain consent for this connection from the sewerage undertaker (Thames Water).
- Inspection of the asset location mapping provided by Thames Water (Appendix A.2) identifies that there is a combined sewer that runs through the centre of the site and

connects to a larger trunk sewer. Therefore, any development buffer-zones will need to be confirmed by Thames Water and a build over agreement will be required.

- Ideally, post-development runoff rates should be restricted to greenfield runoff rates. However, on small sites where discharge rates are exceptionally low, higher rates are generally considered acceptable due to the technical limitations of flow control devices. In this case, a limiting discharge rate of 1.0l/s is likely to be acceptable by the LPA and Thames Water.

- There is also a railway tunnel crossing the site. It is recommended that Network Rail is consulted prior to any works.

6.4 Proposed Surface Water Management Strategy

The drainage strategy set out below discusses each of the different elements of the proposed scheme, along with the results from a numerical drainage model constructed for the site, which can be used to demonstrate how the overall objectives can be achieved. This does not represent a detailed surface water drainage design; it is simply an assessment to demonstrate that the objectives and requirements of the NPPF can be met at the planning stage.

Gravel Paths

The paths surrounding the building will be made of resin bound gravel so that runoff can drain as it currently does. Consequently, these areas are considered permeable and have been excluded from the calculations.

Green Roof

A flat green roof will be located across the roof of the southern half of the proposed building. Rain landing on the roof will be intercepted by the green roof, which during low return period events will store and filter a large amount of runoff from the roof area within the soil substrate of the planted areas. The location and extent of the proposed green roof is shown in Figure 6.1.

Under higher return period events, it is unlikely the green roof will provide a reduction in the peak discharge rate at which surface water runoff is discharged from the site, as the soils are likely to become saturated. As part of the design of a green roof, it will be necessary to incorporate an adequate drainage layer (to avoid stagnation) and to install an overflow system to manage runoff, if the primary discharge pipe becomes blocked.

Although the incorporation of green roofs will provide a significant benefit to the quality of water discharged from the roofs under higher return period events, it is unlikely that a green roof can be designed to restrict the rate runoff is discharged from the site. Consequently, additional storage for storm water will be provided.

Water Butts

To reduce the developments reliance on potable water supplies for external use, there is the potential to incorporate water butts within the two garden areas at the base of the proposed building. Typical sizes and dimensions of water butts are outlined below.

Typical house water butt options	Dimensions of a typical house water butt	Volume of storage provided (litres)
Type 1 (wall mounted – small)	1.22m high x 0.46m x 0.23m	100
Type 2 (standard house water butt)	0.9m high x 0.68m diameter	210
Type 3 (large house water butt)	1.26m high x 1.24m x 0.8m	510
Type 4 (column tank – very large)	2.23m high x 1.28m diameter	2,000

Table 6.2 – Estimated storage capacity of available water butts.

In this case, the demand for potable water from each of the gardens is likely to be relatively small and as a result, small wall mounted water butts (typical 100 litre units) are likely to be the most appropriate size for inclusion within the scheme.

It is recognised that each of the water butts will need to overflow into the main drainage system for the site, to ensure that in the event the water butt is full prior to the onset of the design rainfall event, water can be discharged away from the properties without increasing the risk of flooding.

Geocellular Storage Crate

Runoff from all roofs, including the overflows from the green roof and water butts, and remaining hardstanding areas on site, will be directed via underground pipes into a geocellular storage crate, which will store the runoff and attenuate its discharge to the combined sewer . The rate at which runoff is permitted to exit the geocellular storage crate will be restricted through the use of a vortex flow control device (hydro-brake or similar).

There is very limited space within the site to provide underground SuDS, due to a number of constraints, including root protection zones, and a public sewer and railway tunnel crossing the site. It is recommended that the required easement of the geocellular storage crates from the main combined sewer is confirmed with Thames Water.

A summary of the Causeway Flow+ analysis for the geocellular storage crate is shown in Table 6.3 below.

Parameter	Value (1:100yr+40%cc event)
SuDS	Geocellular Storage Crates
Total area draining to geocellular storage crate, including overflow from other SuDS and a 10% allowance for urban creep	191 m^2
Dimensions	5 m x 2 m x 1.2 m (deep)
Infiltration	Not permitted
Flow control device	Vortex flow control device (Hydro-Brake or similar)
Limiting discharge rate	1.0 l/s
Critical storm duration	240 minutes

Table 6.3 – Summary of geocellular storage crate SuDS.

Runoff rates have been calculated for a range of annual return probabilities, including the 100-year return period event with a 40% increase in rainfall intensity, to account for future climatic changes. The results have been compared to the existing runoff rates and the results are summarised in Table 6.4.

Return Period	Existing Discharge Rates (l/s)	Proposed Discharge Rates (l/s)	Betterment
1 in 2yr	2.6	0.6	77%
1 in 30yr	8.2	0.6	93%
1 in 100yr + 40%cc	10.9	1.0	91%

Table 6.4 – Summary of discharge rates, up to and including 1 in 100yr + 40%cc events.

It is evident that with the inclusion of the proposed SuDS, there is the potential to accommodate all the surface water runoff from the site, up to and including, the design rainfall event. The proposed strategy will allow all surface water discharged to the public sewer system to be attenuated to a rate that is no greater than 1.0l/s.

6.5 Indicative Drainage Layout Plan

Figure 6.1 below is an indicative drainage layout plan delineating how the proposed SuDS can be incorporated into the scheme proposals.

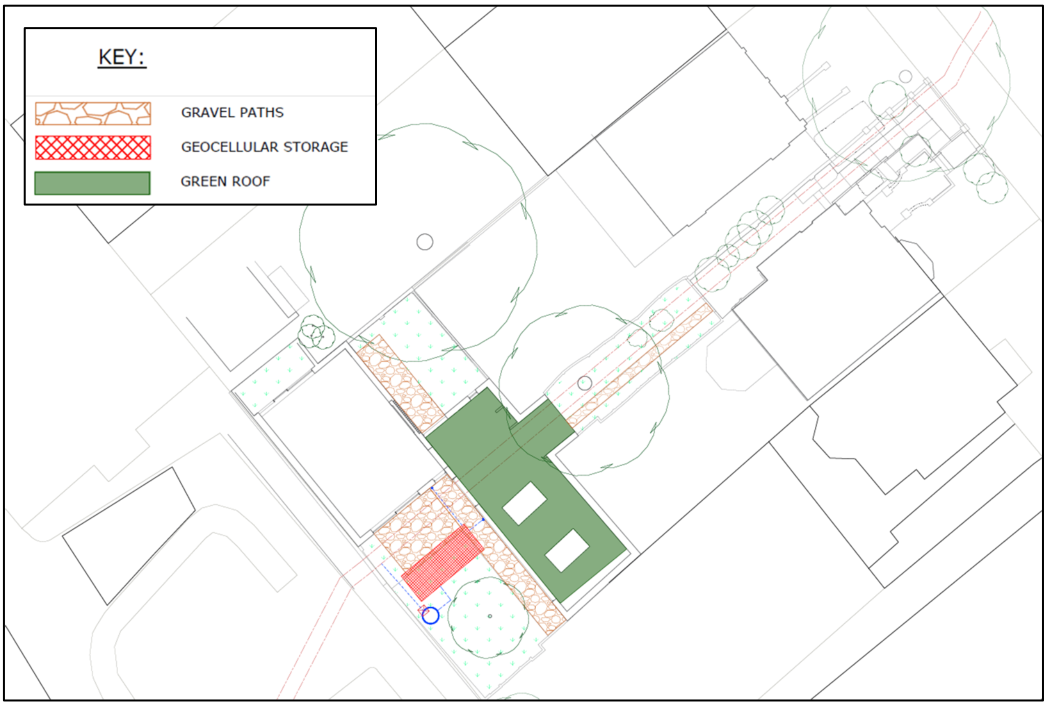


Figure 6.1 - Indicative drainage layout plan showing the proposed location of SuDS.

A full-scale copy of this layout is located in Appendix A.3 of this report.

6.6 Management and Maintenance

In order for any surface water drainage system to operate as originally designed, it is necessary to ensure that it is adequately maintained throughout its lifetime. Therefore, over the lifetime of a development there is a possibility that the performance of the system could be reduced or could fail if it is not correctly maintained. This is even more important when SuDS form a part of the surface water management system, as these require a more onerous maintenance regime than a typical piped network.

The key requirements of any management regime are routine inspection and maintenance. When the development is taken forward to the detailed design stage, an 'owner's manual' will need to be prepared. This should include:

- A description of the drainage scheme.
- A location plan showing all of the SuDS features and equipment, such as flow control devices etc.
- Maintenance requirements for each element, including any manufacturer-specific requirements.
- An explanation of the consequences of not carrying out the specified maintenance.

- Details of who will be responsible for the ongoing maintenance of the drainage system.

For the SuDS recommended by this assessment, the most obvious maintenance tasks will be desilting and cleaning the geocellular storage crates. General maintenance schedules have been included within Appendix A.5 of this report, which demonstrate the maintenance requirements of the proposed SuDS.

For developments such as this, that to some extent rely on the ongoing inspection and maintenance of SuDS, it will be necessary to ensure that measures are in place to maintain the system for the lifetime of the development. In this case, the maintenance of the SuDS will be the responsibility of the individual property owners or occupants.

For some elements of the drainage system, including the green roofs and flow control device, it may be necessary to use specialist contractors or have the original manufacturer inspect the features. If this is the case, the property occupants will need to make allowances for these inspections and works to be carried out.

Further details of the maintenance and management strategy should be confirmed, following the completion of a detailed drainage design for the development.

6.7 Sensitivity Testing and Residual Risk

When considering residual risk, it is necessary to consider the impact of a flood event that exceeds the design event, or the implications if the proposed drainage system was to become blocked.

The proposed drainage system has been designed to accommodate surface water runoff generated under an extreme rainfall event, with a return period of 1 in 100 years, including a 40% increase in peak rainfall intensity (to account for the impacts of climate change). As such, this additional percentage increase complies with the EA's most contemporary guidance on climate change for the upper allowances.

Nonetheless, if a rainfall event was to occur which exceeds the design parameters, surface water would fill up the geocellular storage crates and overflow into the proposed southwest garden space, where it may cause temporary flooding until water is absorbed by the vegetation or infiltrated into the permeable ground areas.

For the water butts there is the potential for a small amount of localised flooding to occur if the overflows from these features were to become blocked. However, given the small catchment area draining to each of these features, the volume of floodwater will be relatively small, and it is unlikely to present a risk to the properties or occupants.

