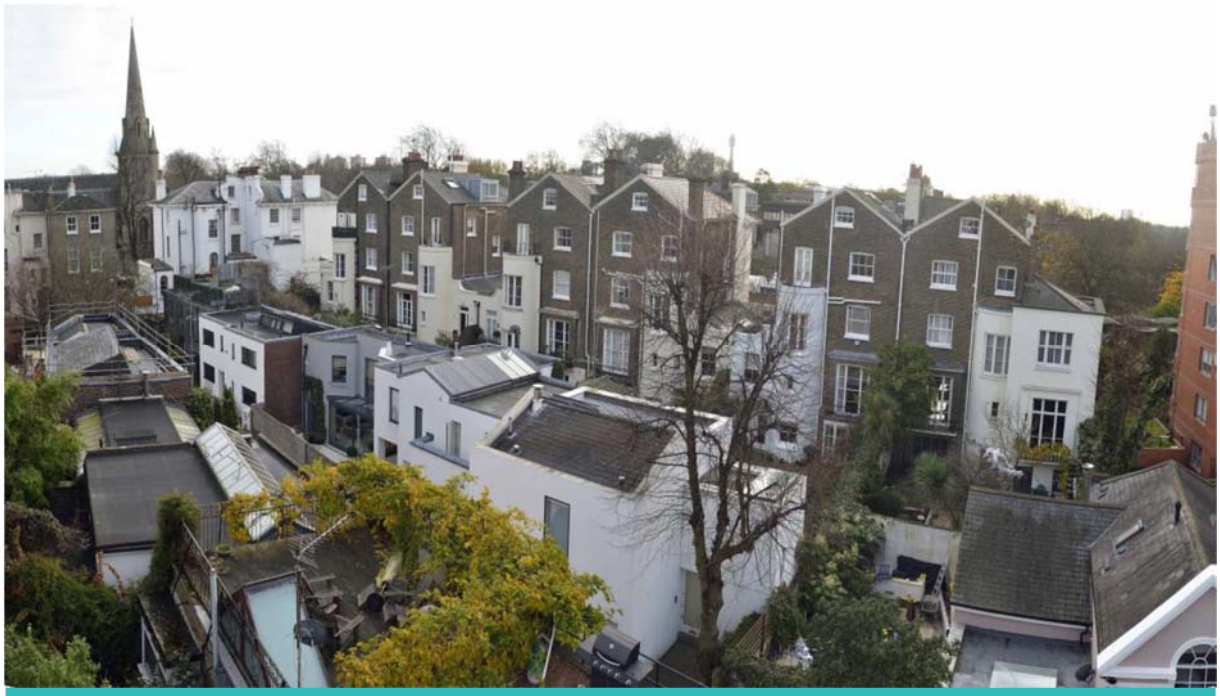
APPENDIX E

FRA & SUDS reports

GeoSmart Information

Environmental Thinking

SuDSmart Pro



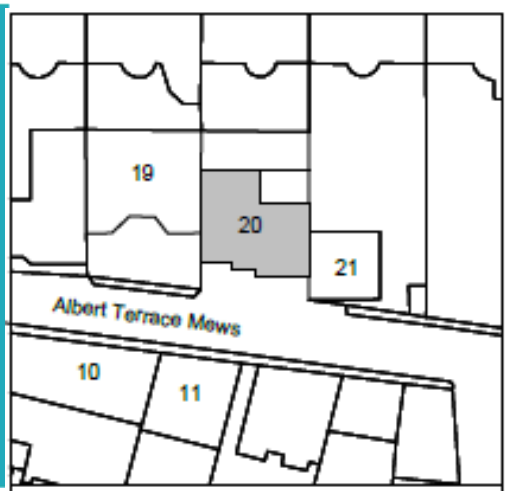
Report reference:	Report status:	Date issued:
70127.01R1rev4	Final	2017-09-22

Site address:

20 Albert Terrace Mews, London, NW1 7TA

Overview:

A combination of SuDS features, comprising GRP storage tank/crate, rainwater harvesting and permeable paving will reduce surface run-off and will be designed to attenuate for a minimum of 3.5 m³.



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1. Executive summary

This report assesses the feasibility of a range of SuDS options in support of the Site development process.

SuDS suitability

Risk	Issue	Result
SuDS suitability	What is the infiltration potential at the Site?	Low
	What is the potential to discharge to surface water features?	Low
	What is the potential to discharge to sewers?	High
Flooding	What is the overall flood risk at the Site?	Moderate
Pollution	Is the groundwater a protected resource?	No
	Is the surface water feature a protected resource?	No

SuDS runoff and volume summary

Potential increase in runoff due to the development*[1] Minimum attenuation assuming some off-site discharge.	Total runoff including climate change (+40%)*[1] Maximum attenuation assuming no off-site discharge	Change in impermeable area on a previously developed site As a % of total area
0 m^3	+11 m^3	0%

*[1] for the 6 hour, 1 in 100 year event excluding mitigation

A combination of SuDS features are proposed (see figure in section 2) comprising a GPS storage tank/crate within the basement and rainwater harvesting and permeable paving with underlying geocellular storage to the front of the property will work to intercept and attenuate surface water runoff; prior to discharging to the combined public sewer in Albert Terrace Mews. SuDS features should be designed to attenuate a minimum of 3.5 m^3, with the outflow rate from the site to the sewer limited to 1 l/s via an orifice control. This would ensure there would be no flooding on the Site during the 1 in 100 year Critical Storm Duration (0.5 hour) including a 40% allowance for climate change.

Based on the available geological information from the British Geological Society, a site investigation and the GeoSmart SuDS infiltration map, discharge to ground is not feasible due to the impermeability of the bedrock geology. There are no accessible water courses or surface water features within 100m of the Site and it would be extremely difficult to obtain third party agreements to connect to the nearest surface water feature therefore attenuated discharge to the existing combined sewer is likely to be the optimum sustainable drainage option for the new development area.

This would ensure compliance of the surface water drainage strategy with the minimum requirements stated within the London Plan, which states surface run-off from site must achieve at least 50% of the site's surface water runoff at peak times prior to re-development.

Next steps

Thames Water should be consulted to ensure acceptance and approval of the final design.

Additional considerations:

The final installation of the drainage system will ensure that walls are installed to prevent overland flow entering the basement area. A regular maintenance regime will be implemented for the basement sump pump and tank system.

Environmental and ecological considerations:

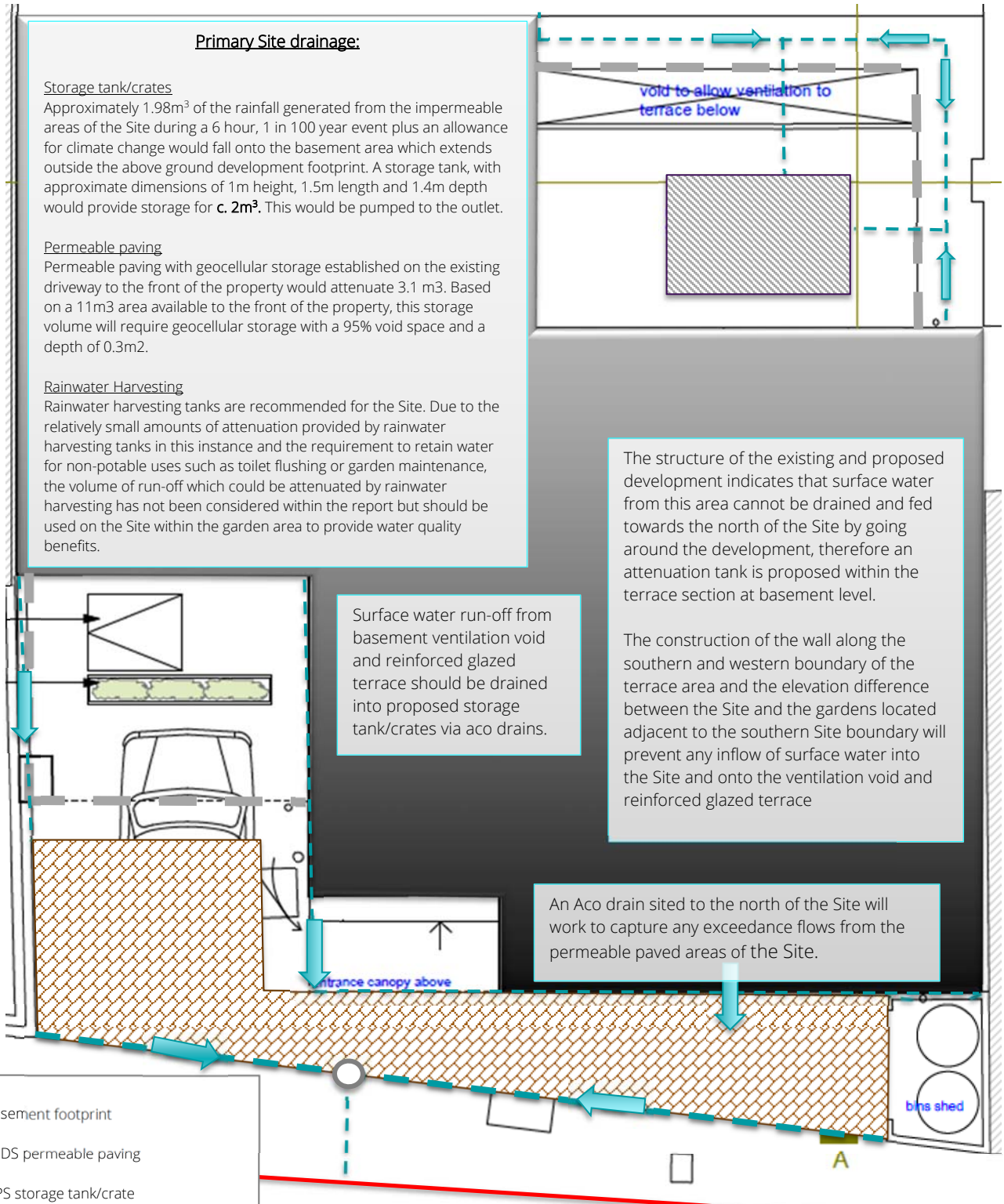
The Site is not located within a Special Protected Area (SPA) or a Site of Special Scientific Interest (SSSI).

CDM considerations:

If your development is defined as 'Construction Work' under CDM 2015, you or the organisation that is having the work carried out will be defined as 'the Client' and have specific duties under the Regulations. A full list of CDM considerations and our Terms and Conditions can be found on our website, the links can be found in section 14 at the back of this report.

2. Potential SuDS scheme options layout

The potential surface water drainage strategy is indicated below with further supporting information provided in subsequent sections. This would provide a minimum attenuation of 3.5m^3 for the development (attenuation required for the 1 in 100 year rainfall event (critical storm duration) including an allowance for climate change (40%) with run-off to the public sewer with controlled discharge to 1 l/s (reduction of more than 50% of existing run off volumes)). Total storage provided: 5.1 m^3.



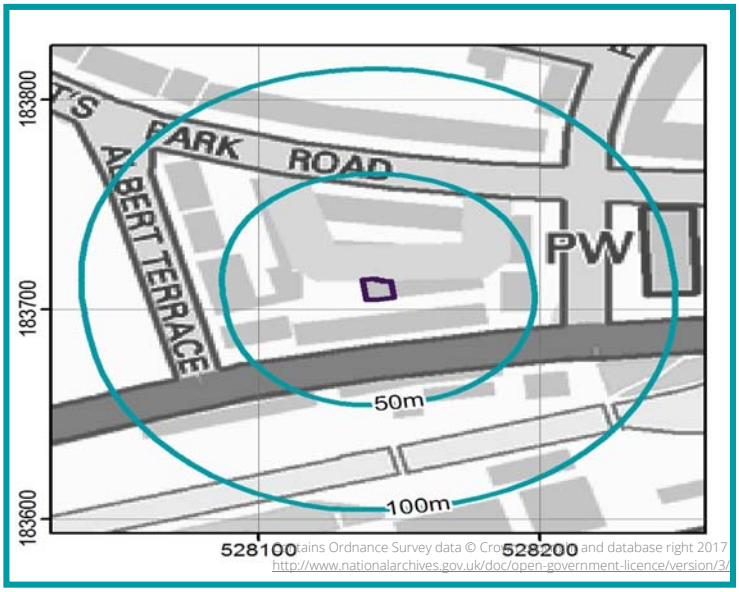
A small orifice control will be required to reduce the into the surface water sewer to an acceptable rate.

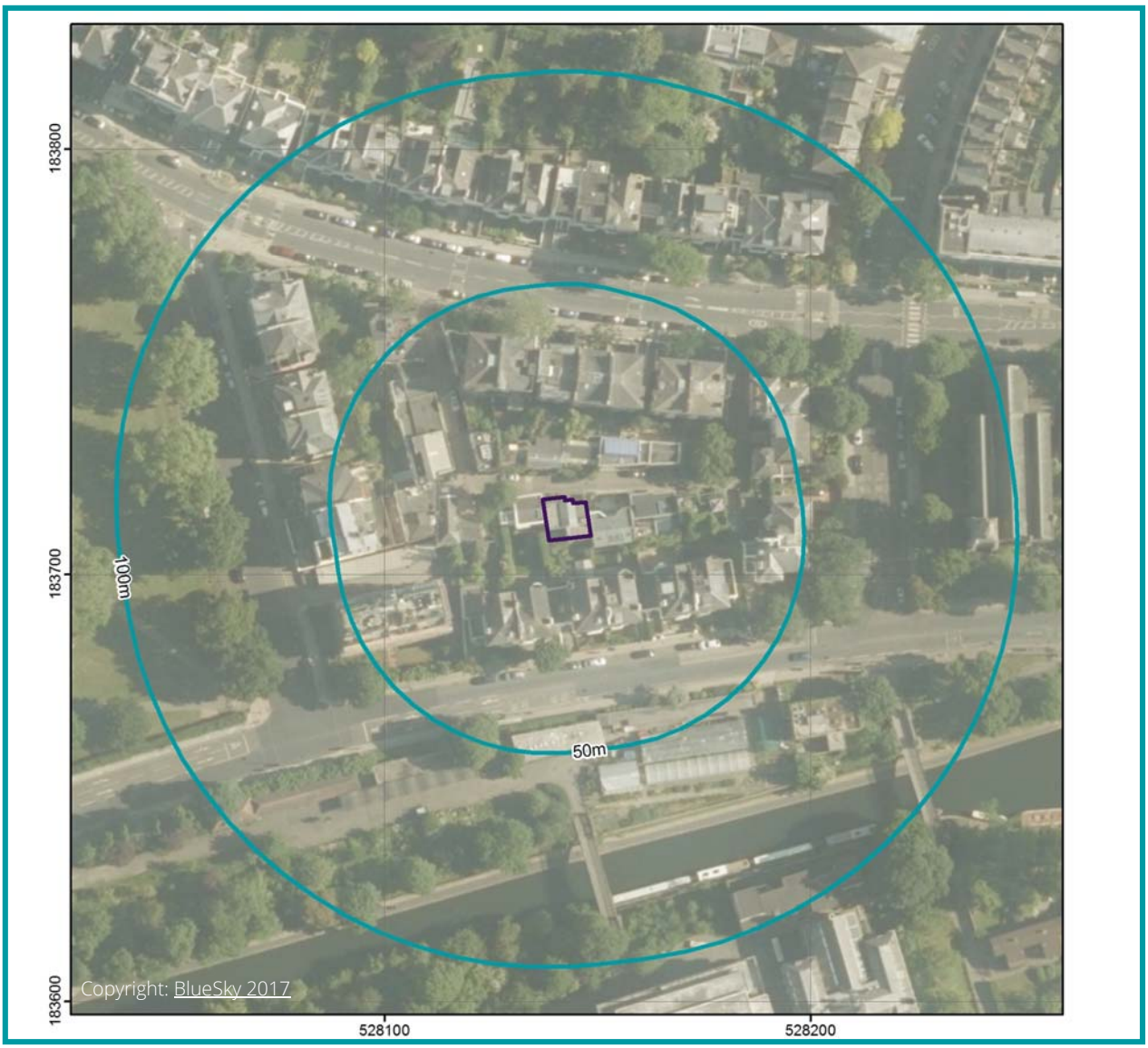
Orifices are a circular or rectangular opening of a shape and size (small diameter holes) which allows a controlled rate of outflow when submerged.

The flow rate depends on the height of the water above the opening (hydraulic head) and the size and edge treatment of the orifice.