To minimise the risk of uncontrolled discharge of floodwater from the drainage system, an overflow pipe can be incorporated into the design of the flow control chamber. If the primary flow control device becomes blocked, this pipe will be used to bypass the flow control device, allowing excess water to drain directly to the public combined sewer system. A non-return valve should also be installed, to prevent flooding from the sewer if the main public network becomes overwhelmed.

Notwithstanding this, it is recognised that the drainage proposals will incorporate a significant volume of additional storage for storm water, which is not currently provided on the existing site. As a result, when compared to the existing site, it is likely that the volume of water discharged from the site during an extreme rainfall event will be reduced, thus minimising the potential impact of flooding to the surrounding area.

Based on the analysis above it is therefore concluded that the proposed drainage system outlined within this strategy will not result in an increased risk of flooding to properties at the site or within the surrounding area.

7 Conclusions and Recommendations

The overarching objective of this report is to appraise the risk of flooding at 22B Harley Road, Camden, London to ensure that the proposals for development are acceptable in this location and that the risk of flooding onsite is appropriately mitigated. In addition, the NPFF also requires the risk of flooding offsite to be managed, to prevent any increase in flood risk as a result of the development proposals. This report has therefore been prepared to appraise the risk of flooding from all sources and to provide a sustainable solution for managing the surface water runoff discharged from the development site, in accordance with the NPPF and local planning policy.

Section 3 of this report identifies that, based on all available information, the risk of flooding from all sources is low, provided that the mitigation measures recommended within this report are included. Examples of appropriate measures are shown within Section 4.1. Furthermore, in order to minimise the impact that the building could have with respect to an increase in surface water runoff, the opportunities for managing surface water at the site have been further analysed.

It is concluded that the most viable solution for managing all surface water runoff discharged from the proposed development will be via a connection to the public combined sewer system which crosses the site.

In order to restrict the rate at which surface water runoff is discharged offsite, various SuDS have been proposed, including green roofs, water butts, permeable gravel paths and geocellular storage crates. These SuDS will be used to store water onsite before it is discharged to the public sewer system. A vortex flow control device has been specified to attenuate the rate at which surface water runoff is discharged from the geocellular storage crate system, limiting the rate to a maximum of 1.0l/s. This is considered to be as close as reasonably practicable to the calculated greenfield runoff rates for the site, in accordance with local planning policies. .

Details of the typical maintenance and management requirements for each element of the drainage system have been provided to ensure that the proposed drainage solution can be maintained and will continue to operate over the lifetime of the development. It is, however, recommended that an "owner's manual" containing additional product specific maintenance requirements is produced as part of the detailed design for the site.

In conclusion, it is evident that the development is at low risk of flooding and a sustainable solution for managing the surface water runoff discharged from the proposed development is available. With the described mitigation measures the proposals will meet the requirements of the NPPF, its Planning Practice Guidance and local planning policy.

8 Appendices

Appendix A.1 – Drawings

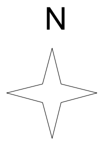
Appendix A.2 – Thames Water Asset Location Data

Appendix A.3 – Indicative Drainage Layout Plan

Appendix A.4 – Surface Water Management Calculations

Appendix A.5 – Maintenance Schedules

Appendix A.1 – Drawings



notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

20 0 20 40 60 80 100

Metres

revision notes

planning

revision	date	comment
p1	12/06/23	Issued for planning

THEIS +KHAN

11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

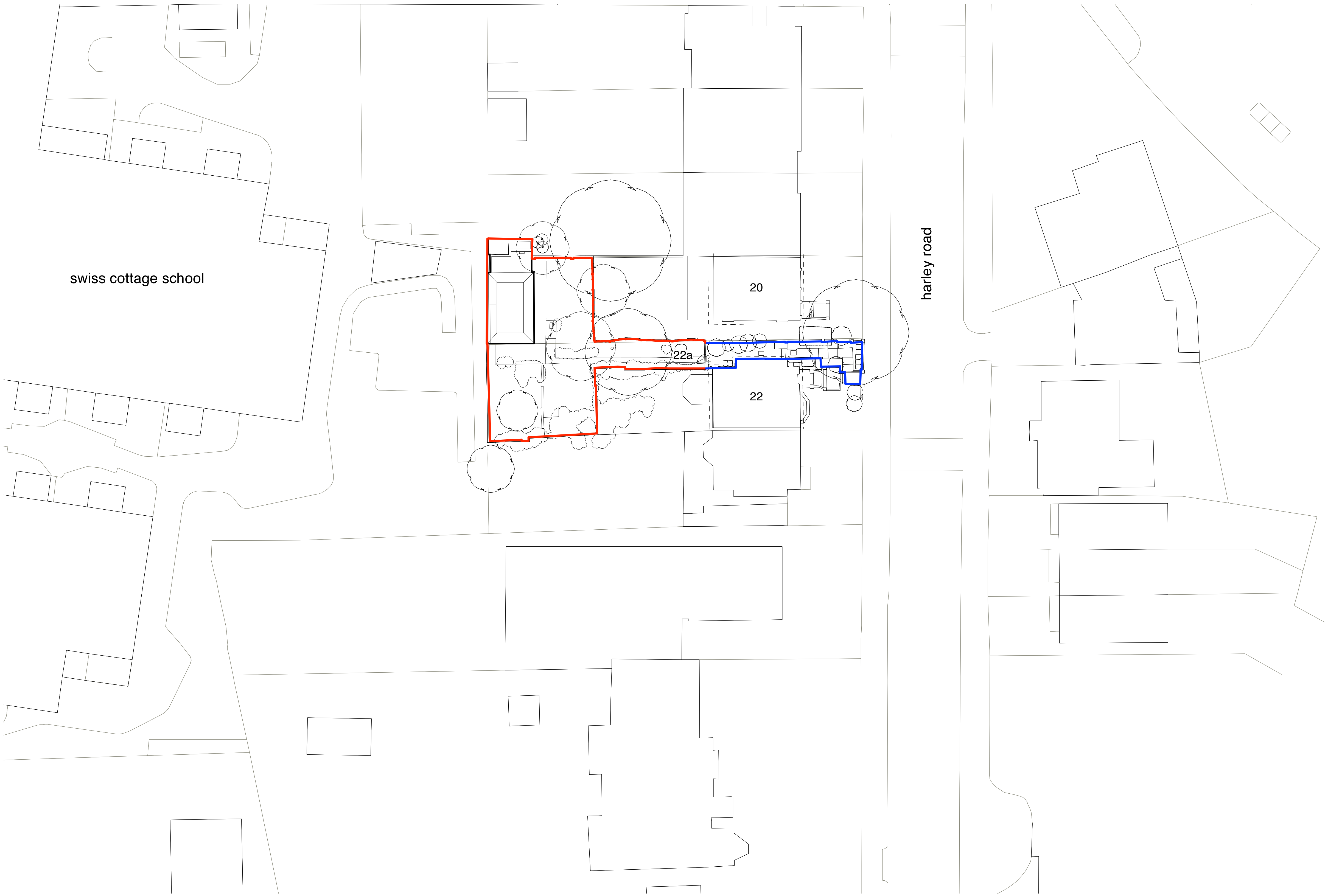
mail@theisandkhan.com
www.theisandkhan.com

project
harley road

drawing
location plan
existing

scale	date
1:1250 @ A3	12/06/23

job number	drawing number	revision
1169	000	p1



notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

N

0 2500m

key

revision notes

planning

revision	date	comment
p1	12/06/23	Issued for planning

THEIS +KHAN

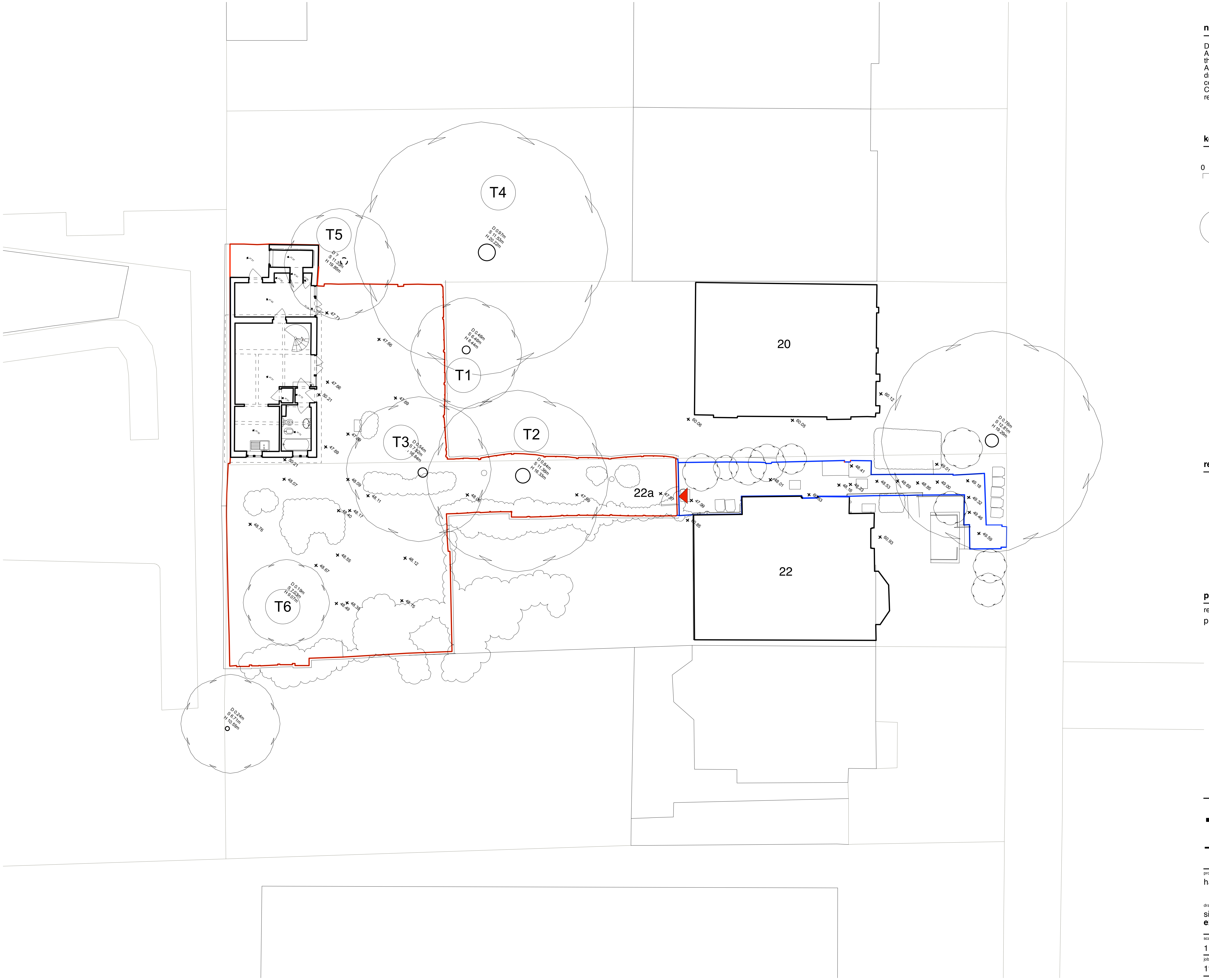
11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

project
harley road

drawing
site plan 1:500
existing

scale	date	
1:500 @ A3	12/06/23	
job number	drawing number	revision
1169	001	p1



notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

0 5m 10m

N

revision notes

planning

revision	date	comment
p1	12/06/23	Issued for planning

THEIS +KHAN

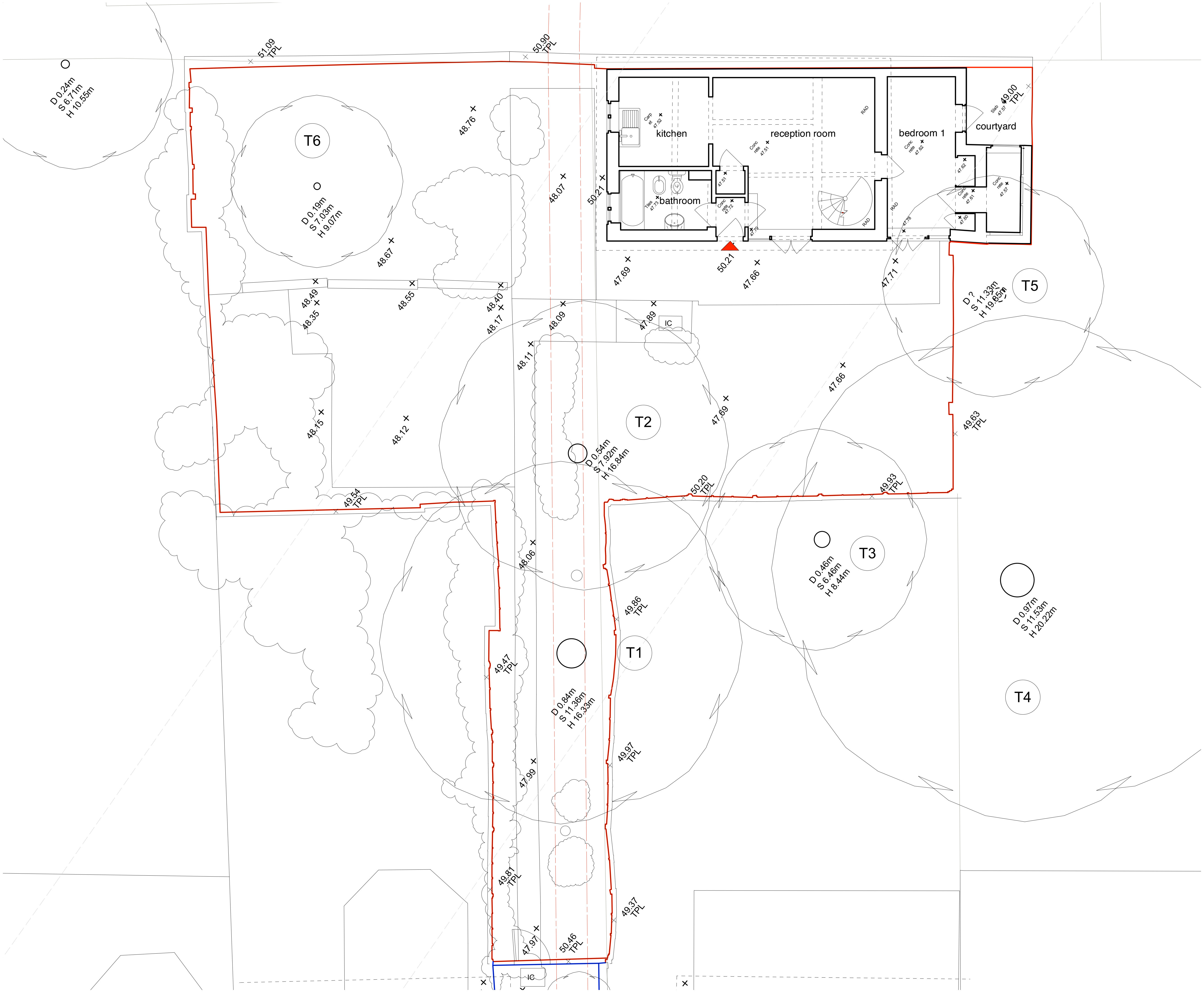
11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

project
harley road

drawing
site plan 1:200
existing

scale	date	
1:200 @ A3	august 22	
job number	**drawing number**	**revision**
1169	002	p1



notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

0 2.5m 5m

N

revision notes

planning

revision	date	comment
p1	12/06/23	Issued for planning

THEIS +KHAN

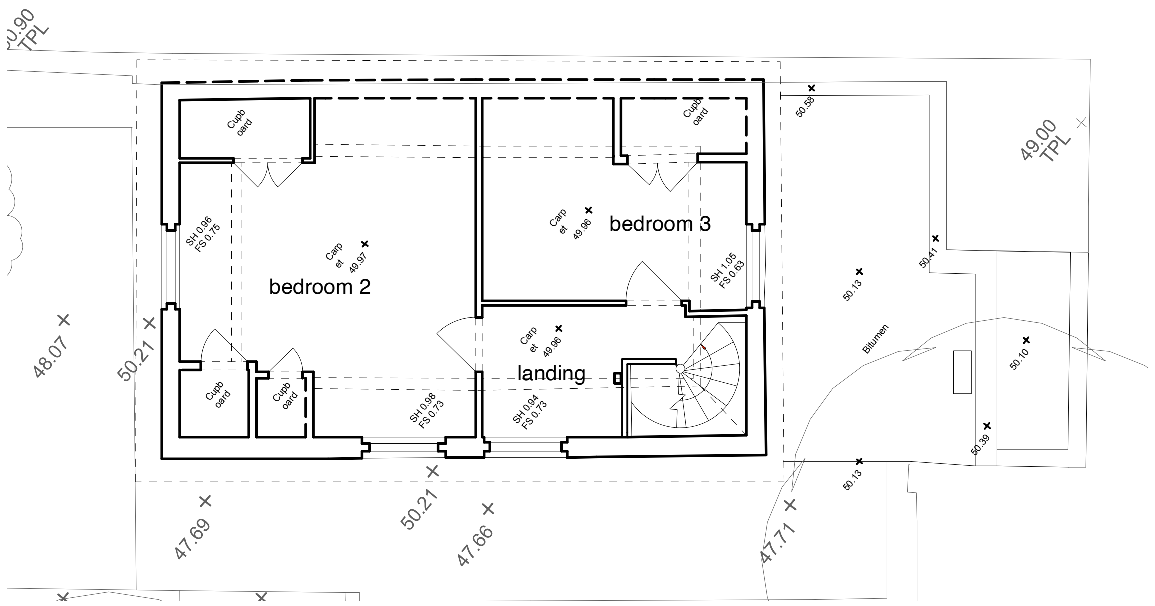
11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

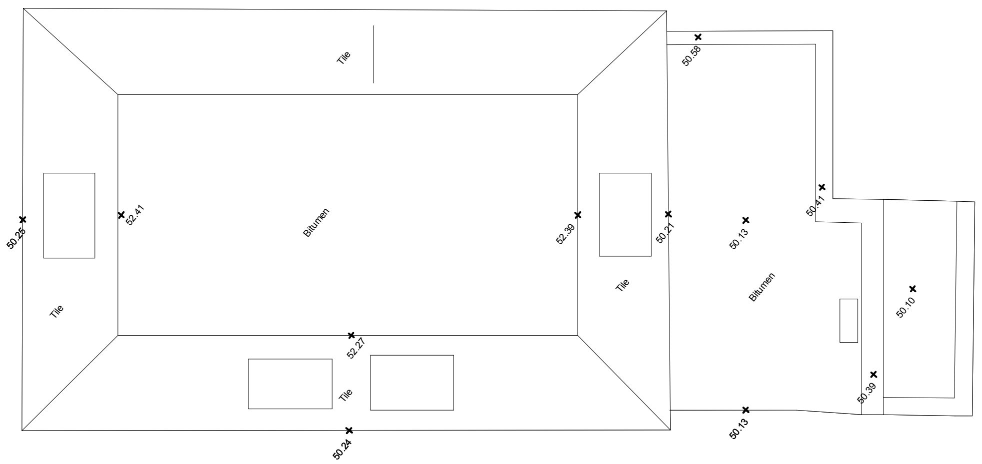
project
harley road

drawing
ground floor
existing

scale	date	
1:100 @ A3	august 22	
job number	**drawing number**	**revision**
1169	010	p1