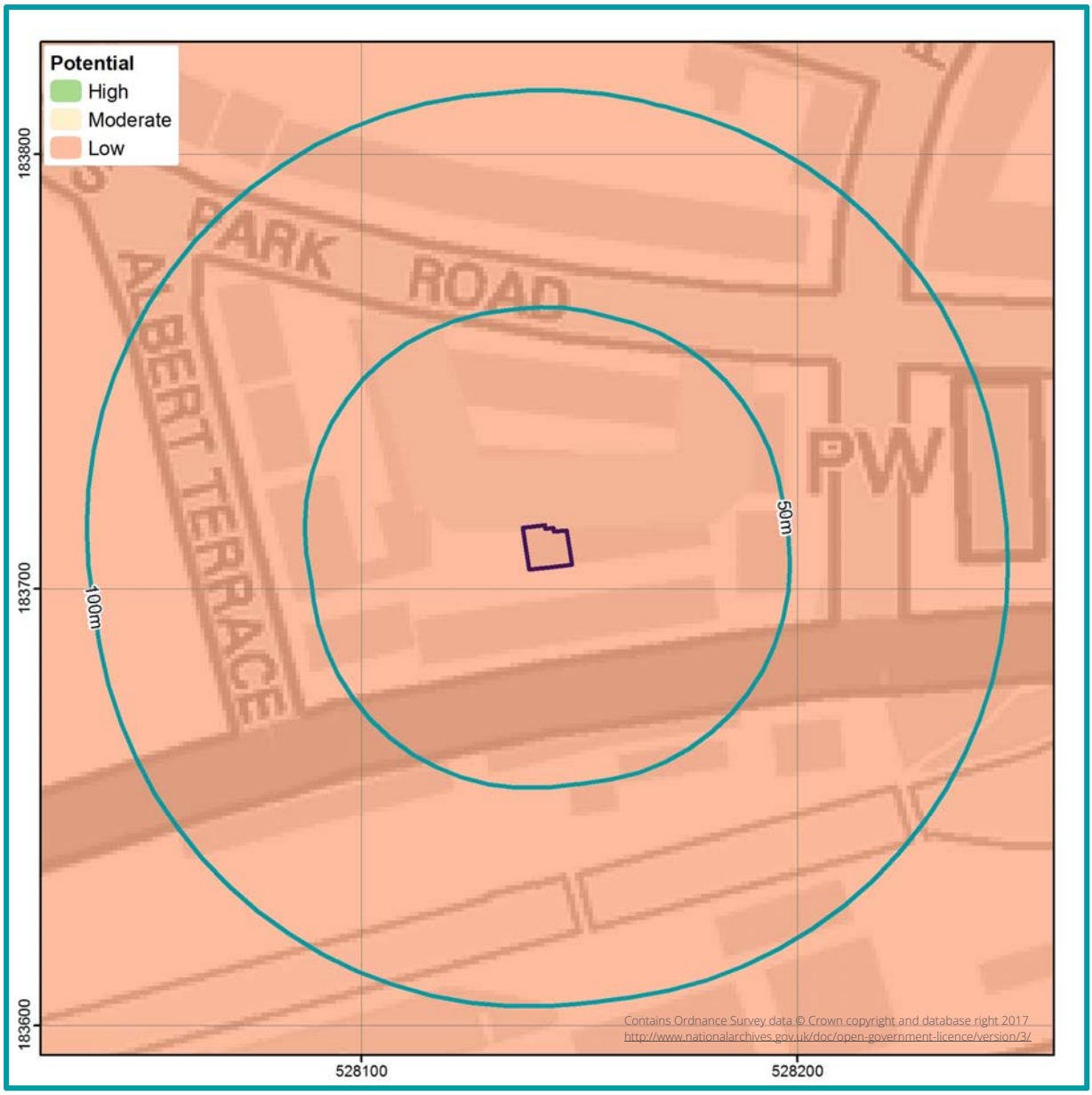
3. Site location

Report prepared on:
2017-09-01
Site area:
91m^2
Current use:
Residential property
Proposed use:
Formation of a basement floor level and the creation of a rear lightwell.
Report writer:
Bob Sargent
Report reviewer:
Paul Ellis





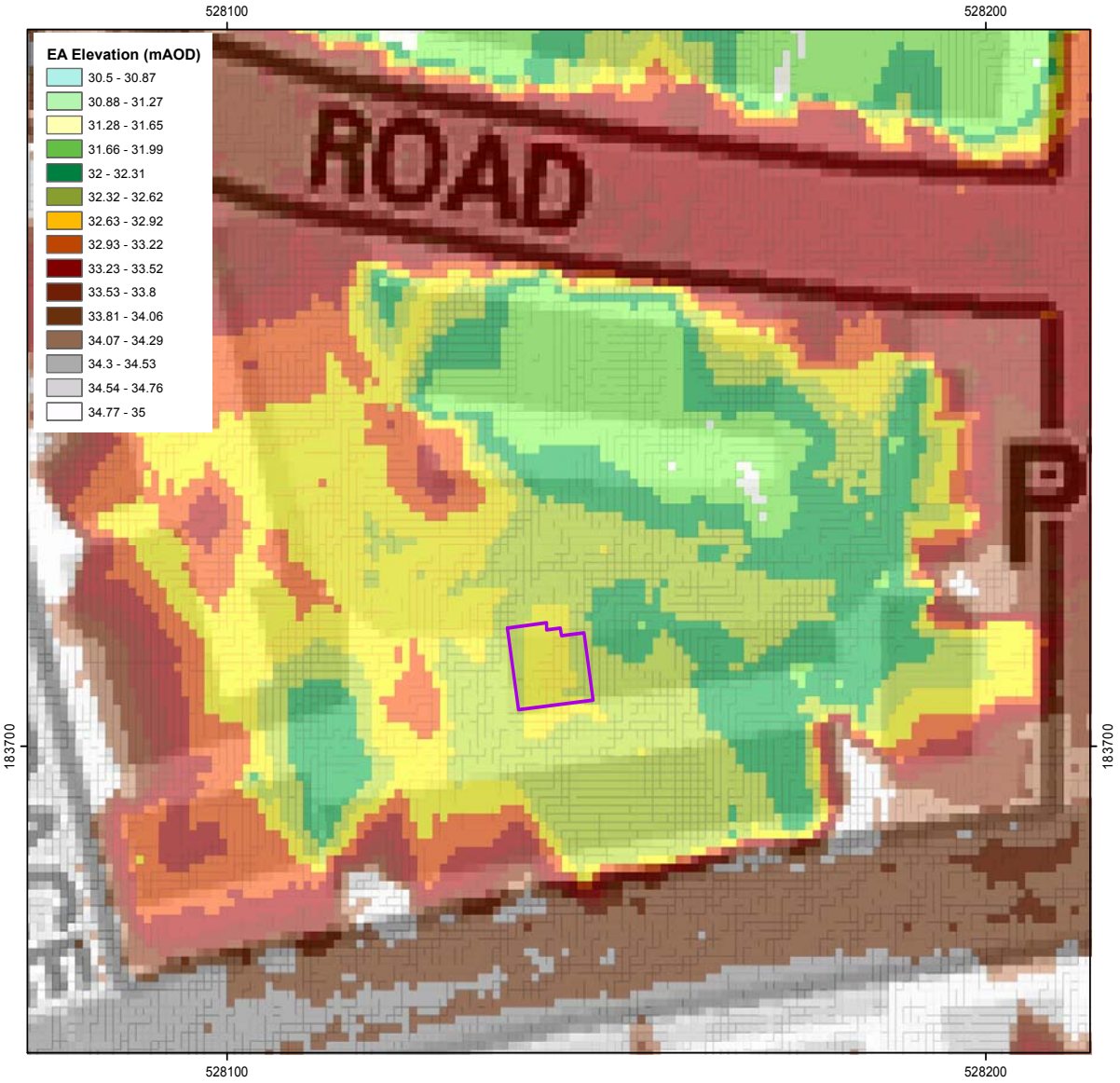
4. SuDS infiltration suitability (SD50) map



The GeoSmart SuDS Infiltration Suitability (SD50) Map screens the potential for infiltration drainage at the Site and indicates where further assessment is recommended. The Site has a low potential for infiltration SuDS, according to the GeoSmart infiltration map due to the impermeable nature of the underlying clay bedrock. Guidance states that if infiltration SuDS are not possible, attenuation SuDS with a controlled discharge into nearby surface water feature or existing surface water drainage is recommended (London Plan, 2016. London Plan SPG, 2014)

The map combines information on the thickness and permeability of the underlying material and the depth to the high groundwater table. A site investigation indicates the underlying London Clay is located underneath a layer of made ground (depth of between 0.70-0.85 metres below ground level (mbgl)) with no trace of unmapped superficial deposits. See Section 14 for further discussion.

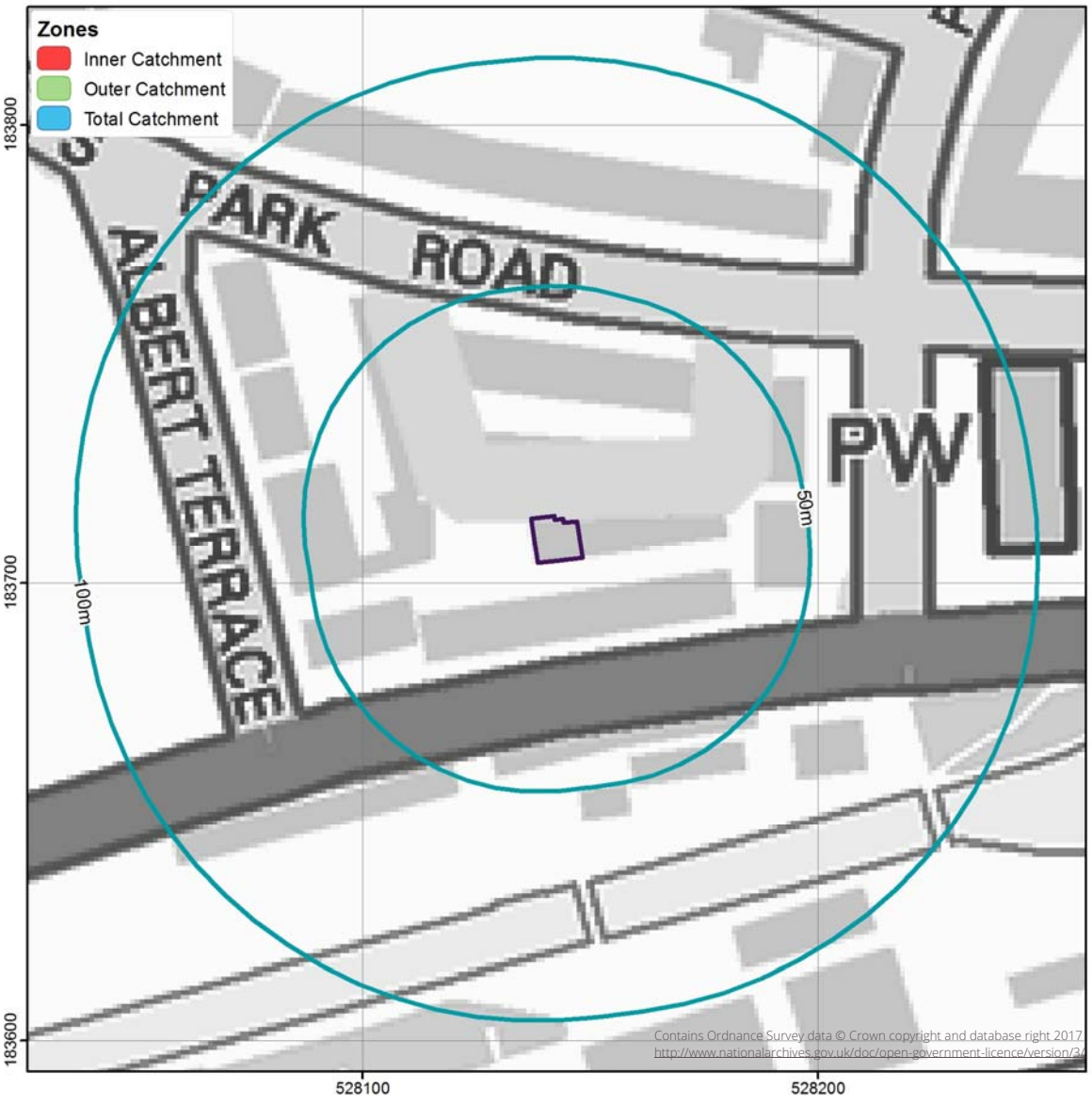
5. Site topography



GeoSmart have undertaken an assessment of the topography at the Site and within its vicinity, using LiDAR elevation data from the Environment Agency. Assessment has been undertaken using GIS/OS mapping data as well as interrogation of LiDAR DTM5 elevation data, to identify localized depressions.

Mapping indicates that there is a fall from North to South from Regents Park Road to the connecting section of Albert Terrace Mews by approximately 1m. Albert Terrace Mews declines towards the East with the lowest point of the mews located towards the South East corner (approximate elevation 31.9 mAOD). Mapping shows the gardens located adjacent to the southern boundary of the Site (relating to the houses on Prince Albert Road) are approximately 0.75m below the existing garden level of 20 Albert Terrace Mews.

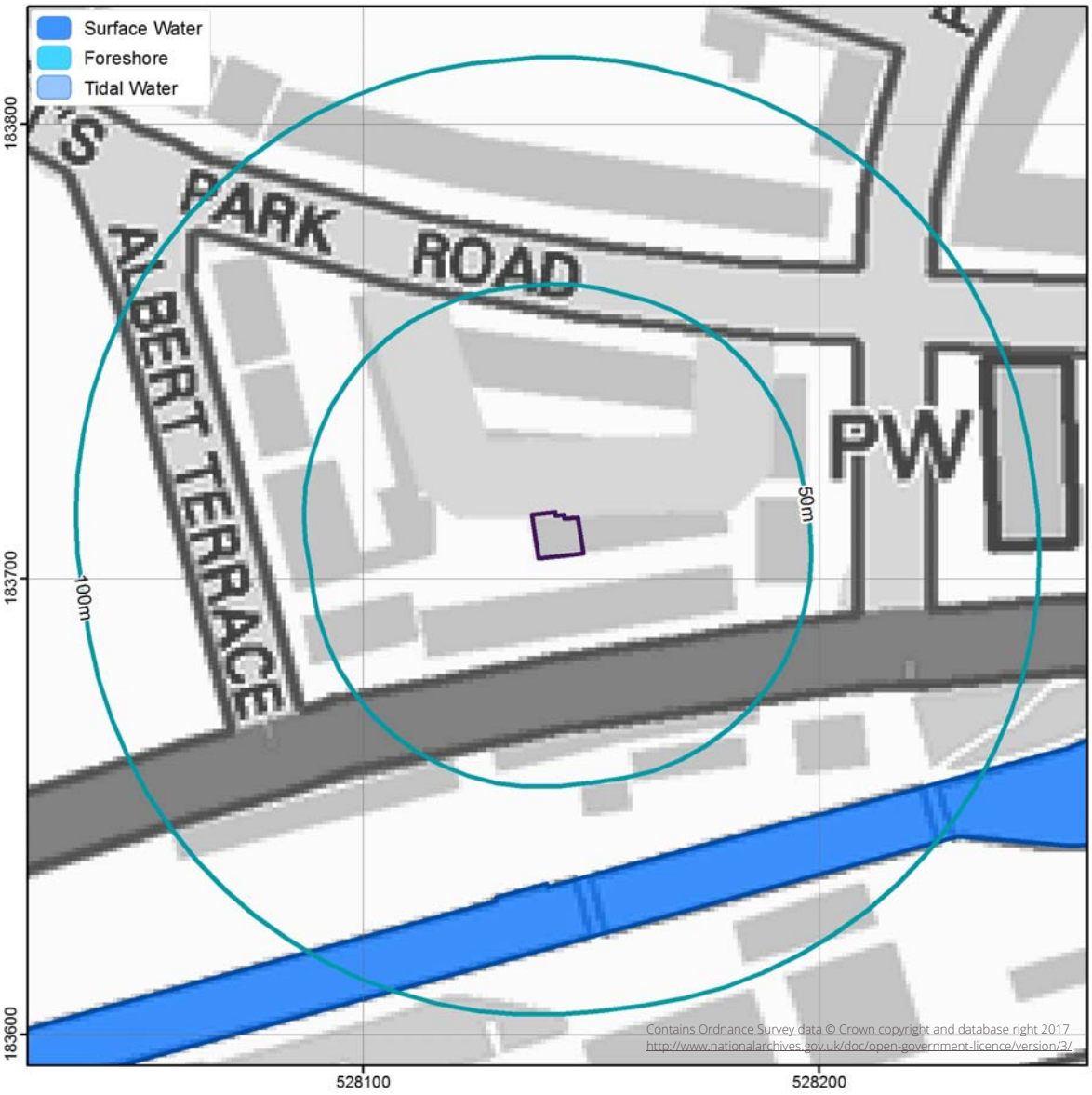
6. Source protection zone map



GeoSmart have undertaken an assessment of the Environment Agency groundwater Source Protection Zones (SPZ) within the vicinity of the Site.