First floor plan



Roof plan

notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

0 2.5m 5m

N

revision notes

planning

revision	date	comment
p1	12/06/23	Issued for planning

THEIS +KHAN

11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

project
harley road

drawing
first floor and roof plan
existing

scale	date	
1:100 @ A3	august 22	
job number	**drawing number**	**revision**
1169	011	p1

notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

0 2.5m 5m

revision notes

planning

revision	date	comment
p1	12/06/23	Issued for planning

THEIS +KHAN

11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

project
harley road

drawing
East elevation
existing

scale	date	
1:100 @ A3	august 22	
job number	**drawing number**	**revision**
1169	020	p1

notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

0 2.5m 5m

revision notes

planning

revision	date	comment
p1	12/06/23	Issued for planning

THEIS
+KHAN

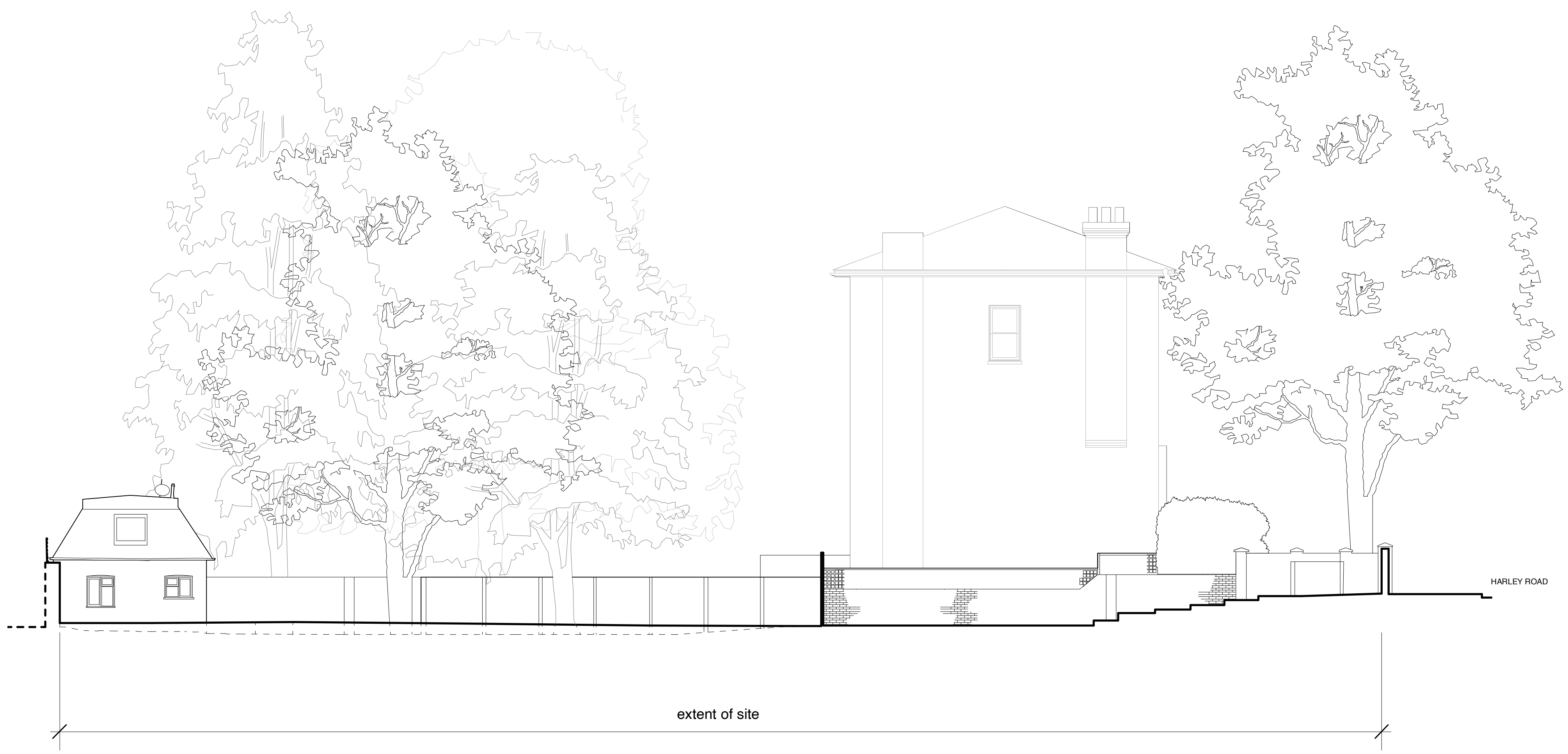
11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

project
harley road

drawing
South elevation
existing

scale	date		
1:100 @ A3	august 22		
job number	drawing number	revision	
1169	021	p1	



notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

0 5m 10m

note: neighbouring window position assumed (unsurveyed)

revision notes

planning

revision	date	comment
p1	12/06/23	Issued for planning

THEIS +KHAN

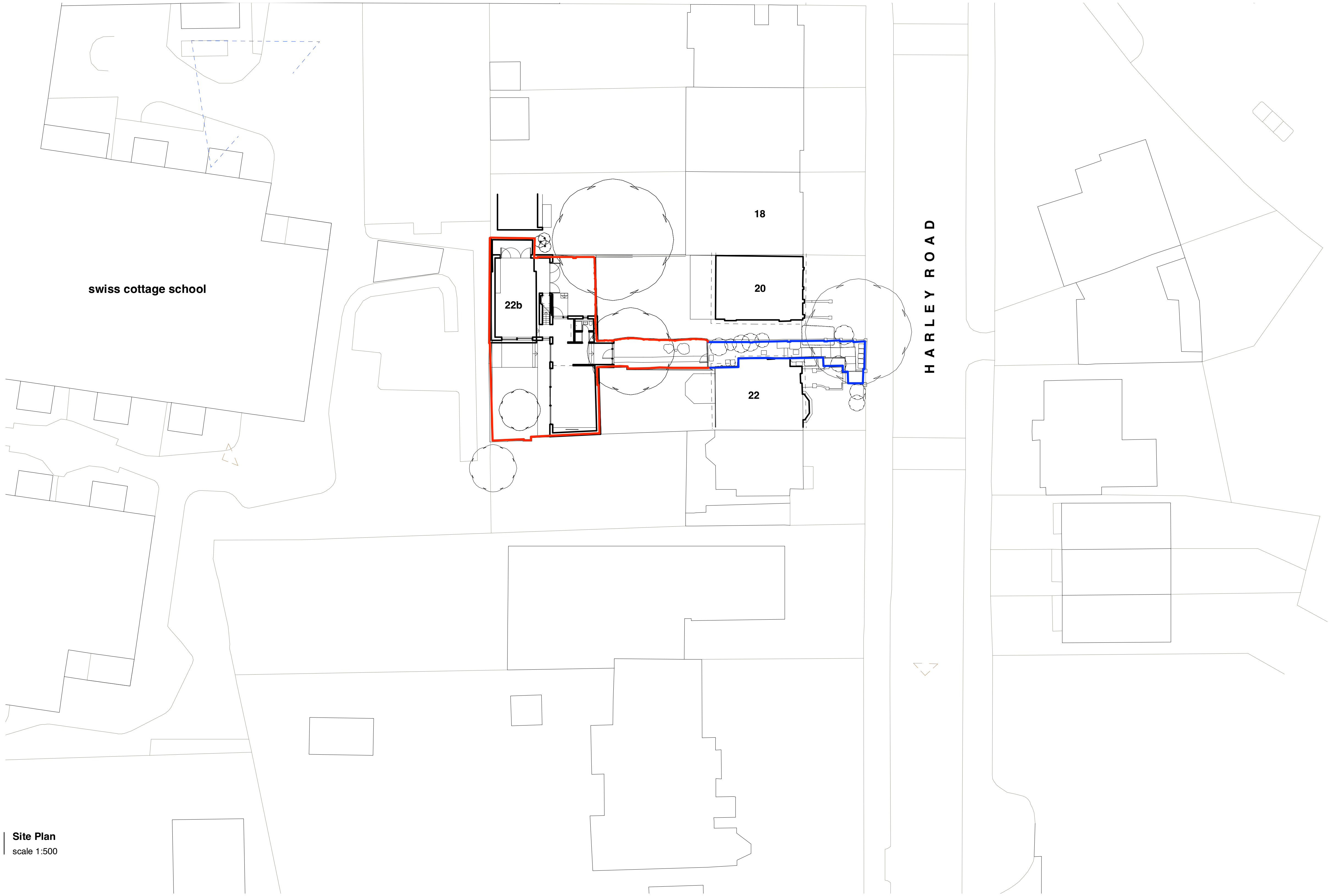
11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

project
harley road

drawing
Site section AA
existing

scale	date	
1:200 @ A3	august 22	
job number	**drawing number**	**revision**
1169	022	p1



01 | **Site Plan**
scale 1:500

notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

N

0 2500m

revision notes

planning

revision	date	comment
p1	16/09/23	Issued for planning

THEIS +KHAN

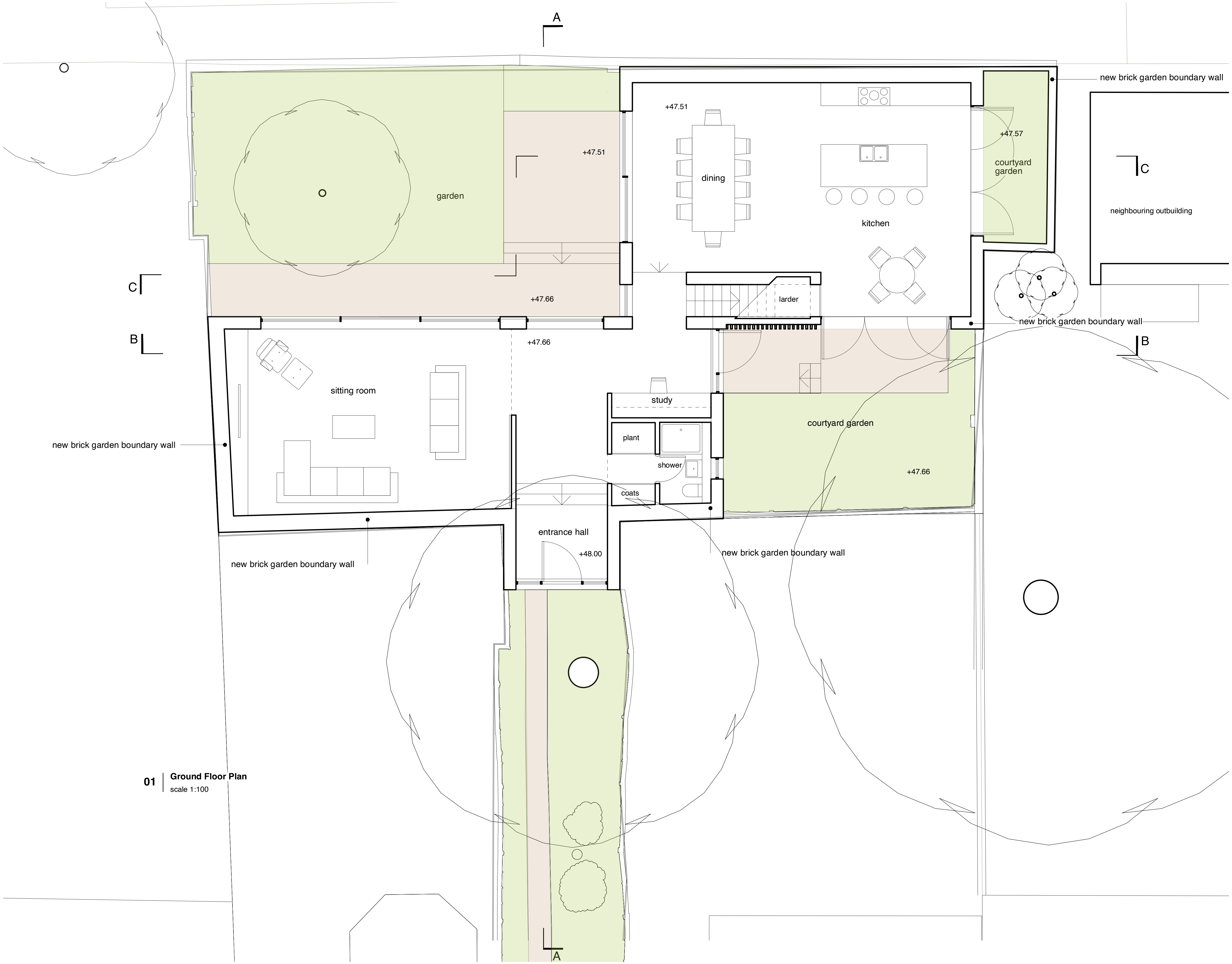
11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

project
22b harley road

drawing
site plan 1:500
proposed

scale	date	
1:500 @ A3	16/09/23	
job number	**drawing number**	**revision**
1169	101	p1



01 | **Ground Floor Plan**
scale 1:100

notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

0 2.5m 5m

N

138.5m2 gross internal floor area

revision notes

planning

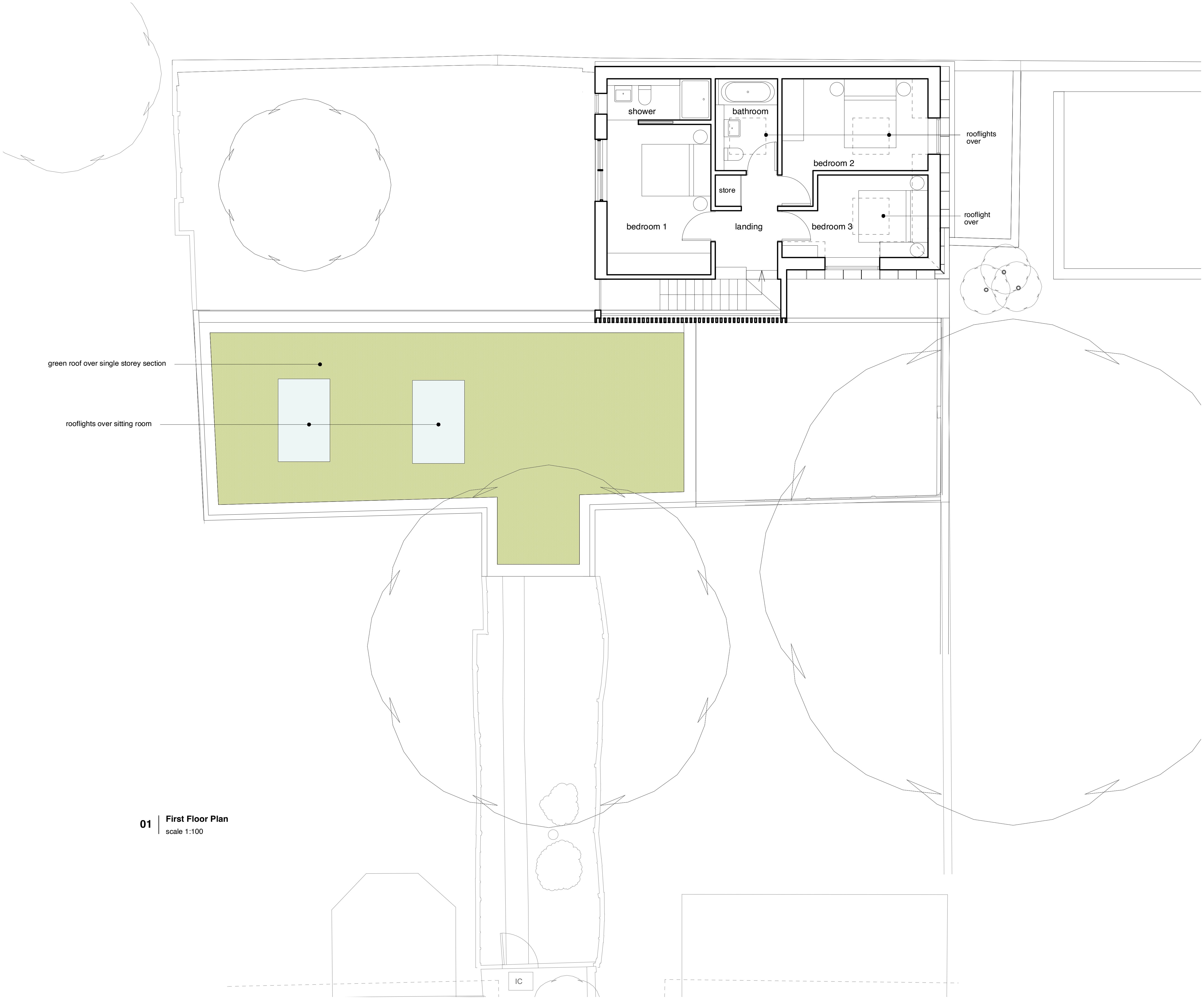
revision	date	comment
p1	16/09/23	Issued for planning

THEIS +KHAN
11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094
mail@theisandkhan.com
www.theisandkhan.com

project
22b harley road

drawing
ground floor plan
proposed

scale	date	
1:100 @ A3	august 22	
job number	drawing number	revision
1169	110	p1



01 | **First Floor Plan**
scale 1:100

notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

0 2.5m 5m

N

gross internal floor area = 51m2

revision notes

planning

revision	date	comment
p1	16/09/23	Issued for planning

THEIS +KHAN

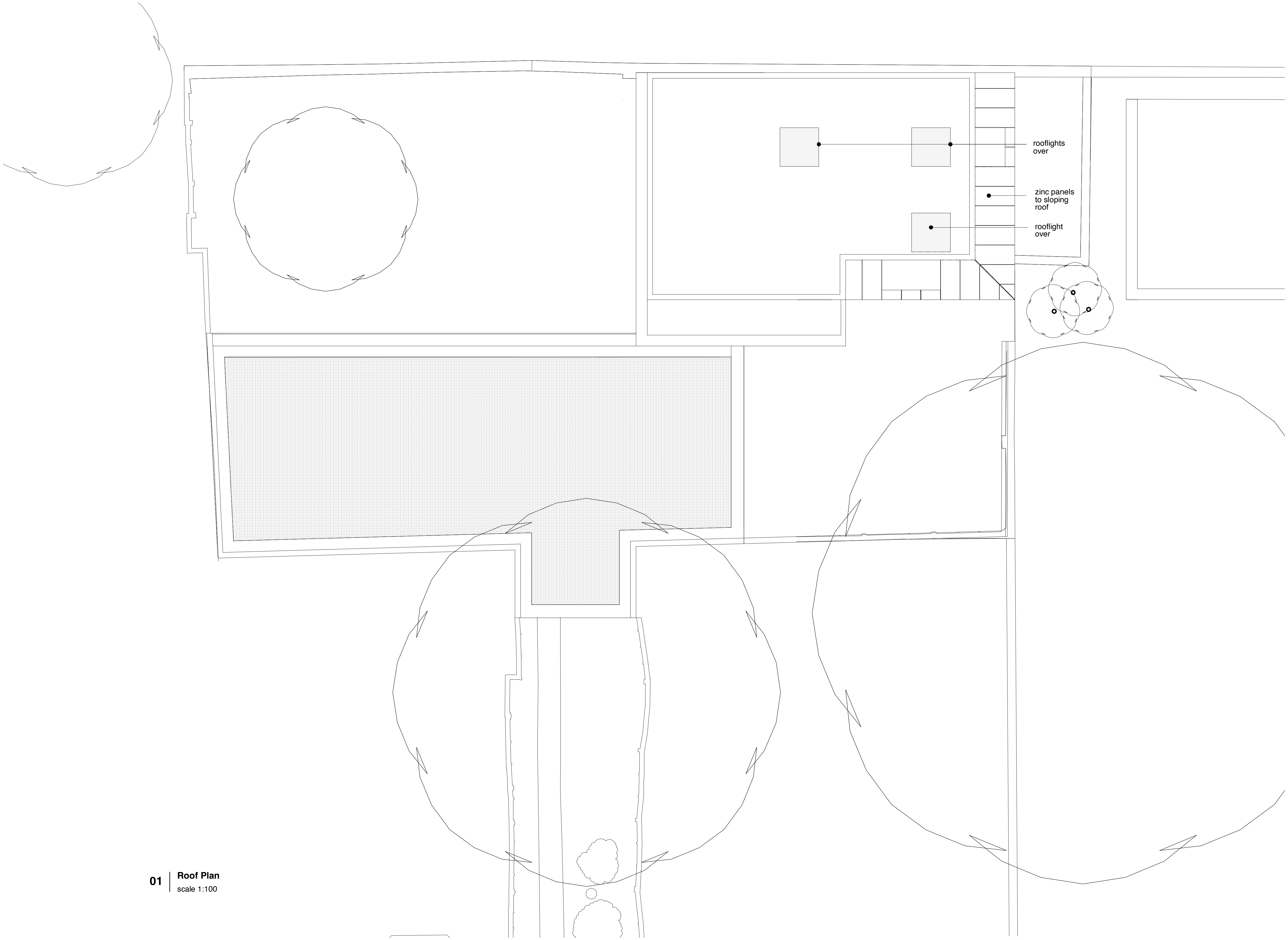
11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

project
22b harley road

drawing
first floor plan
proposed

scale	date	
1:100 @ A3	august 22	
job number	**drawing number**	**revision**
1169	111	p1