The site is not within a source protection zone, therefore infiltration to the ground, if feasible, would be acceptable.

7. Surface water features map



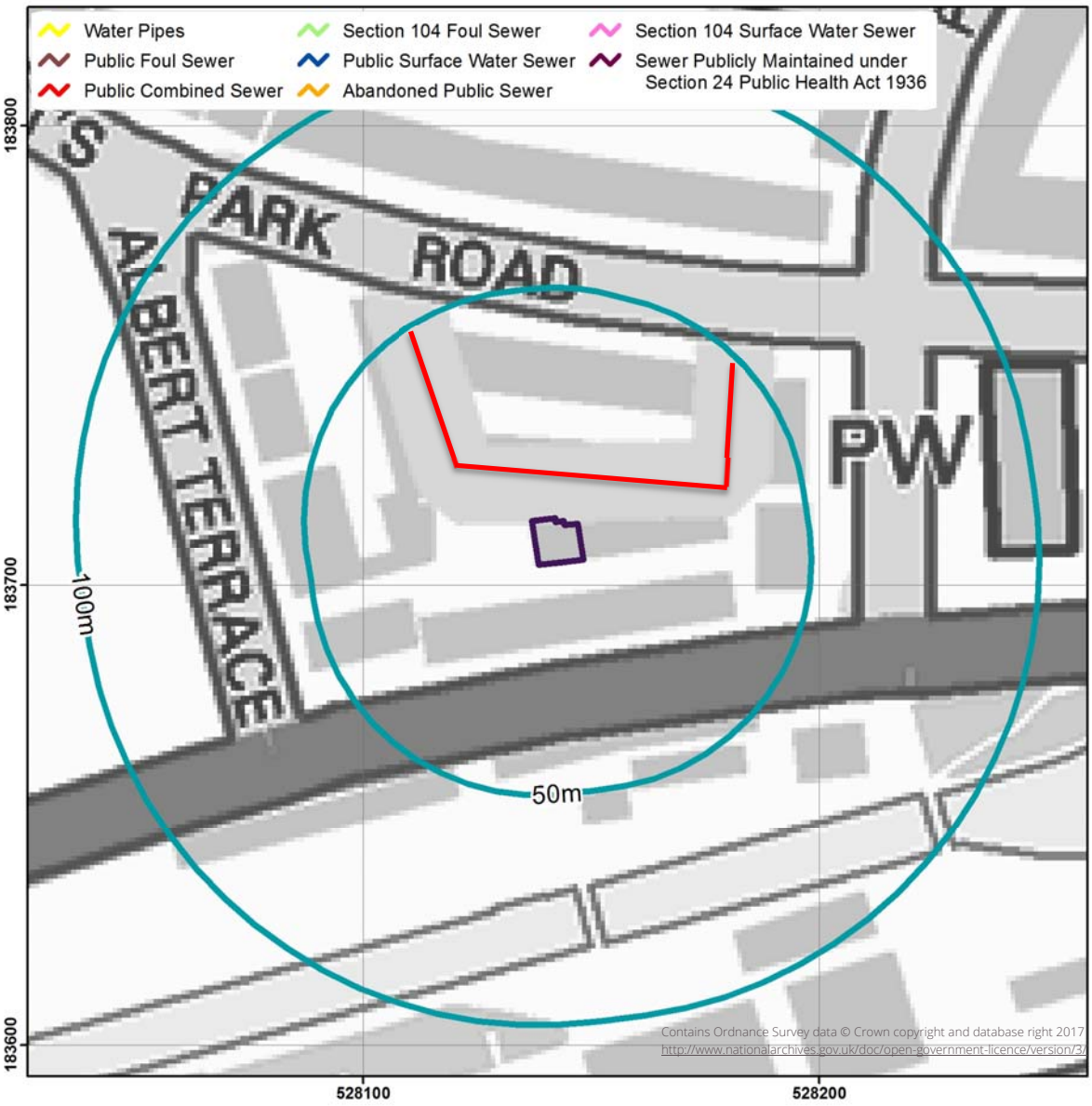
GeoSmart have undertaken an assessment of the location of surface water features within the vicinity of the Site.

The Site is over 50m from a surface water body. Discharge to surface water is unlikely to be appropriate.

While the Grand Union Canal is located within 100m of the Site, a connection would involve crossing over major road networks which would not be permissible.

The Site is also not located within 250m of a SSSI.

8. Sewer features map

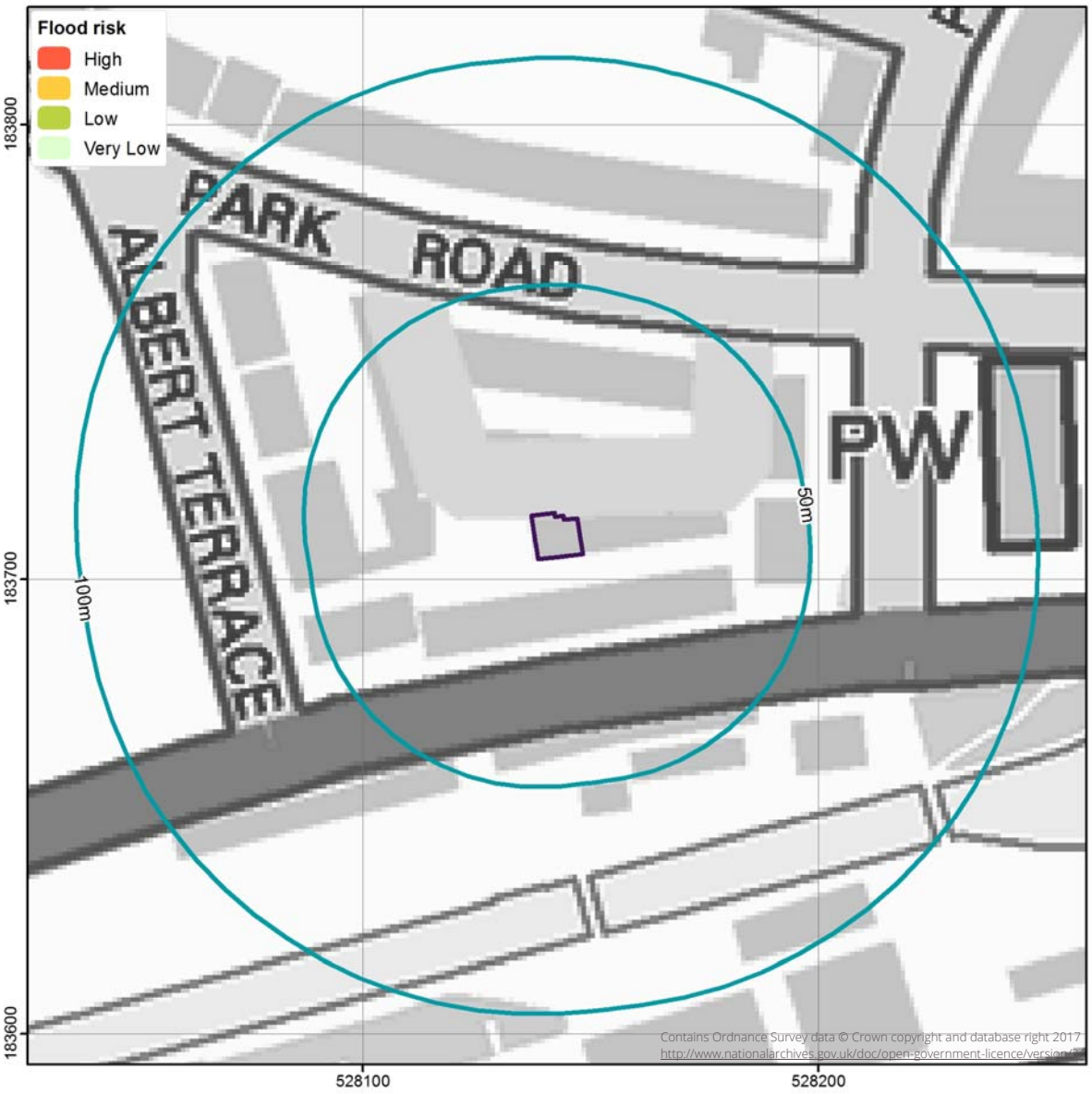


GeoSmart have undertaken an assessment of the location of sewer features within the vicinity of the Site.

The Site is within 50m of a combined sewer, therefore discharge to sewer is a feasible option. It is understood that the Site currently drains to the combined sewer located along Albert Terrace Mews which will continue with the re-development of the Site. The implementation of the SuDS features discussed within this report will work to reduce the volume and rate of water entering this sewer system, measures which are not currently in place on the development.

Thames Water should be consulted to ensure acceptance and approval of the final design.

9. Risk of flooding from rivers and sea map



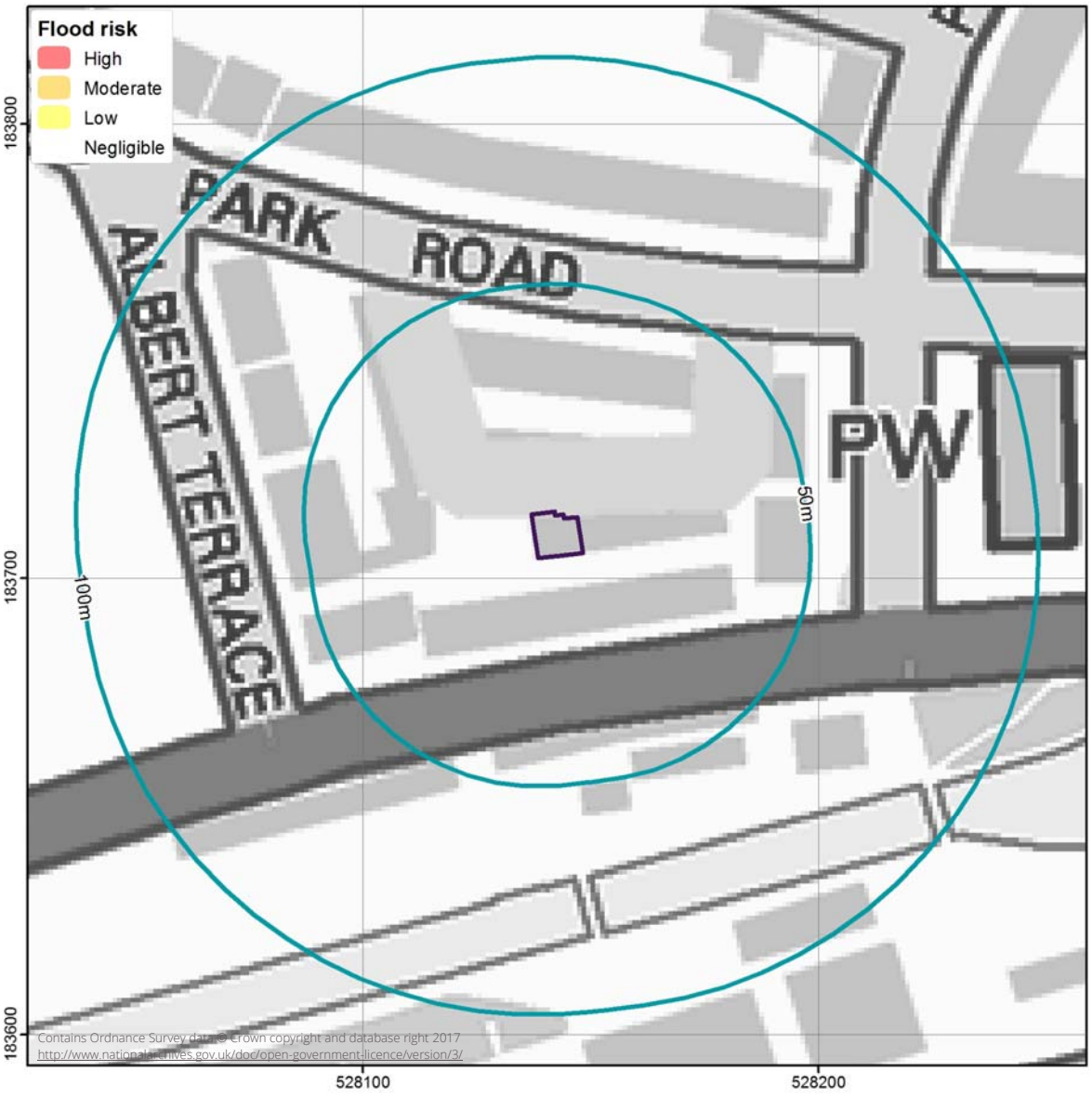
GeoSmart have undertaken an assessment of the risk of flooding from the rivers and the sea within the vicinity of the Site.

According to the Environment Agency's mapping, London Borough of Camden Strategic Flood Risk Assessment (URS Ltd, 2014) and a site specific Flood Risk Assessment (GeoSmart, Report Ref: 70127R1), the Site has a very low risk of fluvial or coastal flooding.

10. Risk of flooding from surface water map

GeoSmart have undertaken an assessment of the risk of flooding from pluvial sources within the vicinity of the Site. The mapping shown above confirms pluvial flood depths in a 1 in 100 year storm event would not affect the Site. According to the Environment Agency's Risk of Flooding from pluvial sources and a site specific Flood Risk Assessment (GeoSmart, Report Ref: 70127R1), the Site is at 'Moderate Risk of pluvial flooding where depths could range between 0.3m to 0.9m above ground level on areas of the Site which have an elevation of under 32.7 mAOD along the southern boundary up to and during a 1 in 100 year flood event. According to updated Figure 6 of the SFRA, the Site is located within a Critical Drainage Area (CDA)(Group3_003). The Site is also located within the Primrose Hill Local Flood Risk Zone (LFRZ) (URS Ltd, 2014). The gardens of Prince Albert Terrace are located at least 0.75m - 1.0m below the southern ground level of the Site which is likely to divert surface water away from the development. Mitigation measures are included within the development design to prevent the accumulation of surface water and restrict inflow of surface water to the basement via the proposed ventilation void in the south of the Site. These measures comprise the construction of a 1.1m high wall, rising to 2m along the southern boundary to prevent the inflow and a cavity drainage system is included within the current specification.

11. Groundwater flood risk (GW5) map



According to GeoSmart's Groundwater Flood Risk (GW5) map and a site specific Flood Risk Assessment (GeoSmart, Report Ref: 70127R1), the Site has a negligible risk of groundwater flooding during the 1 in 100 year event.

This is supported by the Site Investigation which included groundwater monitoring. The only ground water encountered was encountered on the monitoring visit in borehole WS2 at 5.04mbgl.

Therefore SuDS design is unlikely to be affected at the Site by flooding through the underlying geology.

12. Site conditions

Site information

The purpose of this report is to assess the potential for disposing of surface water through a sustainable drainage system (SuDS) for the site of 20 Albert Terrace Mews, London, NW1 7TA (the Site). The Site is located in Camden in a setting of residential use. The general level of the Site is between 32.84 and 32.34 mAOD with the Site declining gradually in a northerly and easterly direction from a centre point of the Site. In relation to the area surrounding the Site, Albert Terrace Mews declines towards the East with the lowest point of the mews located towards the South East corner (approximate elevation 31.9 mAOD). Mapping shows the gardens located adjacent to the southern boundary of the Site (relating to the houses on Prince Albert Road) are elevated approximately 0.75m below the existing garden level of 20 Albert Terrace Mews. This is based on EA elevation data obtained for the Site to a 1m resolution with a vertical accuracy of ±150 mm.

Development

The Site is currently used within a residential capacity. Development proposals comprise the formation of a basement floor level and the creation of a rear lightwell to provide a single additional bedroom, a media room, storage, a plant room and a bathroom. Access to the basement is via an internal stairwell.

A wall is proposed to a height of between 1.1m, rising to 2m along the southern and western boundary of the terrace area to prevent the inflow of surface water into the ventilation void and a cavity drainage system is included within the current specification to remove the impacts of surface water to internal areas.

Geology, permeability and thickness

A number of different formations underlie the site and each formation may have a range of permeability.

Geology present on site		Potentially permeable?
Superficial geology	None recorded	N/A
Bedrock geology	London Clay Formation	✘

The Site has a low potential for infiltration SuDS, according to the GeoSmart infiltration map. This is due to the impermeable nature of the underlying

London Clay bedrock. As a result, focused infiltration methods such as soakaways are unlikely to be practically feasible for this Site. Guidance states that if infiltration SuDS are not possible, attenuation SuDS with a controlled discharge into nearby surface water feature or use of a public surface water / combined drainage system is recommended (London Plan, 2016. London Plan SPG, 2014).

A site investigation has been undertaken by Card Geotechnics Ltd in June 2017 to support a Basement Impact Assessment. which excavated two hand-dug trial pits to a depth of 1.8m below ground level and two window sample boreholes to a depth of 7 m below ground level, undertaken in accordance with BS5930 and BS10175. The window sample borehole records indicate the underlying London Clay is located underneath a layer of made ground (depth of between 0.70-0.85 metres below ground level (mbgl)) with no trace of unmapped superficial deposits.

Depth to groundwater

The Site investigation also included groundwater monitoring. The only ground water encountered was encountered on the monitoring visit in borehole WS2 at 5.04mbgl. The base of the infiltration/attenuation system needs to be 1m above the expected seasonal high water table. Passage through unsaturated soil is important for improving the quality of infiltrating water before it reaches the water table. The infiltration system should be designed to operate in periods of extreme groundwater levels.

Ground conditions

A Site specific review of ground conditions is recommended to ensure focused infiltration does not cause ground instability as a result of landslide or collapse associated with dissolution or shallow mining. Hazards that should be considered include soluble rocks, landslides, compressible ground, collapsible ground, shrink-swell clays, running sand and shallow mining.

In this instance the infiltration potential is low as the permeability of the underlying geology is low, therefore discharging via infiltration is considered extremely unlikely.

Water quality

The site does not lie within a source protection zone. In this case an assessment of the quality of infiltrating runoff and the possibilities for pre-treatment is not required.

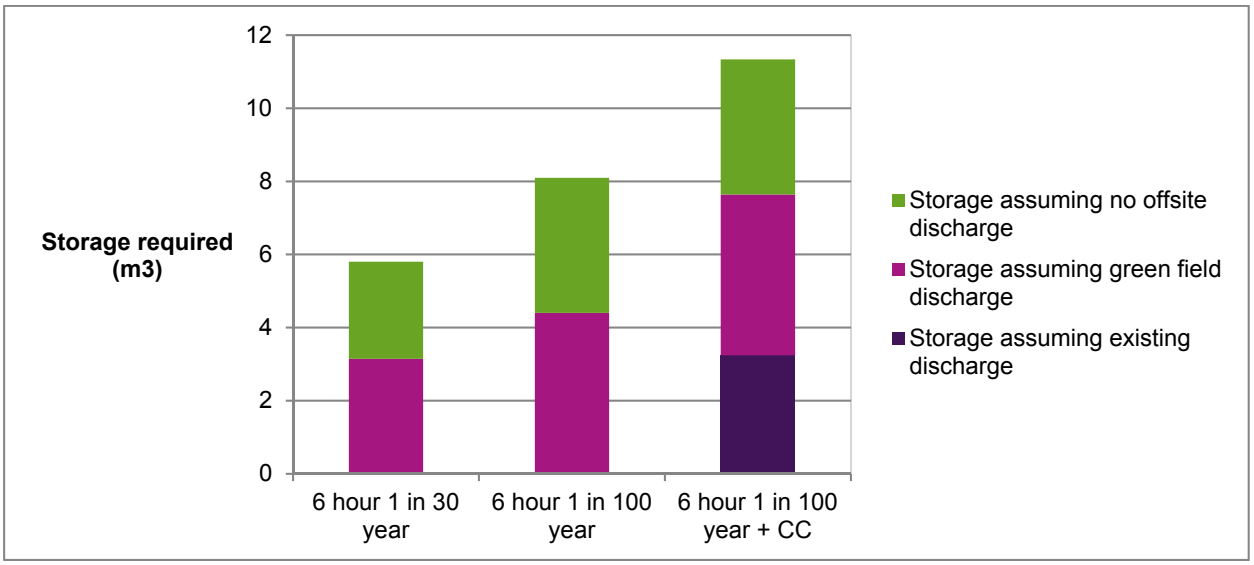
The influence of surface runoff on water quality will depend on whether there is a source of contamination on Site and the sensitivity of the receiving environment, either groundwater or surface water. The intervening pathway

from source to receptor including mitigation and natural attenuation will determine the final impact.

The impact of contaminants on groundwater will be reduced by travel and natural attenuation through the unsaturated soil zone. A greater depth of unsaturated zone and the presence of significant clay and organic material will provide greater protection for the underlying groundwater. Rapid flow through fractures will provide less protection than intergranular flow around soil and rock particles.

13. Storage, volume and peak flow rate

Suggested minimum and aspirational storage requirements for an infiltration SuDS scheme for the development footprint are set out below with more detail provided in subsequent sections. Storage volumes may be reduced (but not below the minimum level) if the design incorporates off-site discharge.



Attenuation scenario	Attenuation requirement (m^3)	Explanation
Minimum (Recommended)	3.5	Attenuation required to achieve a minimum 50% reduction in run off volume across the development and as close to three times the greenfield run off rate as is feasibly practical This would also ensure more than 50% of the Site's (prior to re-development) surface water runoff is attenuated in line with the minimum requirements stated within the London Plan's SDC SPG (2014) and the London Borough of Camden Planning Guidance (CPG 3: Sustainability) (2015) (See Appendix B and overleaf).
Medium	7.6	Attenuation required to ensure surface water runoff is reduced to the greenfield volumes for the 1 in 100 year (6 hour) storm event, including a 40% allowance for climate change in line with the London Plan - Policy 5.13 Sustainable drainage (March, 2016).
Maximum	11	Storage required assuming no off site drainage for the 6 hour 1 in 100 year event, including the maximum effects of climate change. *Note: discharge off site will reduce this, and the increase as a result of climate change is less for buildings with a limited design life.*

London Drainage Policy

London Plan - Policy 5.13 Sustainable drainage (March, 2016)

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

1. store rainwater for later use;
2. use infiltration techniques, such as porous surfaces in non-clay areas;
3. attenuate rainwater in ponds or open water features for gradual release;
4. attenuate rainwater by storing in tanks or sealed water features for gradual release;
5. discharge rainwater direct to a watercourse;
6. discharge rainwater to a surface water sewer / drain;
7. discharge rainwater to the combined sewer.

London Plan - Sustainable design and Construction SPG: Section 3.4.9 (April, 2014)

Most developments have been able to achieve at least 50% attenuation of the site's (prior to re-development) surface water runoff at peak times. This is the minimum expectation from development proposals.

On previously developed sites, runoff rates should not be more than three times the calculated greenfield rate. The only exceptions to this, where greater discharge rates may be acceptable, are where a pumped discharge would be required to meet the standards or where surface water drainage is to tidal waters and therefore would be able to discharge at unrestricted rates provided unacceptable scour would not result.

Discharge to surface water course/sewer

There may be situations where it is not appropriate to discharge at greenfield runoff rates. These include, for example, sites where the calculated greenfield runoff rate is extremely low and the final outfall of a piped system required to achieve this would be prone to blockage.

London Borough of Camden Planning Guidance (CPG 3: Sustainability) (July, 2015)

Within Camden, SuDS systems must be designed in accordance with London Plan policy 5.13. This requires that developments should utilise SuDS unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible.

Camden Development Policy 23 (Water) requires developments to reduce pressure on combined sewer network and the risk of flooding by limiting the rate of run-off through sustainable urban drainage systems.

Camden Planning Guidance 3 (CPG3) requires developments to achieve a greenfield run off rate once SuDS have been installed. Where it can be demonstrated that this is not feasible, a minimum 50% reduction in run off rate across the development is required.

Surface water runoff

An increase in impermeable area on site will result in greater rainfall runoff. Reduction in runoff will help mitigate flood risk both on and off site. Further information on the surface water runoff calculations is provided in Section 6 'Background Information'.

Guidance

The Non-Statutory Technical Guidance for SuDS (Defra, March 2015) states:

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

Table 1: Change in impermeable area associated with the development

Total site area	91 m^2

Impermeable area (and as a percentage of the total area of the proposed development footprint of 91m^2)	
Pre-development	Post-development
91 m^2 (100%)	91 m^2 (100%)
Impermeable Land use: Residential development and hard standing patio area Permeable Land use: None	New impermeable land use: 91 m^2 residential development and basement footprint New permeable land use: None

Guidance

"The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event' and 'flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development"

(Defra, March 2015, non-statutory guidance).

Peak discharge rates

The table below presents peak discharge rates for a range of storm events used to assess the impact of the proposed development and select the maximum permitted discharge rate. Further information on the calculation and control of peak discharge rates is provided in Section 6 'Background Information'.

Table 2: Peak discharge rates associated with the development

Rainfall event	Greenfield runoff rates	Existing runoff rates[1] (l/s)	Potential runoff rates without attenuation	Potential minus existing (l/s)
QBAR	0.04	N/A	N/A	N/A
6 hour 1 in 1 year	0.03	0.11	0.11	0.00
6 hour 1 in 10 year	0.06	0.20	0.20	0.00
6 hour 1 in 30 year	0.09	0.27	0.27	0.00
6 hour 1 in 100 year	0.13	0.37	0.37	0.00
6 hour 1 in 100 year + 20% CC	N/A	N/A	0.45	0.07
6 hour 1 in 100 year + 40% CC	N/A	N/A	0.52	0.15

[1] Assumes 100% runoff from impermeable surfaces. Assumes Greenfield runoff from permeable surfaces calculated using the IoH124 method.

Relevant local and regional plan policy has been consulted to determine restrictions on runoff from previously developed sites. In some cases green field rates may be requested. In practice it is difficult to restrict discharge rates at any one control point to less than 5 l/s.

Total discharge volumes

The table below presents discharge volumes for a range of storm events used to assess the impact of the proposed development and calculate the required storage volumes. Further information on the calculation of total discharge volumes is provided in Section 18 'Methodology and Limitations'.

Table 3: Total discharge volumes associated with the development

Rainfall event	Greenfield runoff volume (m^3)	Existing runoff volume[2] (m^3)	Potential runoff volume without attenuation (m^3)	Potential minus existing (m^3)
QBAR	1	N/A	N/A	N/A
6 hour 1 in 1 year	1	2	2	0.0
6 hour 1 in 10 year	2	4	4	0.0
6 hour 1 in 30 year	3	6	6	0.0
6 hour 1 in 100 year	4	8	8	0.0
6 hour 1 in 100 year + 20% CC	N/A	N/A	10	2
6 hour 1 in 100 year + 40% CC	N/A	N/A	11	3

[2] Assumes 100% runoff from impermeable surfaces. Assumes Greenfield runoff from permeable surfaces calculated using the IoH124 method.

Climate change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high-intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the National Planning Policy Framework (NPPF) recommends that the effects of climate change are incorporated into Flood Risk Assessments (NPPF technical guidance note, DCLG, 2012).

Updated guidance (March 2016) on climate change recommends that both the 20% Central Allowance and 40% Upper End allowances should be added to the peak rainfall intensity for residential or commercial development, to understand the range of impacts. Where feasible, a precautionary approach should be taken particularly in areas at risk of flooding.

Table 4: Peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper End	10%	20%	+40%
Central	5%	10%	+20%

Critical Storm Duration and volume requirements

According to calculations of runoff rate from the Site (table 2 within the section above), the Greenfield QBar run-off rate is c. 0.04 l/s. The existing run-off rates for the 1 in 100 year (6 hour) storm event are 0.3 l/s.

- Restricting flow rates to three times the greenfield runoff rate would result in a run-off rate of 0.12 l/s.
- Restricting run-off rates to 50% of the existing 1 in 100 year (6 hour storm) would result in a run-off rate of 0.15 l/s.

None of these flow rates from the Site are feasibly practical.

Flow control products available on the market can control flow rates to a minimum of 1 l/s via an orifice (where the risk of flooding is low and the impacts of blockage are minimal), therefore this is the discharge rate recommended within this report.

Appendix B presents storage volumes for the 1 in 100 year plus climate change (40%) and the critical storm duration where runoff is limited to a maximum discharge rate of 1 l/s. A maximum discharge rate of 1 l/s is a low rate therefore measures to prevent blocking of the orifice may need to be incorporated. A perforated raiser tube section with controls at each end would enable the control to function. A slightly different anti-clogging design would include debris guards, hooded outlets and orifices protected within T-pieces.

According to calculations within Appendix B, the critical storm duration is 0.5 hours when applying a discharge rate of 1 l/s, this would require a maximum attenuation volume of 3.5m^3. This would also ensure the development is able to achieve at least 50% attenuation of the site's (prior to re-development) surface water runoff volume at peak times and would actually provide attenuation for 73% of the existing runoff.

An enquiry was sent to Campbell Reith to establish a preferred discharge rate for the site on the 4th September 2017 however no response had been received within the timeframe allocated to this report (See Appendix B).

14. Runoff destination

Options for the destination for the runoff generated on-site have been assessed in line with the prioritisation set out in the Building Regulations Part H document (HM Government, 2010) and Defra's Draft National Standards for SuDS (2011). Flow attenuation using infiltration SuDS (discharge to ground) is generally the preferred option. If discharge to ground is not available, runoff discharge to surface water is the other preferred method. Only if these two options are impractical should discharge to the sewer network be considered.

Discharge to ground

As discussed in Section 3, the Site has a low potential for infiltration. Based on the available geological information from the British Geological Society, a site investigation and the GeoSmart SuDS infiltration map, discharge to ground is unlikely to be feasible due to the impermeability of the bedrock geology.

Discharge to surface watercourse

There are no watercourses or surface water features within 50 m of the Site. The Grand Union Canal is within 100m of the Site however providing a connection to this feature would involve works underneath the A5205 which is unlikely to be permissible.

Therefore, it would be extremely difficult to obtain third party agreements to connect into the nearest surface water feature. The Site would be unsuitable for discharge to surface water features.

Discharge to sewer

Discharge to sewer is likely to be the optimum sustainable drainage option for the new development area. According to the Thames Water Property Searches: Asset Location Search (Appendix C) there is a public combined sewer located within 50m of the Site, which runs along Albert Terrace Mews. It is understood that the Site currently drains to the combined sewer located along Albert Terrace Mews which will continue with the re-development of the Site. The implementation of the SuDS features within this report will work to reduce the volume and rate of water entering this sewer system, measures which are not currently implemented on the existing site.

A flow control device will be required to limit peak discharge rates to the maximum selected rate as indicated in Section 13, along with the appropriate attenuation storage volume described in section 2 and 16 of this report.

15. Water quality

A key requirement of any SuDS system is that it protects the receiving water body from the risk of pollution. This can be effectively managed by an appropriate "train" or sequence of SuDS components that are connected in series. The frequent and short duration rainfall events are those that are most loaded with potential contaminants (silts, fines, heavy metals and various organic and inorganic contaminants). Therefore, the first 5-10 mm of rainfall (first flush) should be adequately treated with SuDS.

The minimum number of treatment stages will depend on the sensitivity of the receiving water body and the potential hazard associated with the proposed development SuDS Manual (CIRIA, 2015). The proposed development is a combination of low (roof water) to medium hazard (runoff from car parking and road). The site does not lie within a source protection zone and therefore additional treatment stages are not required.

Table 5: Level of hazard

Hazard	Source of hazard
Very Low	Residential roof drainage
Low	Residential, amenity uses including low usage car parking spaces and roads, other roof drainage.
Medium	Commercial, industrial uses including car parking spaces and roads (excluding low usage roads, trunk roads and motorways).
High	Areas used for handling and storage of chemicals and fuels, handling of storage and waste (incl. scrap-yards).

The recommended minimum number treatment stages suggested for the different runoff waters identified for the proposed development is highlighted in Table 6.

Table 6: Minimum number of treatment stages for runoff

		Sensitivity of the receiving water body		
		Low	Medium	High
Hazard	Low	1	1	1
	Med	2	2	2
	High	3	3	3

16. Sustainable drainage systems

It is recommended the drainage system has the capacity to accommodate the 1 in 100 year event before flooding occurs. Drainage from areas outside the development footprint will continue to use the existing drainage arrangements.

Based on the above sections it is considered likely that a combination of different infiltration SuDS will be a suitable option for this site subject to confirmation by site testing. The recommended drainage strategy has been summarised in Section 2 of this report and provides a minimum storage of 3.5m^3, sufficient to prevent the volume of off-site run-off from the proposed development exceeding the volume for the critical storm duration (0.5 hour) with an outflow rate of 1 l/s for exceedance events (as close to three times greenfield run-off rate as possible).

Storage for basement terrace and void space:

1. Based on client provided plans and the site run-off calculations generated using the IoH124 method, approximately 1.98m^2 of the rainfall generated from the impermeable areas of the Site during a 6 hour, 1 in 100 year event plus an allowance for climate change would fall onto the basement area which extends outside the above ground development footprint.