01 | **Roof Plan**
scale 1:100

notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

0 2.5m 5m

N

revision notes

planning

revision	date	comment
p1	16/09/23	Issued for planning

THEIS +KHAN

11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

project
22b harley road

drawing
roof plan
proposed

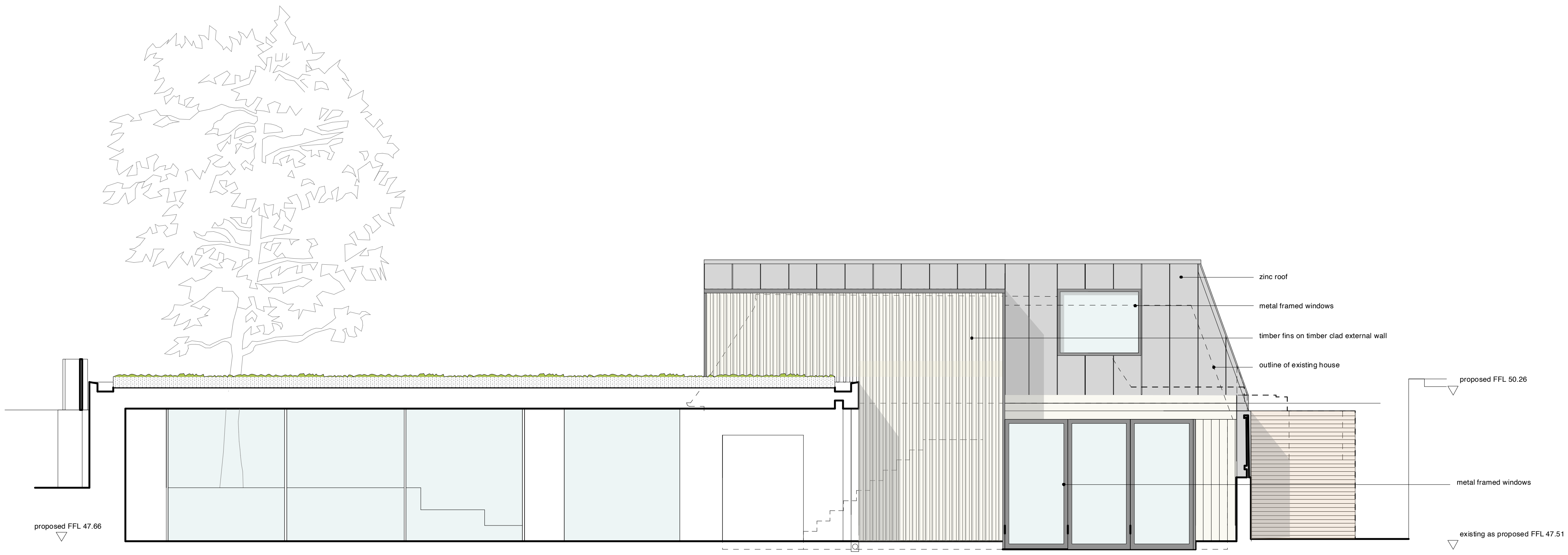
scale	date	
1:100 @ A3	august 22	
job number	drawing number	revision
1169	112	p1

notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

0 2.5m 5m



01 **Section BB East Elevation**
scale 1:100

revision notes

planning

revision	date	comment
p1	16/09/23	Issued for planning

THEIS +KHAN

11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

project
22b harley road

drawing
Section BB East Elevation
proposed

scale	date	
1:100 @ A3	august 22	
job number	**drawing number**	**revision**
1169	120	p1

01 | **Section CC West Elevation**
scale 1:100

notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

0 2.5m 5m

revision notes

planning

revision	date	comment
p1	16/09/23	Issued for planning

THEIS +KHAN

11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

project
22b harley road

drawing
Section CC West Elevation
proposed

scale	date	
1:100 @ A3	august 22	
job number	drawing number	revision
1169	121	p1

01 | **South elevation Long site Section AA**
scale 1:100

notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

0 2.5m 5m

revision notes

planning

revision	date	comment
p1	18/06/23	Issued for planning

THEIS +KHAN

11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

project
22b harley road

drawing
South elevation Long site Section AA
proposed

scale	date	
1:100 @ A3	august 22	
job number	**drawing number**	**revision**
1169	122	p1

01 | **North Elevation**
scale 1:100

notes

Do not scale, except for planning purposes.
All dimensions to be checked on site and verified with the architect prior to construction.
Any discrepencies or uncertainties regarding this drawing to be discussed with the architect prior to construction.

key

0 — 2.5m — 5m

revision notes

planning

revision	date	comment
p1	16/09/23	Issued for planning

THEIS +KHAN

11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094

mail@theisandkhan.com
www.theisandkhan.com

project
22b harley road

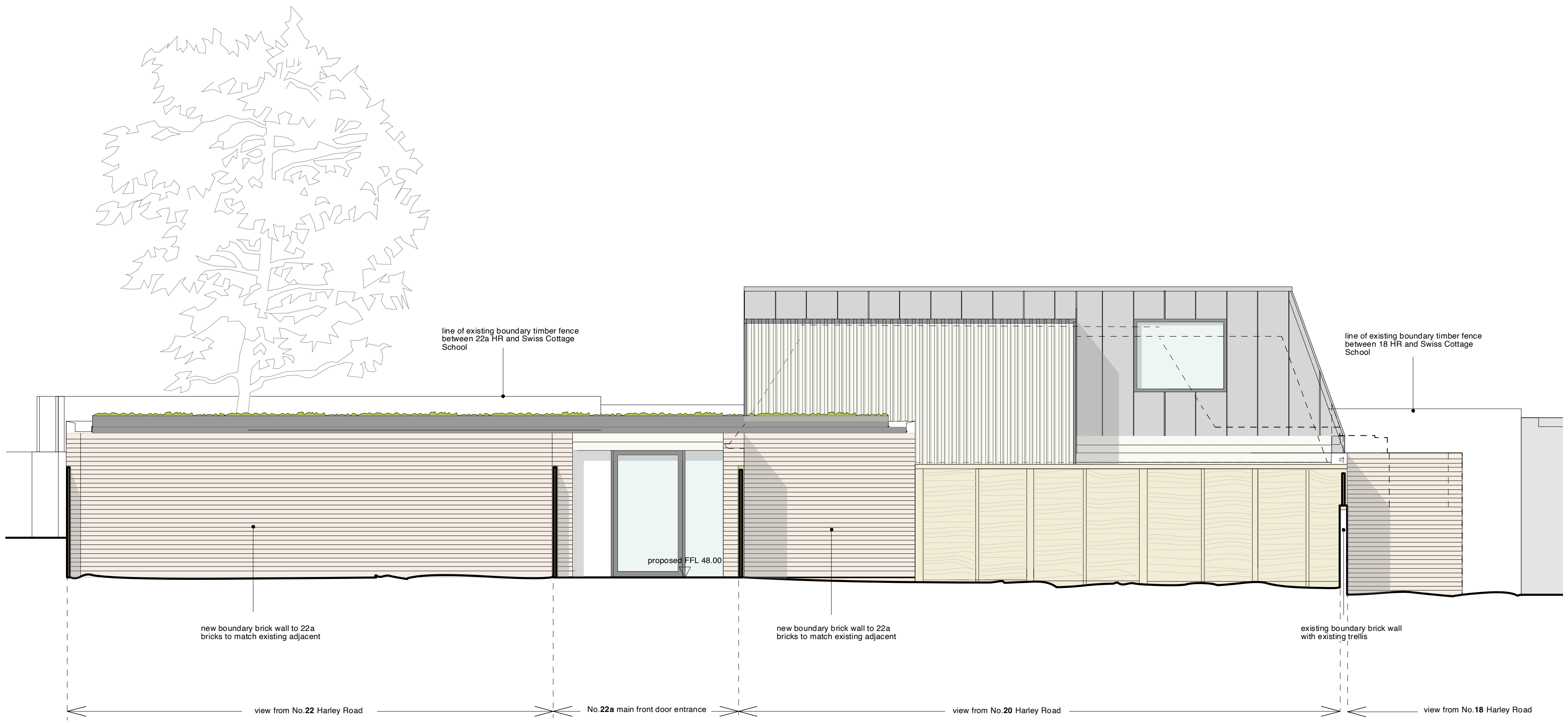
drawing
North elevation
proposed

scale	date	
1:100 @ A3	august 22	
job number	**drawing number**	**revision**
1169	123	p1

notes

key

0 2.5m 5m



01 **East entrance elevation**
scale 1:100

revision notes

planning

revision	date	comment
p1	16/09/23	Issued for planning

THEIS +KHAN
11-13 Lonsdale Gardens
Tunbridge Wells
Kent TN1 1NU
+44 (0)1892 518094
mail@theisandkhan.com
www.theisandkhan.com

project
22b harley road

drawing
East Entrance elevation
proposed

scale	date	
1:100 @ A3	august 22	
job number	**drawing number**	**revision**
1169	124	p1

Appendix A.2 –Thames Water Asset Location Data

Asset location search

Thames Water

Property Searches

Herrington Consulting Limited
Barham Business Park,Unit 6 Barham Business Park

CANTERBURY
CT4 6DQ

Search address supplied	Garden Flat 20 Harley Road London NW3 3BN
Your reference	3788/HA
Our reference	ALS/ALS Standard/2023_4850728
Search date	29 June 2023

Notification of Price Changes

From 1st April 2023 Thames water Property Searches will be increasing the prices of its CON29DW, CommercialDW Drainage & Water Enquiries and Asset Location Searches. Historically costs would rise in line with RPI but as this currently sits at 14.2%, we are capping it at 10%.

Customers will be emailed with the new prices by January 1st 2023.

Any orders received with a higher payment prior to the 1st April 2023 will be non-refundable. For further details on the price increase please visit our website at www.thameswater-propertysearches.co.uk

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

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0800 009 4540

Asset location search

Thames Water Property Searches

Search address supplied: Garden Flat, 20, Harley Road, London, NW3 3BN

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 0800 009 4540, 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

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.