   The structure of the existing and proposed development indicates that surface water from this area cannot be drained and fed towards the north of the Site by going around the development, therefore an attenuation tank is proposed within the terrace section at basement level. Water from the reinforced glazed terrace will be drained and fed into the attenuation tank before water is pumped into the SuDS system located towards the northern site boundary.

   The construction of the wall along the southern and western boundary of the terrace area and the elevation difference between the Site and the gardens located adjacent to the southern Site boundary will prevent any inflow of surface water into the Site. Therefore the attenuation tank, which is to be located within the terrace area on basement level, will only be attenuating for direct rainfall which falls onto the ventilation void and the reinforced glazed terrace.

   A storage tank, with approximate dimensions of 1m height, 1.5m length and 1.4m depth would provide storage for c. 2m^3.

   Please note: dimensions are suggestions

Storage for development roof and the remaining site area run-off:

As the surface water run-off from the basement terrace and void space has been accommodated within a basement storage tank/crate which is to pump out water with its own controlled rate, the calculations were re-run to establish the Critical Storm Duration

(CSD), excluding the basement terrace and void space to ensure that the SuDS features which are proposed to attenuate for the run-off from the development roof and the remaining site area would provide sufficient storage for the CSD with a 1 l/s controlled discharge.

A minimum storage of 2.58m^3 is required to prevent the volume of off-site run-off from the remainder of the site, not attenuated within the basement storage tank/crate, exceeding the volume of the critical storm duration (0.5 hour) with an outflow rate of 1 l/s for exceedance events (as close to three times greenfield run-off rate as possible) with storage provided towards the north of the Site.

2. To comply with London Plan policy, rainwater harvesting tanks should be established for each proposed development. The tanks are likely to be used throughout the year however due to the flood risks which could be associated, overflow from the tanks should be discharged into the geo-cellular storage crate system underneath the permeable paving.

   The run-off from the proposed development roofs should be led into rainwater harvesting butts/tanks via rainwater downpipes. The nature and use of the tank should be confirmed (for water use either within the proposed developments or within an amenity scope – i.e. for watering garden areas). While the proposed rainwater harvesting tank is likely to be used continuously (if used internally) due to the nature of the proposed development, it is acknowledged that an overflow system will still be required for implementation on the Site due to exceedance events (where the pumps fail or there is a blockage within the system / or the number of residents and subsequent water usage is reduced).

   Due to the potential flood risk associated with rainwater harvesting butts/tanks, volume of run-off which could be attenuated by Rainwater Harvesting has not been considered within the Preliminary SuDS schematic.

3. Rainwater from the development roof should be fed to the front of the property via rainwater down pipes and Aco Drains directly into permeable paving, which will be underlain by geocellular storage. Paving areas will slope away from internal areas of the proposed buildings to ensure exceedance flows away from internal areas. Another Aco Drain will be established along the northern Site boundary to capture any additional run-off generated from the permeable paving.

   A 11m^2 area of permeable paving to the front of the development with underlying geocellular storage (95% void space which is standard for geocellular storage capacity) with a depth of 0.3m would provide 3.1 m^3 worth of storage – giving the site a total storage volume of 5.1 m^3 which exceeds the minimum requirements of the London Plan's SDC SPG (2014) and the London Borough of Camden Planning Guidance (CPG 3: Sustainability)(2015).

   A flow limiting device such as a vortex control, will be required to ensure discharge from the Site does not exceed 1 l/s rate as SuDS features will be discharging into the combined sewer. Approval for the final design should be obtained from Thames Water to ensure compliance.

Primary recommendation: Source control (Rainwater storage tank, Rainwater harvesting and permeable paving) with final discharge to sewer.

Basement terrace and void space:

Attenuation Glass Reinforced Plastic (GRP) Tanks/Storage Crates would be feasible for the Site to provide the necessary storage required to deal with rainfall generated from the basement area which extends outside the above ground development footprint.

Attenuation GRP Tanks provide a below-ground void space for use of temporary storage via infiltration or controlled release. They can also be modified to suit specific characteristics of a site. DEFRA, 2015 states that the run-off volume from the development to drain to any sewer of surface water body in the 1 in 100 year rainfall event must be constrained to a value as close as is reasonably practical to the greenfield runoff volume for the same event but should never exceed the runoff volume from the development prior to redevelopment from the Site.

As the GRP tank is to be located within the basement level of the development, issues such as accessibility can be discounted.

Development roof and the remaining site area run-off:

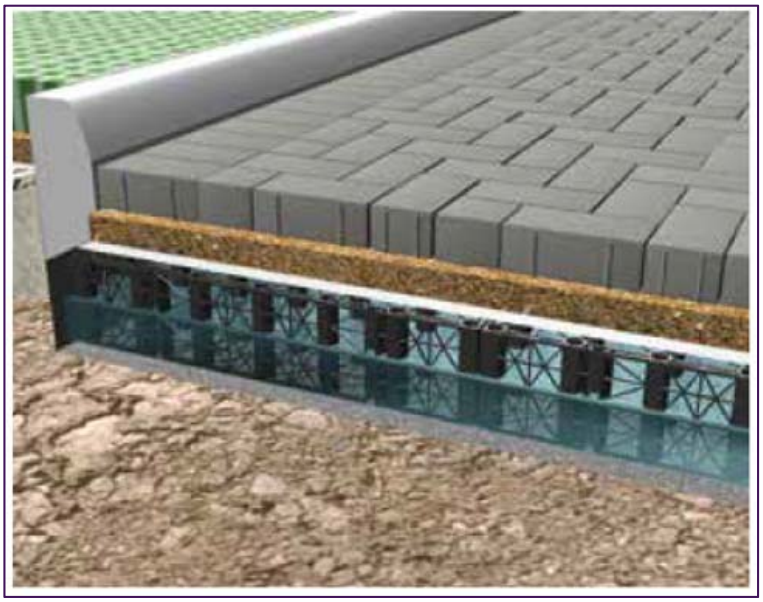
Rainwater Harvesting is primarily used to collect rainwater from impermeable areas and roofs for the use within development buildings and other miscellaneous usage. Due to the relatively small amounts of attenuation provided by rainwater harvesting tanks in this instance and the requirement to retain water for non-potable uses such as toilet flushing or garden maintenance, the volume of run-off which could be attenuated by rainwater harvesting has not been considered within the report. Cost in regards to rainwater harvesting is mainly due to the provision of a storage tank, pumps and pipework which is required for the system to be fully operational. As there is an issue with the storage capability of Rainwater Harvesting tanks, this method should only be used as an additional SuDS “source control” feature with a fixed attenuation volume and a controlled outlet to discharge into the proposed infiltration feature. In terms of attenuation storage within this SuDS scheme, volume of run-off which could be attenuated by Rainwater Harvesting has not been considered within the Preliminary SuDS schematic.

The rainwater harvesting tank will be sited within the geocellular storage system to the front of the house and positioned to act as a sump tank to capture silt and enough rainwater to service the irrigation system. Rainwater from the roofs can therefore enter the geocellular storage system directly via downpipes. The harvesting system will be used for irrigation only. As the rainwater harvesting tank will include an overflow into the geocellular storage located underneath the permeable paving, there will be no additional flood risk associated with the system.

Permeable pavements (geocellular storage) are recommended for the front of the development to increase the amount of permeable land cover, provide a source control SuDS feature and also provide additional storage for exceedance events. In order to provide sufficient storage geo-cellular storage crates are suggested as these can be

installed and inspected relatively easily. Plastic geo-cellular systems can increase the void space and therefore storage but do not allow filtration unless they are combined with aggregate material and/or permeable geotextiles which could increase their storage potential by up to 20%. Geocellular modules also have the added advantage of reducing the amount of aggregate sub base required, thus keeping costs lower. Void systems, such as permavoids, have a void ratio of 95% (i.e. for every $1m^3$ there is $0.95m^3$ of space available for water storage), which has been factored into the storage capacity calculations.

Permeable pavements are multi-layered surfacing systems. The surface layer is constructed out of permeable material allowing infiltration of water through gaps along its surface. A geomembrane isolates stored water from the surrounding soil, especially in contaminated areas and a geotextile layer prevents clogging and damage to the geocellular modules.



These geotextile layers work to catch silt/particles which are coming through from the direct rainfall which falls onto the car park area and into the permeable paving. The majority of silt would be trapped within the top 30mm of the joining material between the paving blocks. Rainfall flowing into the permeable paving directly from the development roof would not contain enough volumes of silt and or partials to cause blockage so will be fed directly into the geo-cellular storage via rainwater pipes.

Exceedance Flow Route:

During an exceedance event, the Site would not be able to discharge into a nearby surface water channel, therefore an exceedance route into the nearest surface water network should be required. The SuDS system recommended for the Site should provide enough storage that this method would only be utilized during a worst case scenario.

Flow control systems are required to reduce the runoff from the Site into the sewer system if required during exceedance events. These are usually a device used for controlling water flow into a connecting feature, such as a sewer, to a specific attenuation performance. The design consists of an intake, a volute and an outlet and the configuration is critical to ensure discharge control. For drainage areas which are less then 3 ha, outlet throttle diameters

would have to be small (<150mm diameter) to achieve outflow rates which could result in blockage. For most SuDS features, a flow control device will comprise a fixed orifice or a throttle such as a short pipe. A Vortex Control is usually a self-activating vortex flow device which directs water into a volute to form a vortex. A non-return flap value is also required for the outflow pipes to reduce the risk of backflow from the sewer during a large scale rainfall event.

SuDS maintenance

Regular maintenance is essential to ensure effective operation of SuDS over the intended lifespan of the proposed development. The SuDS Manual (C753) (CIRIA, 2015) provides a maintenance schedule for SuDS with details of the necessary required actions as shown in the Table below.

Table 7: SuDS operation and recommended maintenance requirements

Asset type	Maintenance schedule (and frequency)
GRP Tanks / Geo-cellular storage/ pump	Regular maintenance: • Inspect and identify any areas that are not operating correctly. If required, take remedial actions (monthly for 3 months then annually) • Remove debris from catchment surface where it may cause risks to performance (monthly) • For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment or other matter, remove and replace surface infiltration medium as necessary (annually) Remedial Actions: • Repair/rehabilitate inlets, outlets, overflows and vents (as required) Monitoring: • Inspect inlets, outlets and overflows for blockages (annually). • Inspect tank for silt accumulation (every 5 years).
Permeable pavements	Regular maintenance: • Brushing and vacuuming – Standard cosmetic sweep over the whole surface (once a year or based on site specific observations of clogging or manufacturers recommendations.). Occasional maintenance: • Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying (as required-once per year on less frequently used pavements) • Trimming any roots and surrounding grass and weeds that may be causing blockages (annually or as required). Remedial actions: • Remediate landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving (as required) • Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material (As Required) • Rehabilitation of surface and upper structure by remedial sweeping (every 10 to 15 years or as required if performance is reduced due to significant clogging)

	Monitoring: • Initial inspection (monthly for three months after instillation). • Inspect for poor performance and/or weed growth (three monthly, 48 hours after large storms in first six months). • Establish appropriate brushing frequencies (Annually)
Rainwater Harvesting	Regular maintenance: • Inspection of tank for debris and sediment build up (annually and following poor performance). • Cleaning of tank, inlets, outlets, gutters, roof drain filters and withdrawal devices (annually or as required). Occasional maintenance: • Cleaning and replacement of any filters (three monthly or as required) Remedial actions: • Repair or overflow erosion damage or damage to tank and associated components (as required) • Pump repairs (as required)

Health and safety considerations for SuDS

GeoSmart Pro reports may include outline strategies or designs to support with development plans. Any drawings or advice provided do not comprise any form of detailed

design. Implementation of any conceptual scheme options may constitute 'Construction Work' as defined by CDM Regulations (2015).

The CDM Regulations place specific Health and Safety duties on those commissioning, planning and undertaking construction works. If you are uncertain what this means you should seek the advice of your architect, builder or other competent professional.

GeoSmart does not provide health and safety advisory services but we are required to advise you of your general responsibilities under CDM (visit http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/ for more information).

Please remember that detailed design work should be undertaken by a competent professional who might be your engineer, architect, builder or another competent party.

17. Methodology and limitations of study

This report assesses the feasibility of infiltration SuDS and alternative drainage strategies in support of the Site development process. From April 6th 2015 SuDS are regulated by Local Planning Authorities and will be required under law for major developments in all cases unless demonstrated to be inappropriate. What is considered appropriate in terms of costs and benefits by the Planning Authority will vary depending on local planning policy, and Site setting. The Lead Local Flood Authority will require information as a statutory consultee on major planning applications with surface water drainage implications. The National Planning Policy Framework requires that new developments in areas at risk of flooding should give priority to the use of SuDS and demonstrate that the proposed development does not increase flood risk downstream to third parties.

How was the suitability of SuDS estimated for the Site?

There are a range of SuDS options available to provide effective surface water management that intercept and store excess runoff. When considering these options, the destination of the runoff should be assessed using the order of preference outlined in the Building Regulations Part H document (HM Government, 2010) and Defra's Draft National Standards for SuDS (2011):

1. Discharge to the ground;
2. Discharge to a surface water body;
3. Discharge to a surface water sewer;
4. Discharge to a local highway drain; and
5. Discharge to a combined sewer.

Data sets relating to each of the potential discharge options have been analysed to assess the feasibility of each option according to the hierarchy set out above. Hydrogeological characteristics for the Site are assessed in conjunction with the occurrence of SPZ's to assess infiltration suitability. The Site has been screened to determine whether flood risk from groundwater, surface water, fluvial or coastal sources may constrain SuDs. The distance to surface water bodies and sewers has been reviewed gauge whether these provide alternative options.

GeoSmart SuDS Infiltration Suitability Map (SD50)

The GeoSmart SuDS Infiltration Suitability Map (SD50) screens the suitability for infiltration drainage in different parts of the Site. In producing the SuDS Infiltration Suitability Map (SD50), GeoSmart used data from the British Geological Survey on groundwater levels, geology and permeability to screen for areas where infiltration SuDS may be suitable. The

map classifies areas into 3 categories of High, Medium and Low suitability for infiltration SuDS. This can then be used in conjunction with additional data on Site constraints to give recommendations for SuDS design and further investigation.

The primary constraint on infiltration potential is the minimum permeability of the underlying material and in some cases the range in permeability may be considerable, ranging down to low. The map classifies these areas as moderate infiltration suitability requiring further investigation. In cases where the thickness of the receiving permeable horizon is less than 1.5 meters then additional Site investigation is recommended. If the Site is at risk of groundwater flooding for up to the 1% annual occurrence the map classifies these areas as moderate infiltration suitability requiring further investigation.

The GeoSmart SuDS Infiltration Suitability Map (SD50) is a national screening tool for infiltration SuDS techniques. Further information on the GeoSmart SuDS Infiltration Suitability Map (SD50) is available at geosmartinfo.co.uk

How is the suitability to discharge to sewers and watercourses calculated?

The suitability to discharge to discharge to sewers and watercourses has been calculated using the distance from the Site to both. For example, where the Site is within 50m of a surface water body. Discharge to surface water is potentially appropriate subject to land access arrangements and a feasibility assessment. Where the Site is within 50m of a sewer, discharge to sewer is potentially appropriate subject to land access arrangements and a feasibility assessment. The utility company should be contacted to agree connection feasibility and sewer capacity.

Further information relating to sewers available in the area can be found in Appendix C

What is a Source Protection Zone?

The Environment Agency have defined Source Protection Zones (SPZs) for 2000 groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. The maps show three main zones (inner, outer and total catchment) and a fourth zone of special interest, which is occasionally applied. The zones are used to set up pollution prevention measures in areas which are at a higher risk. The shape and size of a zone depends on the condition of the ground, how the groundwater is removed, and other environmental factors. Inner zone (Zone 1) is defined as the 50 day travel time from any point below the water table to the source (minimum radius of 50 metres). Outer zone (Zone 2) is defined by a 400 day travel

time. Total catchment (Zone 3) is defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source.

How was surface water runoff estimated from the site?

In accordance with The SuDS Manual (C753) (CIRIA, 2015), the Greenfield runoff from the Site has been calculated using the IoH124 method and is assumed representative of the runoff generated on the undeveloped surfaces that are affected by the proposed development. The method used for calculating the runoff complies with the NPPF (DGLC, 2014). For the impermeable surfaces, it has been assumed that 100% runoff will occur (calculations provided in Appendix A). Rainfall data is derived from the Flood Estimation Handbook (FEH) CD-ROM, developed by NERC (2009). Only areas affected by the proposed development are considered in the flow and volume calculations. Permeable areas that remain unchanged are not included in the calculations as it is assumed these will not be actively drained and attenuated.

What is the peak discharge rate?

An estimation of peak runoff flow rate and volume is required to calculate infiltration, storage and discharge requirements. The peak discharge rate is the maximum flow rate at which surface water runoff leaves the site during a particular storm event, without considering the impact of any mitigation such as storage, infiltration or flow control. Proposed discharge rates (with mitigation) should be no greater than existing rates for all corresponding storm events. If all drainage is to infiltration there will be no discharge off site. Discharging all flow from site at the existing 1 in 100 event would increase flood risk during smaller events. Flow restriction is generally required to limit the final discharge from site during all events as a basic minimum to the green field QBAR rate. A more complex flow restriction which varies the final discharge rate from the site depending on the storm event will reduce the volume of storage required on site. Drainage to infiltration SuDS is subtracted from the total discharge off site to achieve a beneficial net affect.

What is the total discharge volume?

The total discharge volume is calculated on the basis of the surface water runoff that has the potential to leave the site as a result of the assumed 6 hour duration design storm event. The runoff is related to the underlying soil conditions, impermeable cover, rainfall intensity and duration of the storm event. The total volume generated by the current site is compared to the potential total volume from the developed site (not taking into consideration any mitigation). The difference provides the minimum total volume that will need to be stored and infiltrated on site or released at a controlled rate. Guidance indicates that the total discharge volume should never exceed the runoff volume from the

development site prior to redevelopment for that event and should be as close as is reasonably practicable to the Greenfield runoff volume.

18. Background SuDS information

SuDS control surface water runoff close to where it falls. SuDS are designed to replicate, as closely as possible, the natural drainage from the Site before development to ensure that the flood risk downstream does not increase as a result of the Site being developed, and that the Site will have satisfactory drainage under current and likely future climatic conditions. SuDS provide opportunities to reduce the causes and impacts of flooding; remove pollutants from urban runoff at source; and combine water management with green space with benefits for amenity, recreation and wildlife. Government planning policy and planning decisions now include a presumption in favour of SuDS being used for all development Sites, unless they can be shown to be inappropriate.

For general information on SuDS see our web site: http://geosmartinfo.co.uk/

Infiltration SuDS

Government policy for England is to introduce sustainable drainage systems (SuDS) via conditions in planning approvals. Guidance indicates that capturing rainfall runoff on site and infiltrating it into the ground (infiltration SuDS) is the preferred method for managing surface water without increasing flood risk downstream.

The greatest benefit to general flood risk is if all runoff is infiltrated on site, however, this may not be feasible due to physical and economic constraints in which case infiltration may be considered as a part of an integrated drainage solution. The final design capacity for an infiltration SuDS system depends on the site constraints and the requirements of the individual Planning Authority and the Lead Local Flood Authority.

The capacity of the ground to receive infiltration depends on the nature, thickness and permeability of the underlying material and the depth to the high groundwater table. The final proportion of the site drained by infiltration will depend on topography, outfall levels and a suitable drainage gradient. It is important to note that, even if the whole site cannot be drained by infiltration, the use of partial infiltration is encouraged, with the remainder of runoff discharged via other SuDS systems.

Types of infiltration SuDS

Infiltration components include infiltration trenches, soakaways, swales and infiltration basins without outlets, rain gardens and permeable pavements. These are used to capture surface water runoff and allow it to infiltrate (soak) and filter through to the subsoil layer, before returning it to the water table below.

An infiltration trench is usually filled with permeable granular material and is designed to promote infiltration of surface water to the ground. An infiltration basin is a dry basin or depression designed to promote infiltration of surface water runoff into the ground. Soakaways are the most common type of infiltration device in the UK where drainage is often connected to over-sized square or rectangular, rubble-filled voids sited beneath lawns. According to the guidance in Building Research Establishment (BRE) Digest 365 (2007) a soakaway must be able to discharge 50% of the runoff generated during a 1 in 10 year storm event within 24 hours in readiness for subsequent storm flow. This is the basic threshold criteria for a soakaway design and the internal surface area of the proposed soakaway design options should be calculated on this basis by taking into account the soil infiltration rate for the Site.

Developers need to ensure their design takes account of the construction, operation and maintenance requirements of both surface and subsurface components, allowing for any machinery access required.

SuDS maintenance and adoption

Regular maintenance is essential to ensure effective operation of the soakaway(s) over the intended lifespan of the proposed development. A maintenance schedule for SuDs is required. Sewerage undertakers or Local Authorities may adopt SuDS and will require maintenance issues to be dealt with in accordance with their Management Plan. If the SuDS will not be adopted other provision is required with associated financial implications. Maintenance is a long-term obligation requiring the upkeep of all elements of the SuDS, including mechanical components (e.g. pumps), as well as inspections, regular maintenance and repair.

Additional background SuDS information can be found on our website:
http://geosmartinfo.co.uk/

19. References and glossary

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Glossary[3]

Attenuation	Reduction of peak flow and increased duration of a flow event.
Combined sewer	A sewer designed to carry foul sewage and surface water in the same pipe.
Detention basin	A vegetated depression, normally is dry except after storm events, constructed to store water temporarily to attenuate flows. May allow infiltration of water to the ground.
Evapotranspiration	The process by which the Earth's surface or soil loses moisture by evaporation of water and by uptake and then transpiration from plants.
FEH	Flood Estimation Handbook, produced by Centre for Ecology and Hydrology, Wallingford (formerly the Institute of Hydrology).
Filter drain or trench	A linear drain consisting of a trench filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water, but may also be designed to permit infiltration.
First flush	The initial runoff from a site or catchment following the start of a rainfall event. As runoff travels over a catchment it will collect or dissolve pollutants, and the "first flush" portion of the flow may be the most contaminated as a result. This is especially the case for intense storms and in small or more uniform catchments. In larger or more complex catchments pollution.
Flood plain	Land adjacent to a watercourse that would be subject to repeated flooding under natural conditions (see Environment Agency's Policy and practice for the protection of flood plains for a fuller definition).
Greenfield runoff	This is the surface water runoff regime from a site before development, or the existing site conditions for brownfield redevelopment sites.
Impermeable surface	An artificial non-porous surface that generates a surface water runoff after rainfall.
Permeability	A measure of the ease with which a fluid can flow through a porous medium. It depends on the physical properties of the medium, for example grain size, porosity and pore shape.
Runoff	Water flow over the ground surface to the drainage system. This occurs if the ground is impermeable, is saturated or if rainfall is particularly intense.
Sewerage undertaker	This is a collective term relating to the statutory undertaking of water companies that are responsible for sewerage and sewage disposal including surface water from roofs and yards of premises.
Soakaway	A subsurface structure into which surface water is conveyed to allow infiltration into the ground.
Treatment	Improving the quality of water by physical, chemical and/or biological means.

[3] The terms included in this glossary have been taken from CIRIA (2015) guidance.

20. Further information

Disclaimer

This report has been prepared by GeoSmart in its professional capacity as soil and groundwater specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client, and is provided by GeoSmart solely for the internal use of its client.

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to GeoSmart at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

This report is confidential to the client. The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, GeoSmart may, by prior written agreement, agree to such release, provided that it is acknowledged that GeoSmart accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. GeoSmart accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against GeoSmart except as expressly agreed with GeoSmart in writing.

Further information

Information on confidence levels and ways to improve this report can be provided for any location on written request to info@geosmart.co.uk or via our website. Updates to our model are ongoing and additional information is being collated from several sources to improve the database and allow increased confidence in the findings. Further information on groundwater levels and flooding are being incorporated in the model to enable improved accuracy to be achieved in future versions of the map. Please contact us if you would like to join our User Group and help with feedback on infiltration SuDS and mapping suggestion.

Important consumer protection information

This search has been produced by GeoSmart Information Limited, New Zealand House, 160-162 Abbey Foregate, Shrewsbury, SY2 6FD.

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- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.
- by giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

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

Complaints

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your

complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award compensation of up to £5,000 to you if he finds that you have suffered actual loss as a result of your search provider failing to keep to the Code.

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

TPOs contact details:

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

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

Please ask your search provider if you would like a copy of the search code

Complaints procedure

GeoSmart Information Limited is registered with the Property Codes Compliance Board as a subscriber to the Search Code. A key commitment under the Code is that firms will handle any complaints both speedily and fairly.

If you want to make a complaint, we will:

- Acknowledge it within 5 working days of receipt.
- Normally deal with it fully and provide a final response, in writing, within 20 working days of receipt.
- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

If you are not satisfied with our final response, or if we exceed the response timescales, you may refer the complaint to The Property Ombudsman scheme (TPOs): Tel: 01722 333306, E-mail: admin@tpos.co.uk. We will co-operate fully with the Ombudsman during an investigation and comply with his final decision.

Complaints should be sent to:

Jemma Prydderch
Operations Manager
GeoSmart Information Limited
New Zealand House
160 Abbey Foregate
Shrewsbury
SY2 6FD
Tel: 01743 298 100
jemmaprydderch@geosmartinfo.co.uk

21. Terms and conditions, CDM regulations and data limitations

Terms and conditions can be found on our website: http://geosmartinfo.co.uk/terms-conditions/

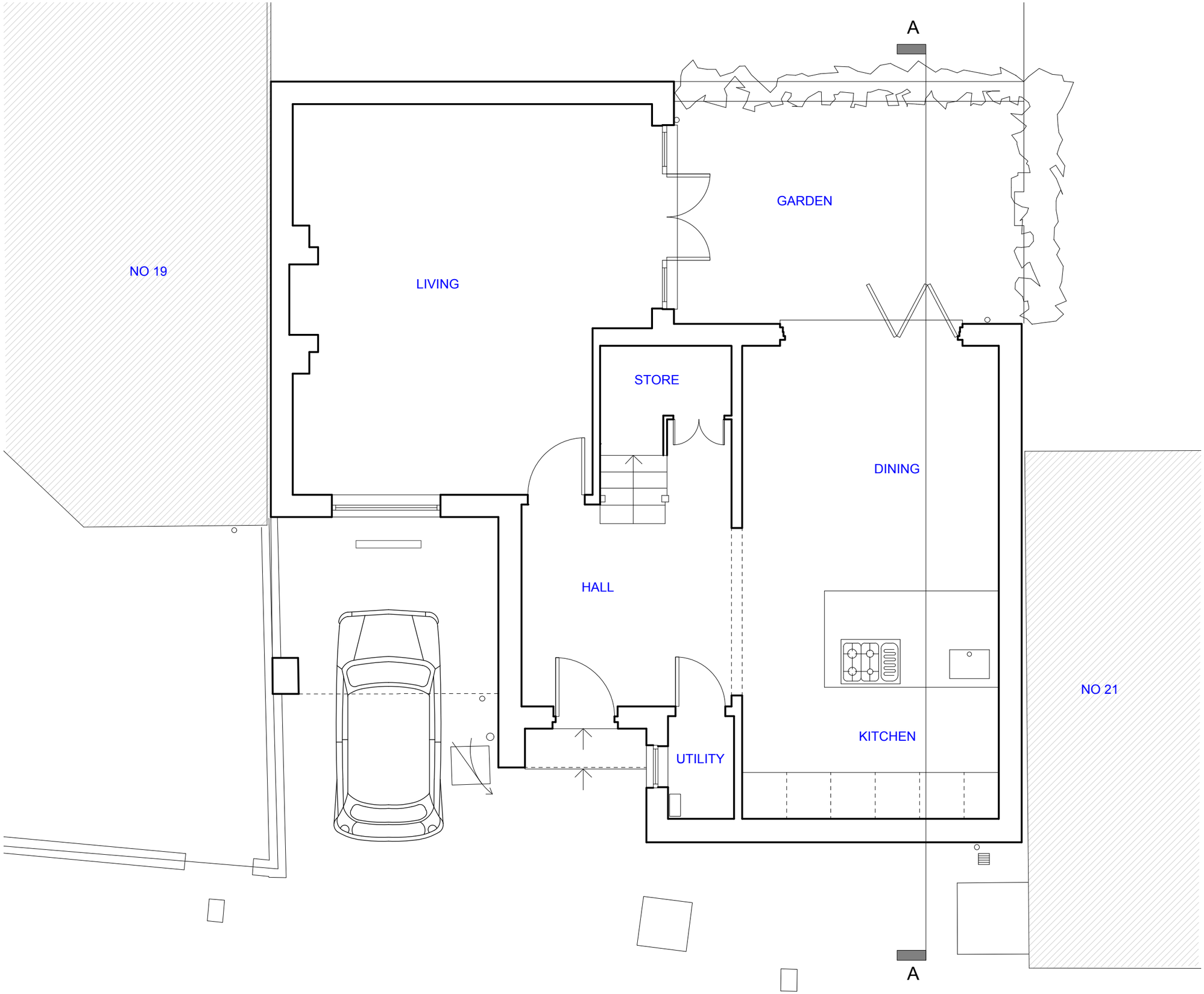
CDM regulations can be found on our website: http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/

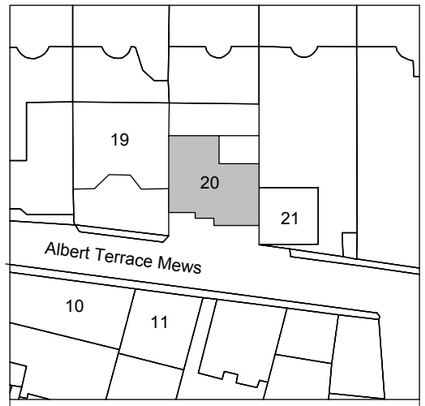
Data use and limitations can be found on our website: http://geosmartinfo.co.uk/data-limitations/

22. Appendices

Appendix A

Existing and proposed Site plans (layout and topography)





KEY PLAN
nts

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REV	Description	Date
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Scale	1:50
Size	A3
Drawn by	ET