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: 0800 009 3921
Email: developer.services@thameswater.co.uk

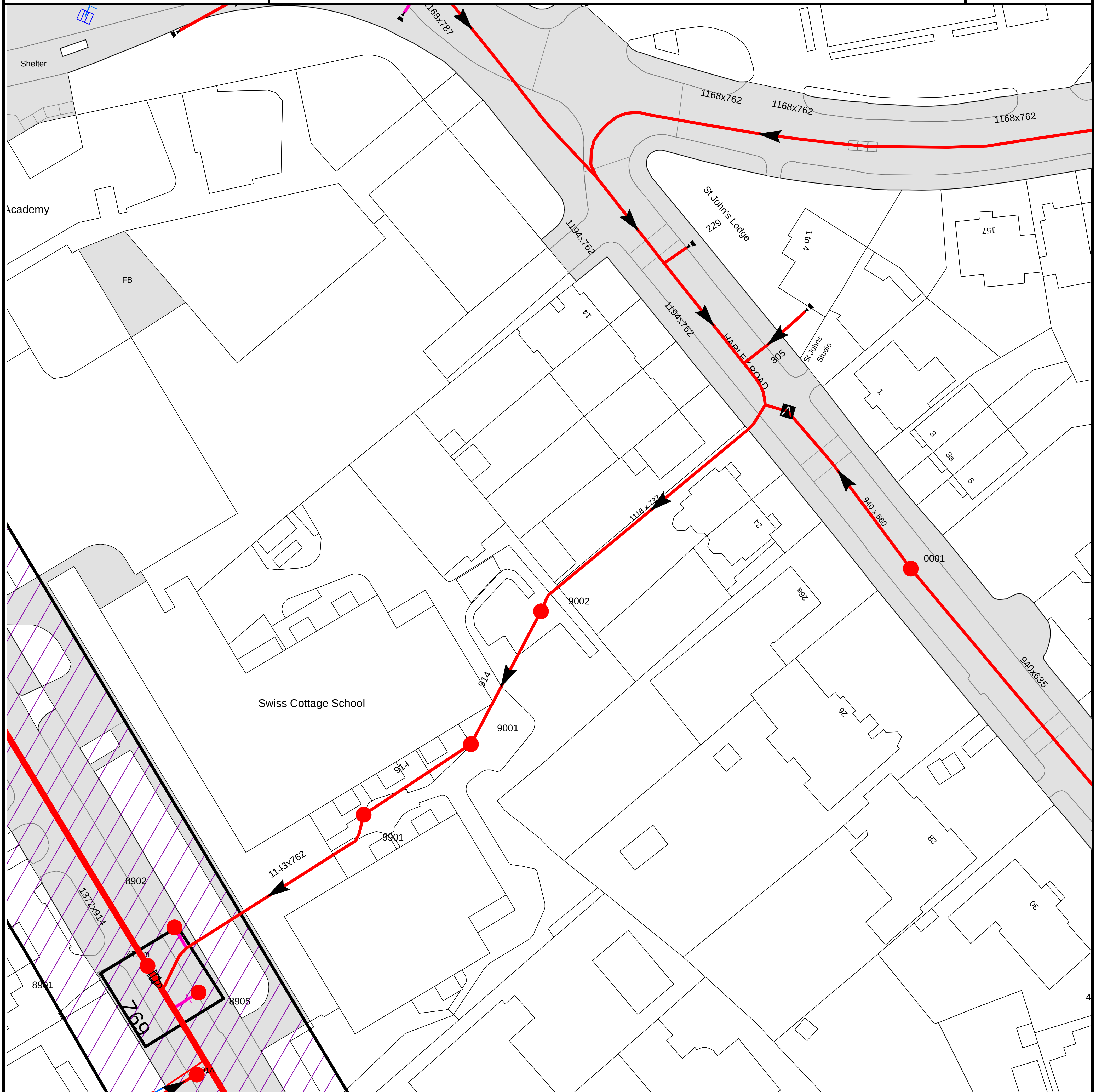
Clean Water queries

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: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2023_4850728



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 526942,184048

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
891A	46.81	43.31
8905	n/a	n/a
8901	47.37	42.69
8902	n/a	n/a
9901	47.61	44.07
9001	47.81	44.29
9002	48.22	44.47
0001	49.35	44.86

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.

Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

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

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

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

- Storm Sewer
- Sludge Sewer
- Foul Trunk Sewer
- Surface Trunk Sewer
- Combined Trunk Sewer
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Vacuum
- Thames Water Proposed
- Vent Pipe
- Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

- Sewer
- Culverted Watercourse
- Proposed
- Decommissioned Sewer
- Content of this drainage network is currently unknown
- Ownership of this drainage network is currently unknown

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
- Meter
- Dam Chase
- Vent
- Fitting

Operational Controls

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

- Ancillary
- Drop Pipe
- Control Valve
- 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.

- Inlet
- Outfall
- Undefined End

Other Symbols

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

- Change of Characteristic Indicator
- Public / Private Pumping Station
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Chamber
- Operational Site

Ducts or Crossings

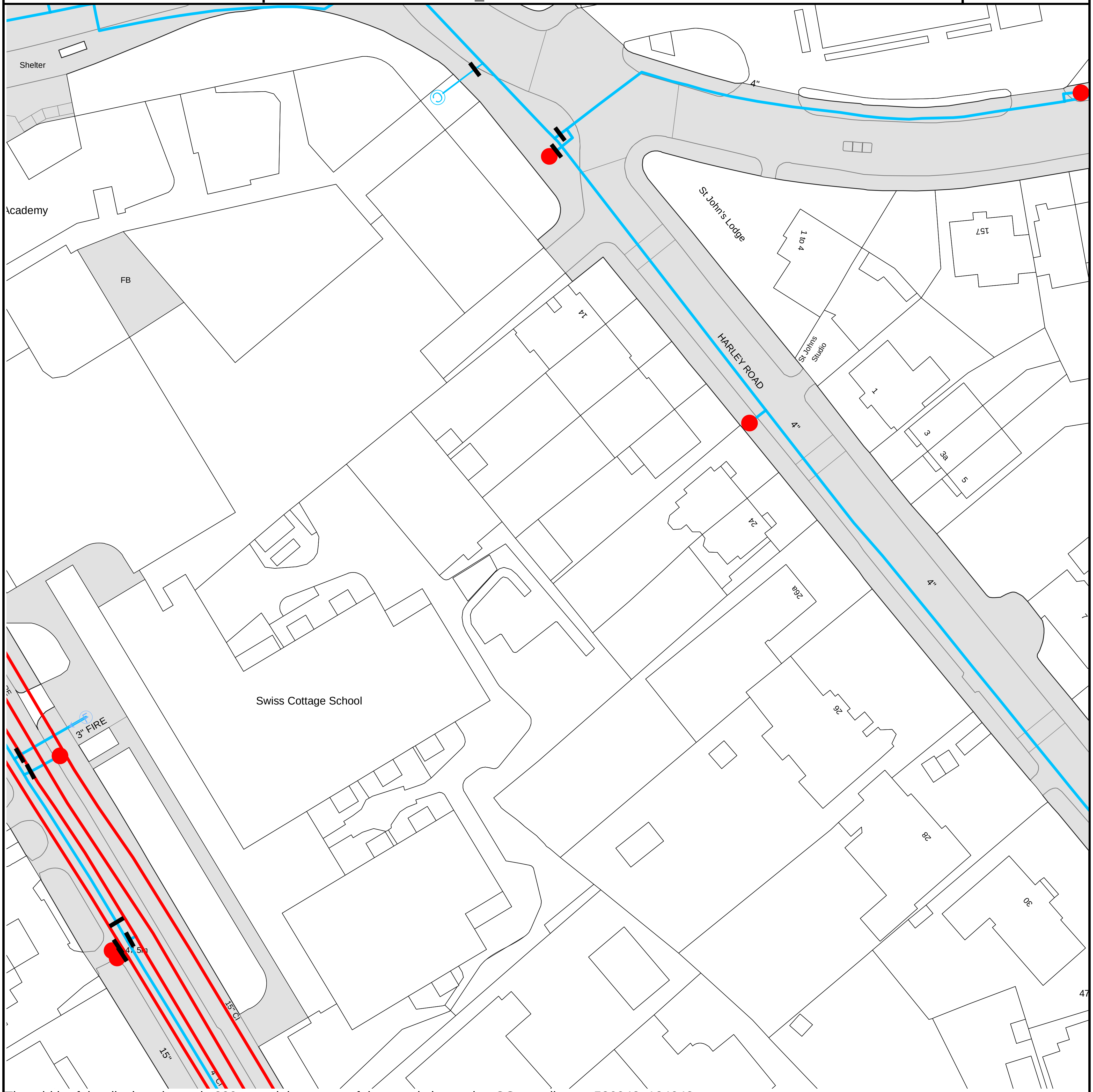
- Casement
- Conduit Bridge
- Subway
- Tunnel

Ducts may contain high voltage cables. Please check with Thames Water.

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plan are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the 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 indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. 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, please contact Property Searches on 0800 009 4540.

Asset Location Search Water Map - ALS/ALS Standard/2023_4850728



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 526942, 184048.

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.

Asset Location Search - Water Key

Water Pipes (Operated & Maintained by Thames Water)

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

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.

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

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

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.

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')

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

Casement: Ducts may contain high voltage cables. Please check with Thames Water.

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.

Payment 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 within 14 days of the 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. 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'.
5. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
6. 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 still not satisfied with the outcome provided, we will refer the matter to a Senior Manager for resolution who will provide you with a response.

If you are still dissatisfied with our final response, and in certain circumstances such as you are buying a residential property or commercial property within certain parameters, The Property Ombudsman will investigate your case and give an independent view. The Ombudsman can award compensation of up to £25,000 to you if he finds that you have suffered actual financial loss and/or aggravation, distress, or inconvenience because of your search not keeping to the Code. Further information can be obtained by visiting www.tpos.co.uk or by sending an email to admin@tpos.co.uk.

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 0300 034 2222 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**
Please Call **0800 009 4540** 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

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

Appendix A.3 – Indicative Drainage Layout Plan

GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS AND SPECIALISTS DRAWINGS AND THE SPECIFICATION.
2. ALL WORK IS TO BE CARRIED OUT IN ACCORDANCE WITH THE RELEVANT BRITISH STANDARDS, EUROPEAN NORMS, CODES OF PRACTICE AND BUILDING PRACTICE.
3. ALL DIMENSIONS ARE TO BE CHECKED BY THE CONTRACTOR PRIOR TO STARTING THE WORKS ON SITE. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
4. ALL DRAINAGE SYSTEMS WILL NEED TO BE INSTALLED AND DESIGNED FOR SUITABLE LOADING REQUIREMENTS.
5. THE CONTRACTOR SHALL OBTAIN PRIOR APPROVAL AND ALL NECESSARY LICENCES FROM THE THE HIGHWAY AUTHORITY AND/OR SEWERAGE UNDERTAKER BEFORE CARRYING OUT ANY WORKS.
6. THIS DRAWING WAS PRODUCED FOR USE IN CONJUNCTION WITH A PLANNING SUBMISSION AND SHOULD NOT BE USED FOR OTHER PURPOSES. A MORE DETAILED DESIGN INCLUDING PRODUCT SPECIFICATIONS WILL NEED TO BE PRODUCED PRIOR TO CONSTRUCTION.