Client
JONATHAN MORLEY

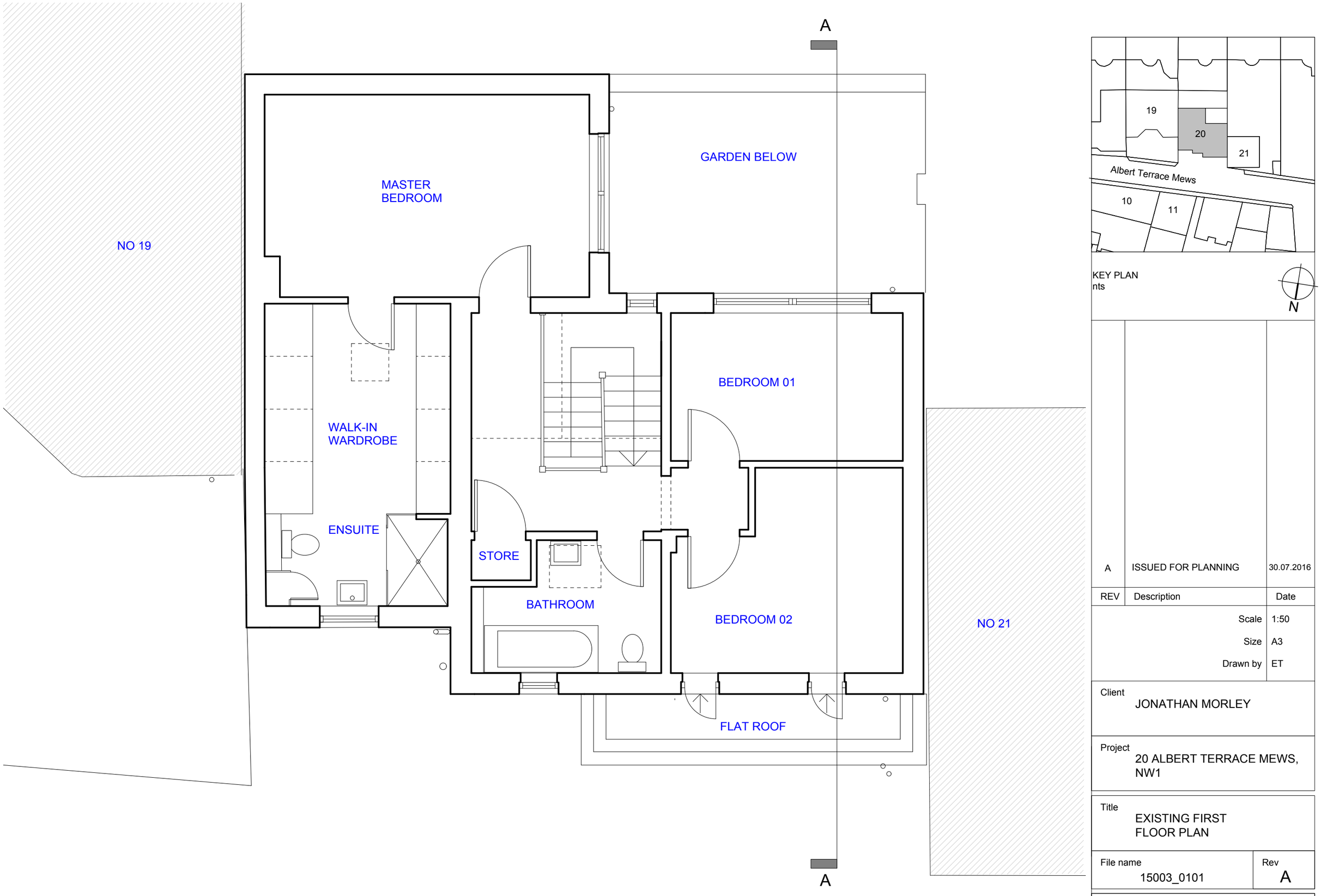
Project
20 ALBERT TERRACE MEWS, NW1

Title
EXISTING GROUND FLOOR PLAN

File name
15003_0100

Rev
A

Status
PLANNING



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Client
JONATHAN MORLEY

Project
20 ALBERT TERRACE MEWS, NW1

Title
EXISTING FIRST FLOOR PLAN

File name
15003_0101

Rev
A

Status
PLANNING

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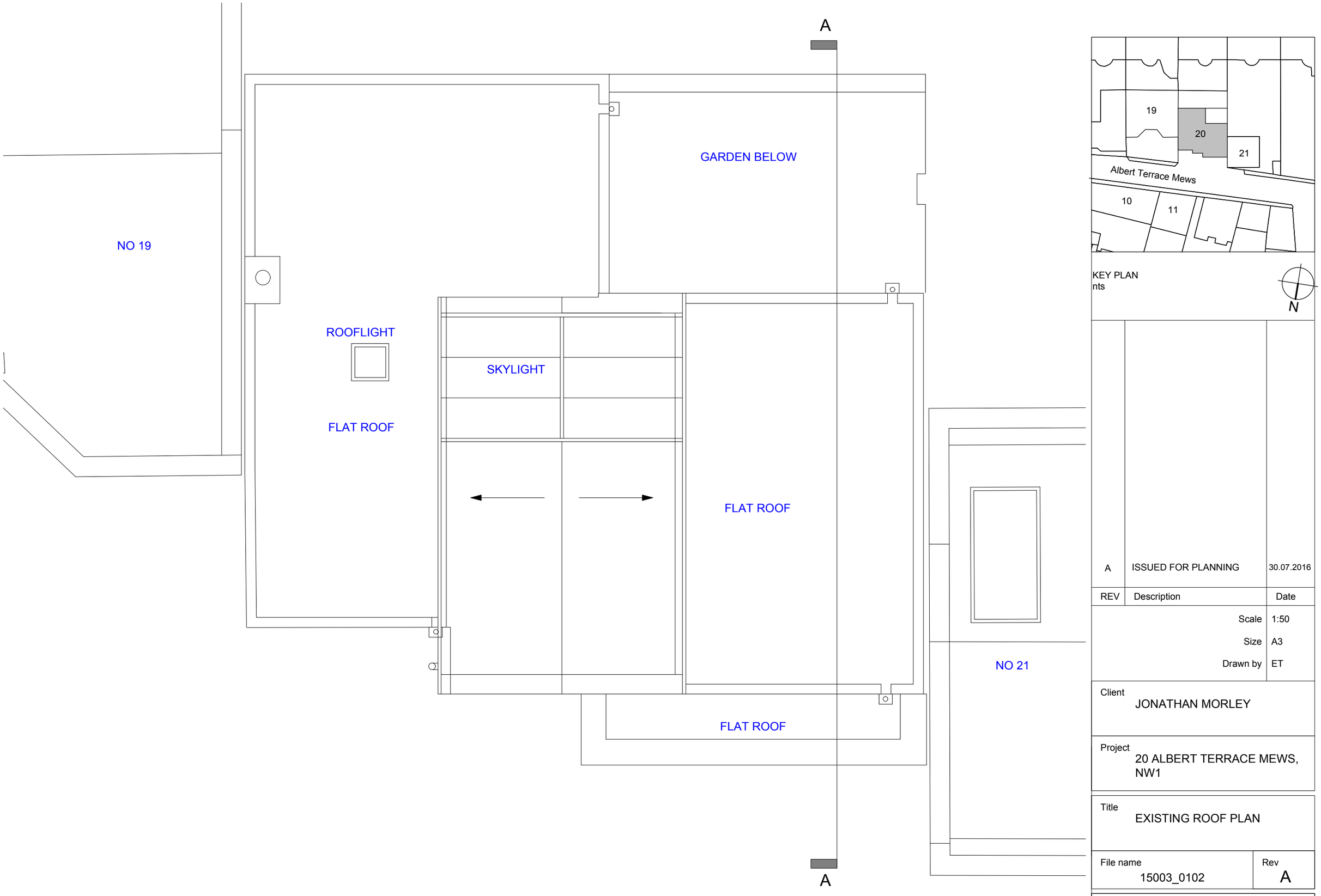
Metres



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REV	Description	Date
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Size	A3
Drawn by	ET

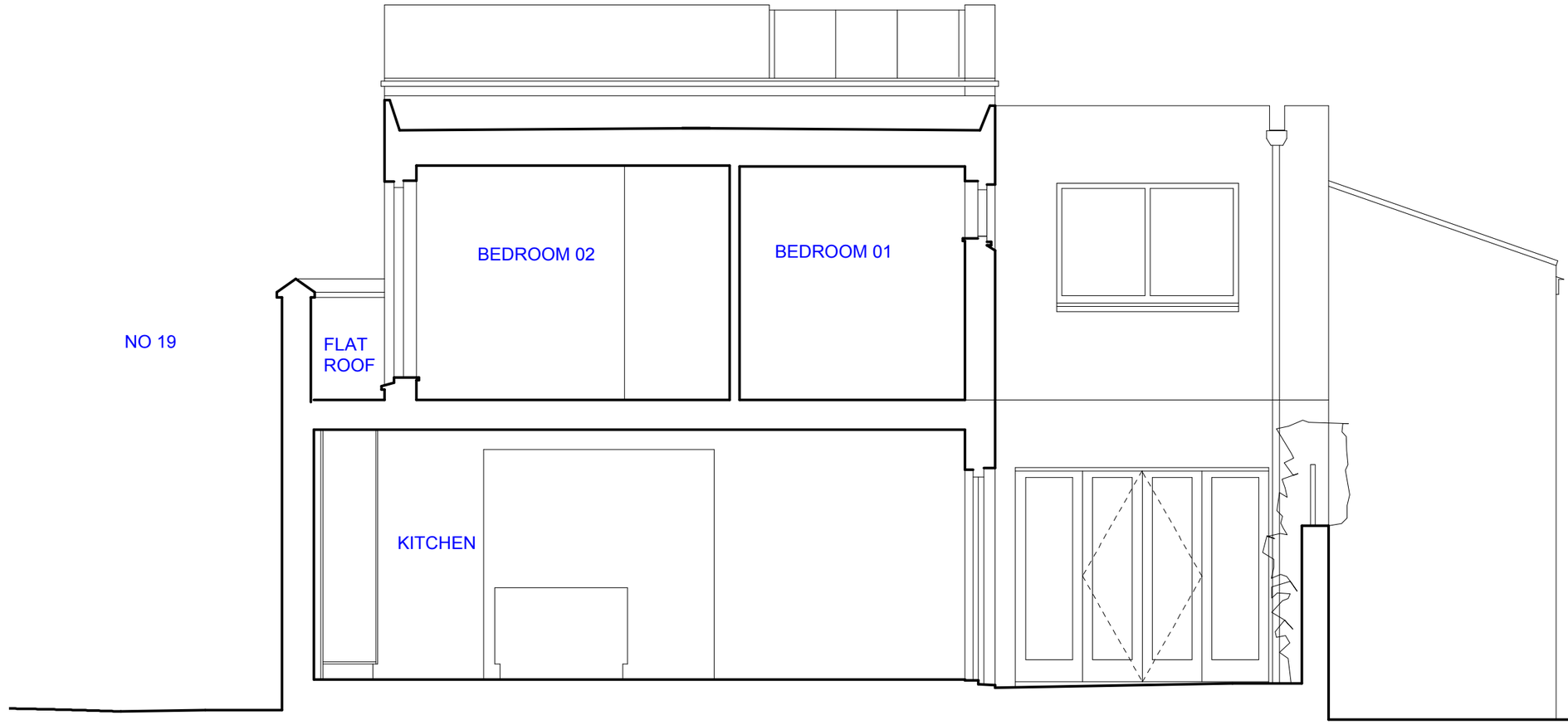
Client
JONATHAN MORLEY

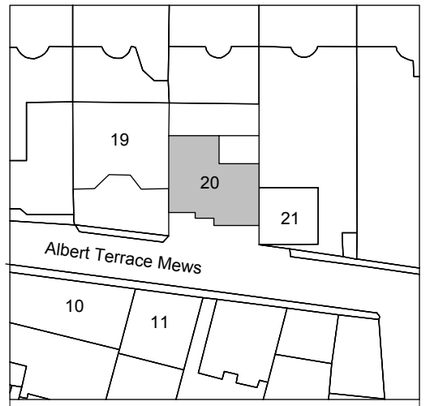
Project
20 ALBERT TERRACE MEWS, NW1

Title
EXISTING ROOF PLAN

File name	Rev
15003_0102	A

Status
PLANNING





KEY PLAN
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Drawn by ET

Client
JONATHAN MORLEY

Project
20 ALBERT TERRACE MEWS, NW1

Title
EXISTING SECTION A

File name
15003_0200

Rev
A

Status
PLANNING

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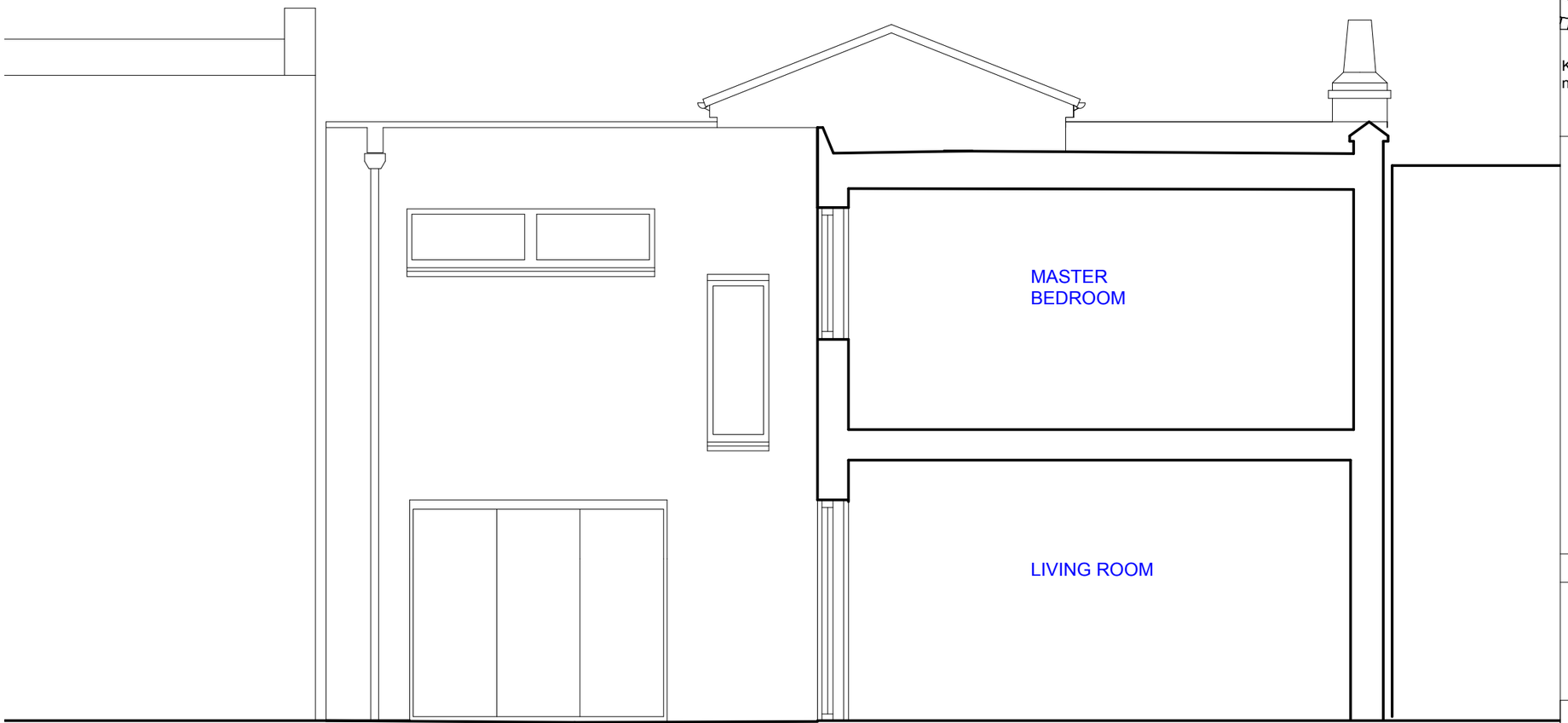
Metres



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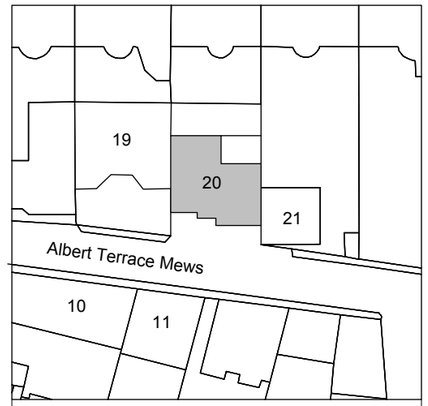
Metres



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REV	Description	Date

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Drawn by	ET

Client
JONATHAN MORLEY

Project
20 ALBERT TERRACE MEWS, NW1

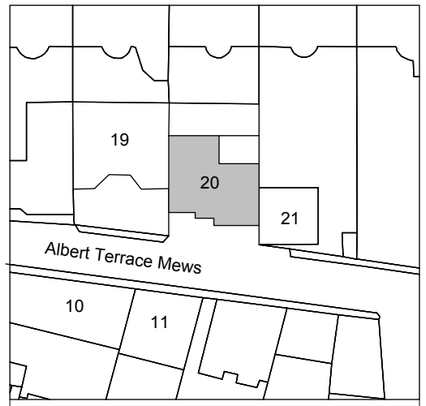
Title
EXISTING SECTION B

File name	Rev
15003_0201	A

Status
PLANNING

19 ALBERT TERRACE MEWS | APPLICATION SITE | 21 ALBERT TERRACE MEWS

0 1 2 3 4 5
Metres



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Scale	1:100
Size	A3
Drawn by	ET

Client
JONATHAN MORLEY

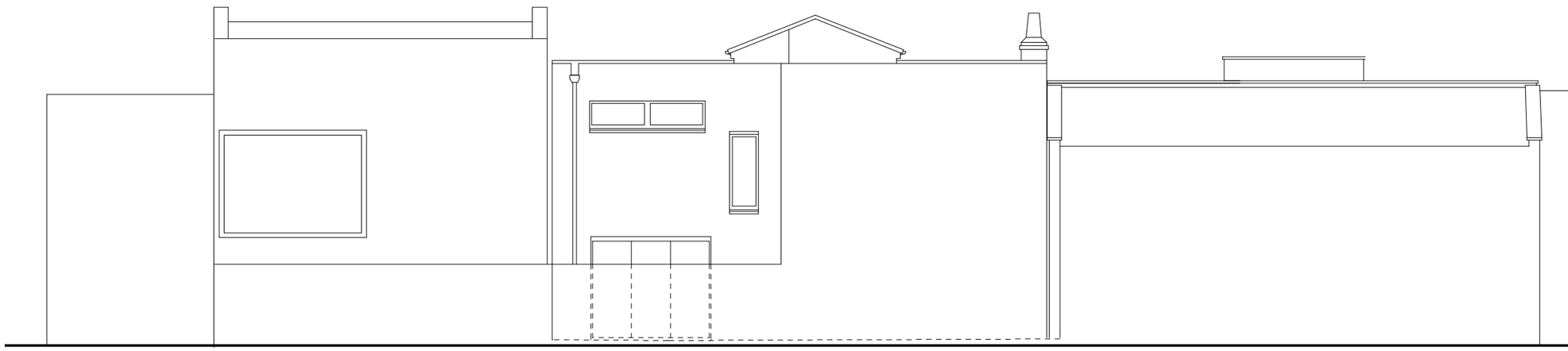
Project
20 ALBERT TERRACE MEWS, NW1

Title
EXISTING NORTH ELEVATION

File name
15003_0300

Rev
A

Status
PLANNING



21 ALBERT TERRACE MEWS | APPLICATION SITE | 19 ALBERT TERRACE MEWS

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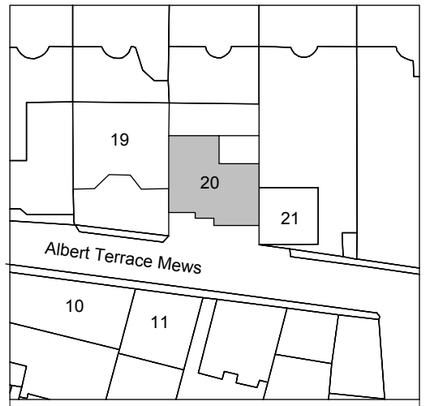
Metres