KEY:

- SURFACE WATER DRAIN
- SURFACE WATER MANHOLE
- RAINWATER PIPE
- FLOW CONTROL DEVICE
- GRAVEL PATHS
- GEOCELLULAR STORAGE
- GREEN ROOF
- EXISTING PUBLIC COMBINED SEWER

herrington CONSULTING Part of eps
Canterbury | London | Cambridge | Bristol | Leeds
Tel : 01227 833855
enquiries@herringtonconsulting.co.uk
www.herringtonconsulting.co.uk

Rev	Description	Author	Checked	Date
P1	Revised issue	HA	EC	27/09/23
P0	First issue	HA	EC	26/07/23

CLIENT
PHILLIPS PLANNING SERVICES LTD

PROJECT
22B HARLEY ROAD, CAMDEN, LONDON

SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:100	3788	HA	EC

HC DWG REF.
3788_DWG_r1

DWG TITLE
INDICATIVE SURFACE WATER DRAINAGE LAYOUT

DWG No.
HC-3788-501

Appendix A.4 – Surface Water Management Calculations

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Hamza Askari
Site name:	Harley Road
Site location:	Camden

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.54107° N
Longitude:	0.17088° W
Reference:	3754039722
Date:	Jul 03 2023 15:24

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha):	0.0326

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.217
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.14

Hydrological characteristics

	Default	Edited
SAAR (mm):	640	644
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):		0.16
1 in 1 year (l/s):		0.14
1 in 30 years (l/s):		0.37
1 in 100 year (l/s):		0.51
1 in 200 years (l/s):		0.6

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	40	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	0.500
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	200.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Impermeable Areas	0.013	4.00	10.000	1000	-4.097	82.103	0.650
Outlet			10.000	1000	78.003	68.786	0.850

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Impermeable Areas	Outlet	20.000	0.600	9.350	9.150	0.200	100.0	150	4.33	200.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.005	17.8	13.2	0.500	0.700	0.013	0.0	96	1.099

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	20.000	100.0	150	Circular	10.000	9.350	0.500	10.000	9.150	0.700

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Impermeable Areas	1000	Manhole	Adoptable	Outlet	1000	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Impermeable Areas	-4.097	82.103	10.000	0.650	1000	0	1.000	9.350	150
Outlet	78.003	68.786	10.000	0.850	1000	1	1.000	9.150	150

Simulation Settings

Rainfall Methodology	FEH-13	Drain Down Time (mins)	10080	100 year (l/s)	0.9
Summer CV	1.000	Additional Storage (m³/ha)	20.0	Check Discharge Volume	✓
Winter CV	1.000	Check Discharge Rate(s)	✓	100 year 360 minute (m³)	
Analysis Speed	Normal	2 year (l/s)	0.2		
Skip Steady State	x	30 year (l/s)	0.7		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
10	0	0	0
30	0	0	0
100	0	0	0

Pre-development Discharge Rate

Site Makeup	Brownfield	Time of Concentration (mins)	5.00
Brownfield Method	MRM	Betterment (%)	0
Contributing Area (ha)	0.013	Q 2 year (l/s)	0.2
PIMP (%)	100	Q 30 year (l/s)	0.7
CV	1.000	Q 100 year (l/s)	0.9

Pre-development Discharge Volume

Site Makeup	Brownfield	CV	1.000	Betterment (%)	0
Brownfield Method	MRM	Return Period (years)	100	PR	1.000
Contributing Area (ha)	0.013	Climate Change (%)	0	Runoff Volume (m³)	12
PIMP (%)	100	Storm Duration (mins)	360		

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Impermeable Areas	10	9.389	0.039	2.6	0.0468	0.0000	OK
15 minute summer	Outlet	10	9.189	0.039	2.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Impermeable Areas	1.000	Outlet	2.6	0.713	0.146	0.0729	1.0

Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Impermeable Areas	10	9.412	0.062	6.0	0.0733	0.0000	OK
15 minute summer	Outlet	10	9.210	0.060	6.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Impermeable Areas	1.000	Outlet	6.0	0.895	0.338	0.1341	2.3

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Impermeable Areas	10	9.424	0.074	8.2	0.0879	0.0000	OK
15 minute summer	Outlet	10	9.221	0.071	8.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Impermeable Areas	1.000	Outlet	8.2	0.968	0.462	0.1695	3.2

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Impermeable Areas	10	9.439	0.089	10.9	0.1051	0.0000	OK
15 minute summer	Outlet	10	9.235	0.085	10.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Impermeable Areas	1.000	Outlet	10.9	1.034	0.614	0.2109	4.2

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	40	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	0.500
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	200.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Impermeable Areas	0.017	5.00	10.000	1200	-3.935	71.619	1.000
Outlet			10.000	1350	80.384	61.790	3.130
Storage			10.000	1350	32.676	65.916	2.200

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Impermeable Areas	Storage	5.000	0.600	9.000	8.550	0.450	11.1	450	4.72	167.3
1.001	Storage	Outlet	5.000	0.600	7.800	6.870	0.930	5.4	450	4.73	200.0

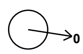
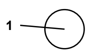
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	6.124	974.0	14.4	0.550	1.000	0.017	0.0	37	2.265
1.001	8.810	1401.2	17.2	1.750	2.680	0.017	0.0	35	3.114

Pipeline Schedule

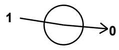
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	5.000	11.1	450	Circular	10.000	9.000	0.550	10.000	8.550	1.000
1.001	5.000	5.4	450	Circular	10.000	7.800	1.750	10.000	6.870	2.680

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Impermeable Areas	1200	Manhole	Adoptable	Storage	1350	Manhole	Adoptable
1.001	Storage	1350	Manhole	Adoptable	Outlet	1350	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
Impermeable Areas	-3.935	71.619	10.000	1.000	1200		0	1.000	9.000	450
Outlet	80.384	61.790	10.000	3.130	1350		1	1.001	6.870	450

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Storage	32.676	65.916	10.000	2.200	1350	1	1.000	8.550	450
									
						0	1.001	7.800	450

Simulation Settings

Rainfall Methodology	FEH-13	Skip Steady State	x	2 year (l/s)	0.3
Summer CV	1.000	Drain Down Time (mins)	10080	30 year (l/s)	0.9
Winter CV	1.000	Additional Storage (m³/ha)	20.0	100 year (l/s)	1.1
Analysis Speed	Normal	Check Discharge Rate(s)	✓	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	40	10	0

Pre-development Discharge Rate

Site Makeup	Brownfield	Time of Concentration (mins)	5.00
Brownfield Method	MRM	Betterment (%)	0
Contributing Area (ha)	0.017	Q 2 year (l/s)	0.3
PIMP (%)	100	Q 30 year (l/s)	0.9
CV	1.000	Q 100 year (l/s)	1.1

Node Storage Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	x
Invert Level (m)	7.800	Product Number	CTL-CHE-0043-1000-1200-1000
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.0	Min Node Diameter (mm)	1200

Node Storage Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	7.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	164

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	10.0	0.0	1.200	10.0	0.0	1.210	0.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Impermeable Areas	10	9.019	0.019	3.1	0.0285	0.0000	OK
15 minute summer	Outlet	1	6.870	0.000	0.6	0.0000	0.0000	OK
120 minute summer	Storage	78	7.919	0.119	1.5	1.2980	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Impermeable Areas	1.000	Storage	3.1	1.393	0.003	0.0111	
120 minute summer	Storage	Hydro-Brake®	Outlet	0.6				3.0

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
15 minute summer	Impermeable Areas	10	9.034	0.034	9.7	0.0493	0.0000	OK
15 minute summer	Outlet	1	6.870	0.000	0.6	0.0000	0.0000	OK
120 minute winter	Storage	96	8.277	0.477	2.9	5.2149	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute summer	Impermeable Areas	1.000	Storage	9.7	1.908	0.010	0.0253	
120 minute winter	Storage	Hydro-Brake®	Outlet	0.6				8.3

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Impermeable Areas	10	9.048	0.048	19.8	0.0728	0.0000	OK
15 minute summer	Outlet	1	6.870	0.000	0.8	0.0000	0.0000	OK
240 minute winter	Storage	184	8.942	1.142	3.7	12.4803	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Impermeable Areas	1.000	Storage	19.7	2.320	0.020	0.0426	
240 minute winter	Storage	Hydro-Brake®	Outlet	1.0				21.6

Appendix A.5 – Maintenance Schedules

Operation and Maintenance Schedule – Geo-Cellular Storage System		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months then annually
	Remove debris and sediment from the catchment surface, wherever is presents a risk to the performance of the drainage system,	Monthly, or as required based on inspection frequencies.
	Remove sediment from pre-treatment structurers (e.g. sediment traps) and from internal forebays	Annually or as required based on inspection frequencies
Remedial Actions	Repair; inlets, outlets, overflow pipes, and vent mechanisms	As required, based on inspections
	Replace tank or geotextile if significant damage is observed or geotextile is torn.	As required
Monitoring	Inspect and check all inlets, outlets, vents, and overflows to ensure that they are in good condition and operating as designed.	Following installation, and annually hereafter
	Survey inside of tank, and at any sediment trap mechanisms, for sediment build-up and remove sediment if necessary. Use inspections to develop a regular maintenance and inspection procedure for sediment removal.	Every 5 years, or as required if inspections show high siltation rates.

General Operation and Maintenance Table for Geo-Cellular Storage Systems

Operation and Maintenance Schedule – Green Roofs		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Routine Inspection	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Routine maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (i.e. year one), replace all dead plants as required	Monthly (usually the responsibility of the manufacturer)
	Post establishment replace dead plants as required (where >5% of coverage)	Annually (in Autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow gasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly or as required
Remedial Actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

General Operation and Maintenance Table for Green Roofs.

Operation and Maintenance Schedule – Water Butts		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Inspections and Maintenance	Inspection and cleaning of debris and sedimentation at the base of the tank.	At least once per year and following any noticeable deterioration in performance (e.g. observation of sediment entrained within water).
	Cleaning out of house guttering	As frequently as advised by maintenance plan for the property. Must be cleaned as soon as possible if blockage of guttering occurs.
	Inspection and repair of areas receiving overflow from the tank in the event of erosion	Inspected at least once every 3 months for the first year following installation, reduced inspection frequencies thereafter, at least once per year.
	inspection and repair of the inlet, outlet and overflows.	Inspected at least once every 3 months for the first year following installation, reduced inspection frequencies thereafter, at least once per year.
	cleaning of the tank, inlets, outlets, filters (if present) and removal of debris.	Inspected at least once every 3 months for the first year following installation, reduced inspection frequencies thereafter, at least once per year.
Remedial Maintenance	Repairing of any erosive damage or damage to the tank	As required, whenever damage leaks or erosion is detected.
	Inspection of the tank for debris, leaks or other damage and repair where necessary.	
	Inspection of area receiving overflow from the tank in the event of erosion	
Occasional maintenance	Replacement of any filters	When Required, due to clogging, or manufacturer specific instructions.

Typical Maintenance Requirements for Water Butts.