KEY PLAN
nts

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REV	Description	Date
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Scale 1:100
Size A3
Drawn by ET

Client
JONATHAN MORLEY

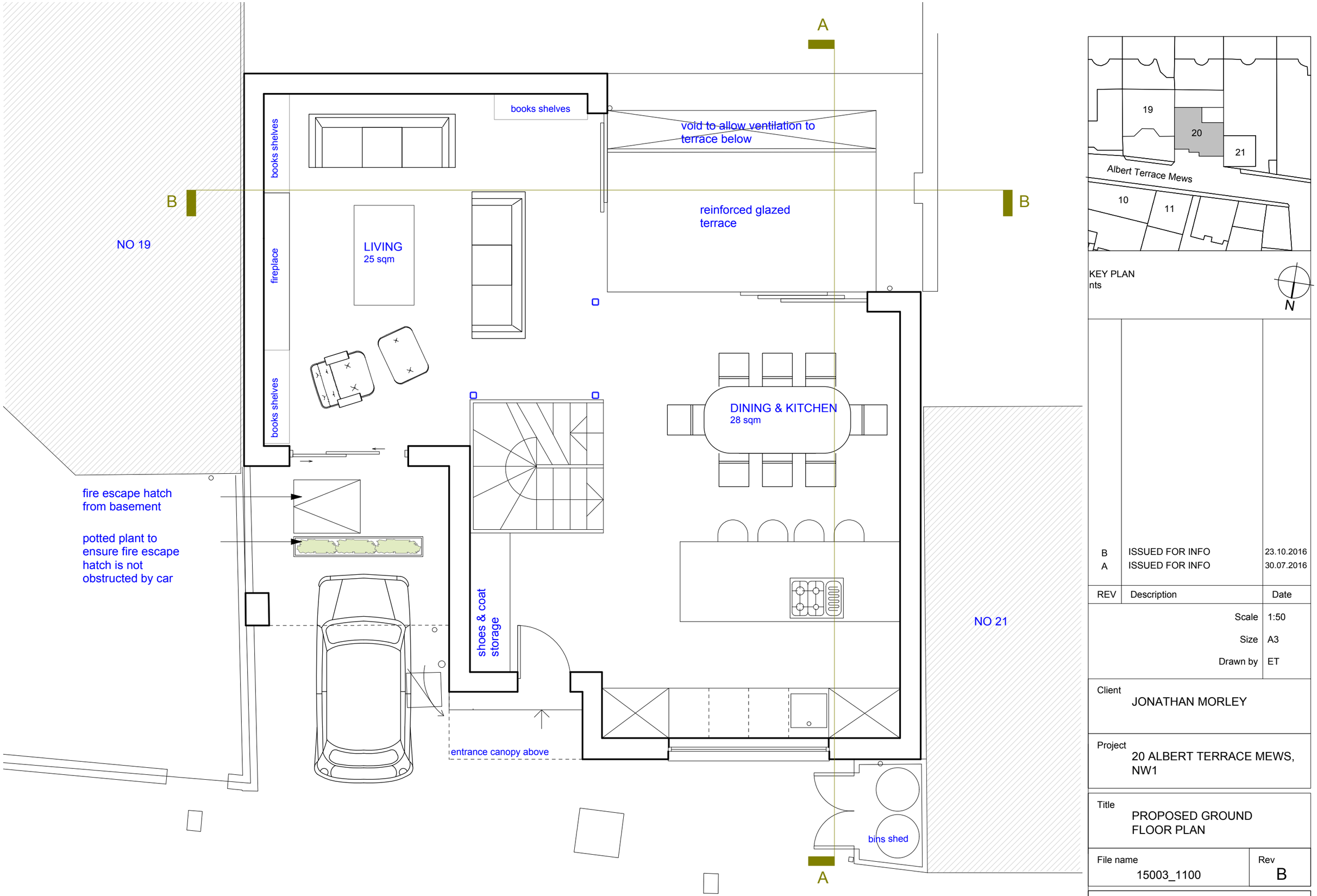
Project
20 ALBERT TERRACE MEWS, NW1

Title
EXISTING SOUTH ELEVATION

File name
15003_0301

Rev
A

Status
PLANNING



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A	ISSUED FOR INFO	30.07.2016

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Size	A3
Drawn by	ET

Client
JONATHAN MORLEY

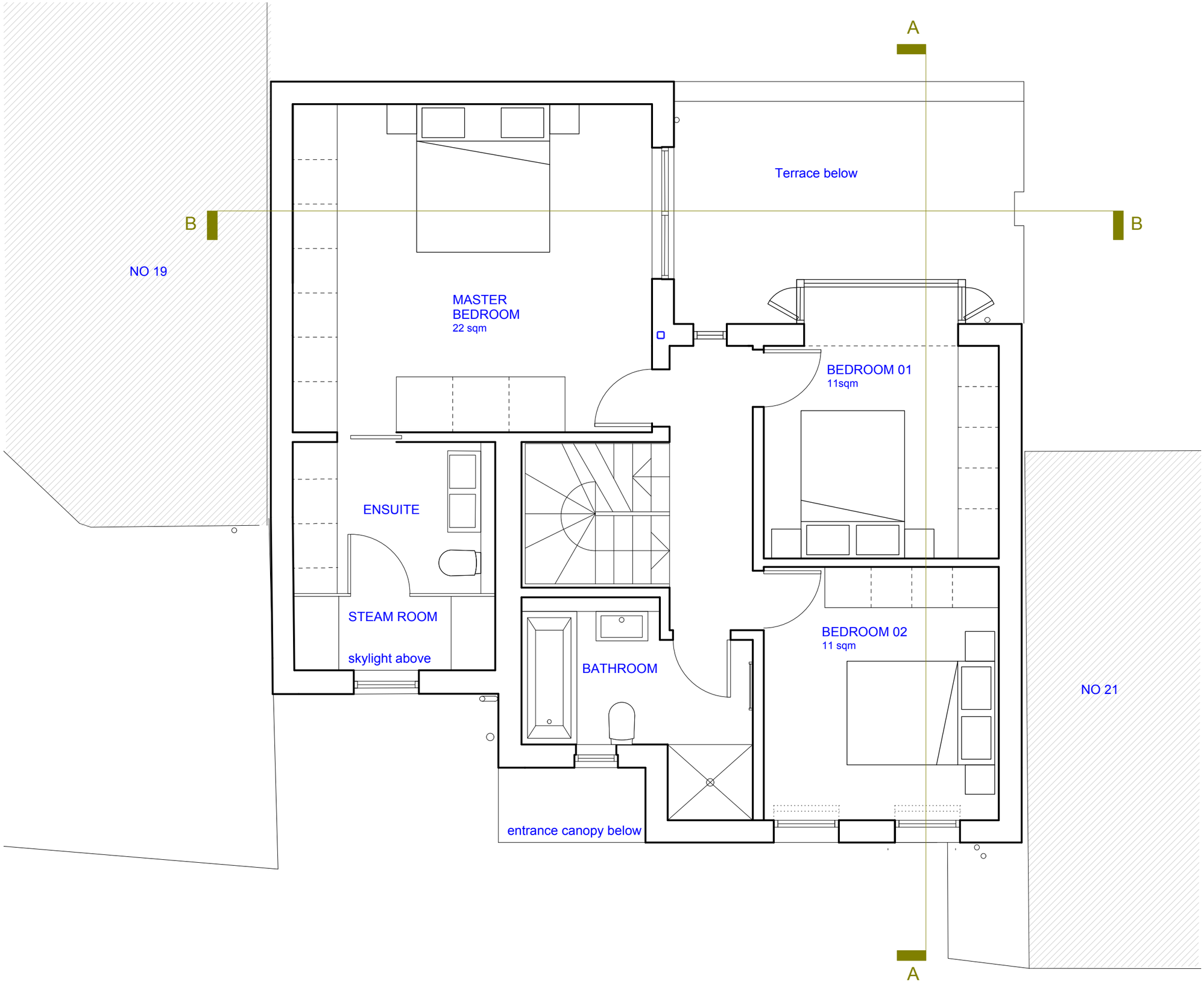
Project
20 ALBERT TERRACE MEWS, NW1

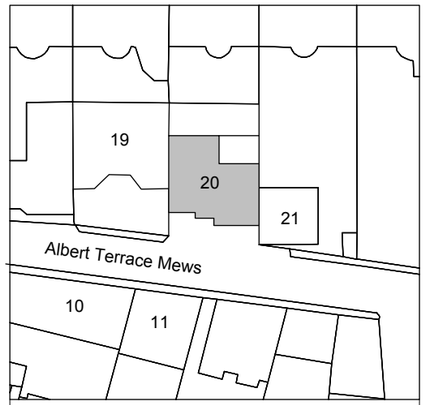
Title
PROPOSED GROUND FLOOR PLAN

File name
15003_1100

Rev
B

Status
PLANNING





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A	ISSUED FOR PLANNING	30.07.2016

Scale	1:50
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Drawn by	ET

Client
JONATHAN MORLEY

Project
20 ALBERT TERRACE MEWS, NW1

Title
PROPOSED FIRST FLOOR PLAN

File name
15003_1101

Rev
B

Status
PLANNING

0 1 2 3 4 5
Metres

A

B

B

Terrace below

NO 19

Oriel window below

FLAT ROOF

SKYLIGHT

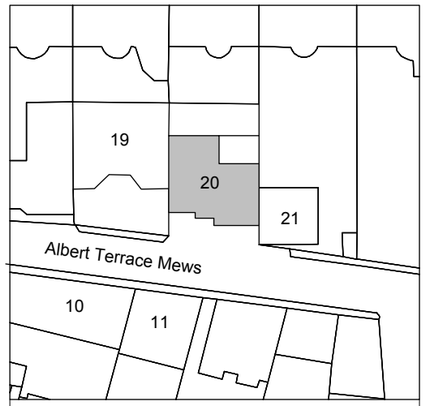
ROOFLIGHT

FLAT ROOF

entrance canopy below

NO 21

A



KEY PLAN
nts

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REV	Description	Date
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A	ISSUED FOR PLANNING	30.07.2016

Scale 1:50

Size A3

Drawn by ET

Client
JONATHAN MORLEY

Project
20 ALBERT TERRACE MEWS, NW1

Title
PROPOSED ROOF PLAN

File name
15003_1102

Rev
B

Status
PLANNING

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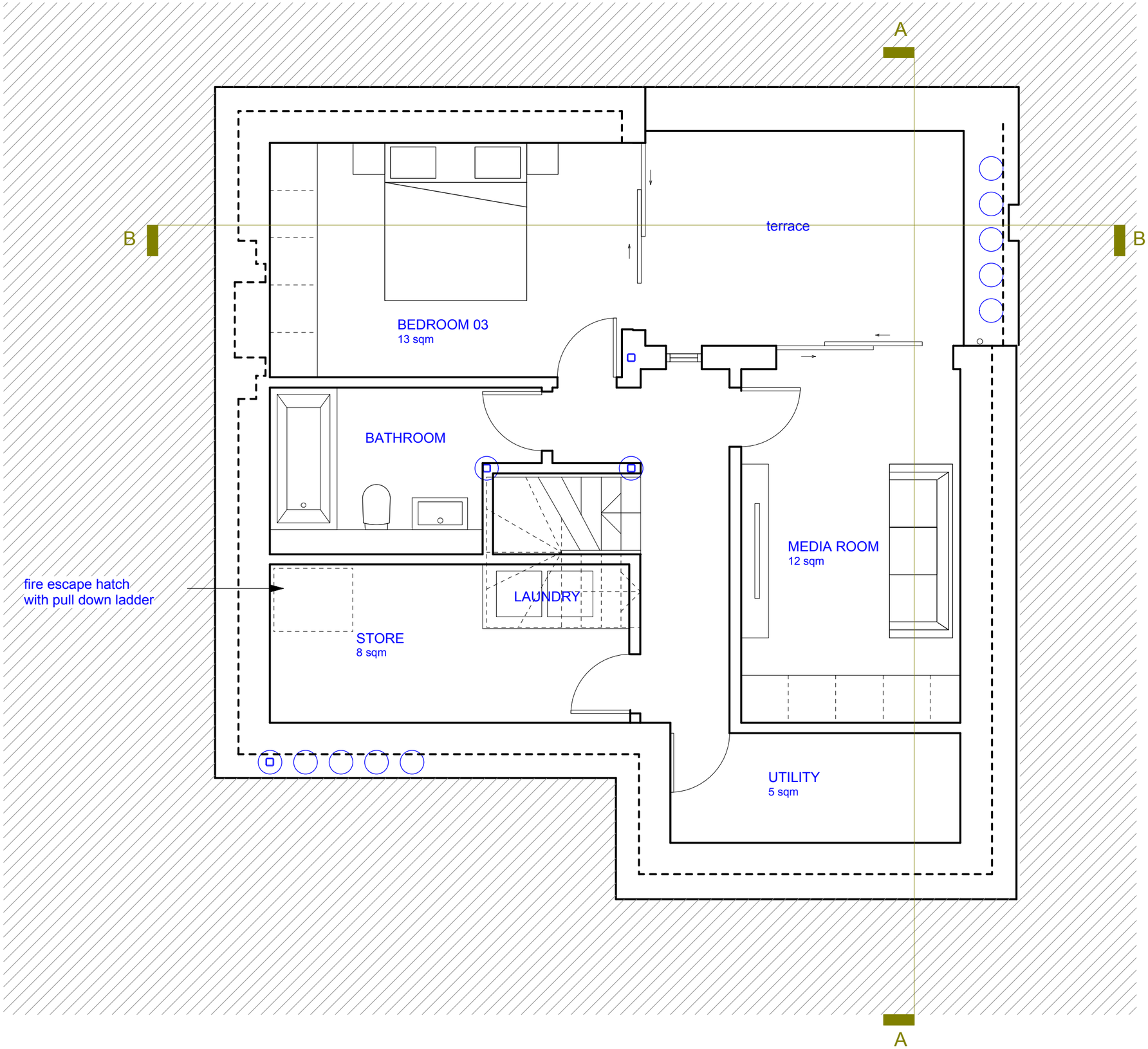
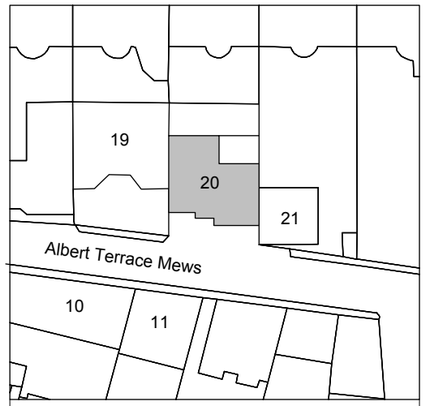
Metres





KEY PLAN
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REV	Description	Date
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A	ISSUED FOR PLANNING	30.07.2016

Scale	1:50
Size	A3
Drawn by	ET

Client
JONATHAN MORLEY

Project
20 ALBERT TERRACE MEWS, NW1

Title
PROPOSED BASEMENT FLOOR PLAN

File name	Rev
15003_1103	B

Status
PLANNING

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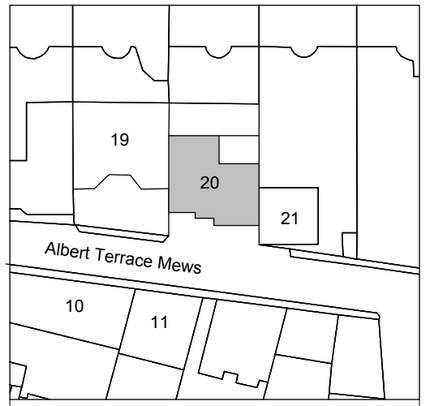
Metres

ALBERT TERRACE MEWS | APPLICATION SITE | 20 PRINCE ALBERT ROAD

0 1 2 3 4 5
Metres



KEY PLAN
nts

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REV	Description	Date
B	ISSUED FOR INFO	23.10.2016
A	ISSUED FOR PLANNING	30.07.2016

Scale	1:50
Size	A3
Drawn by	ET

Client
JONATHAN MORLEY

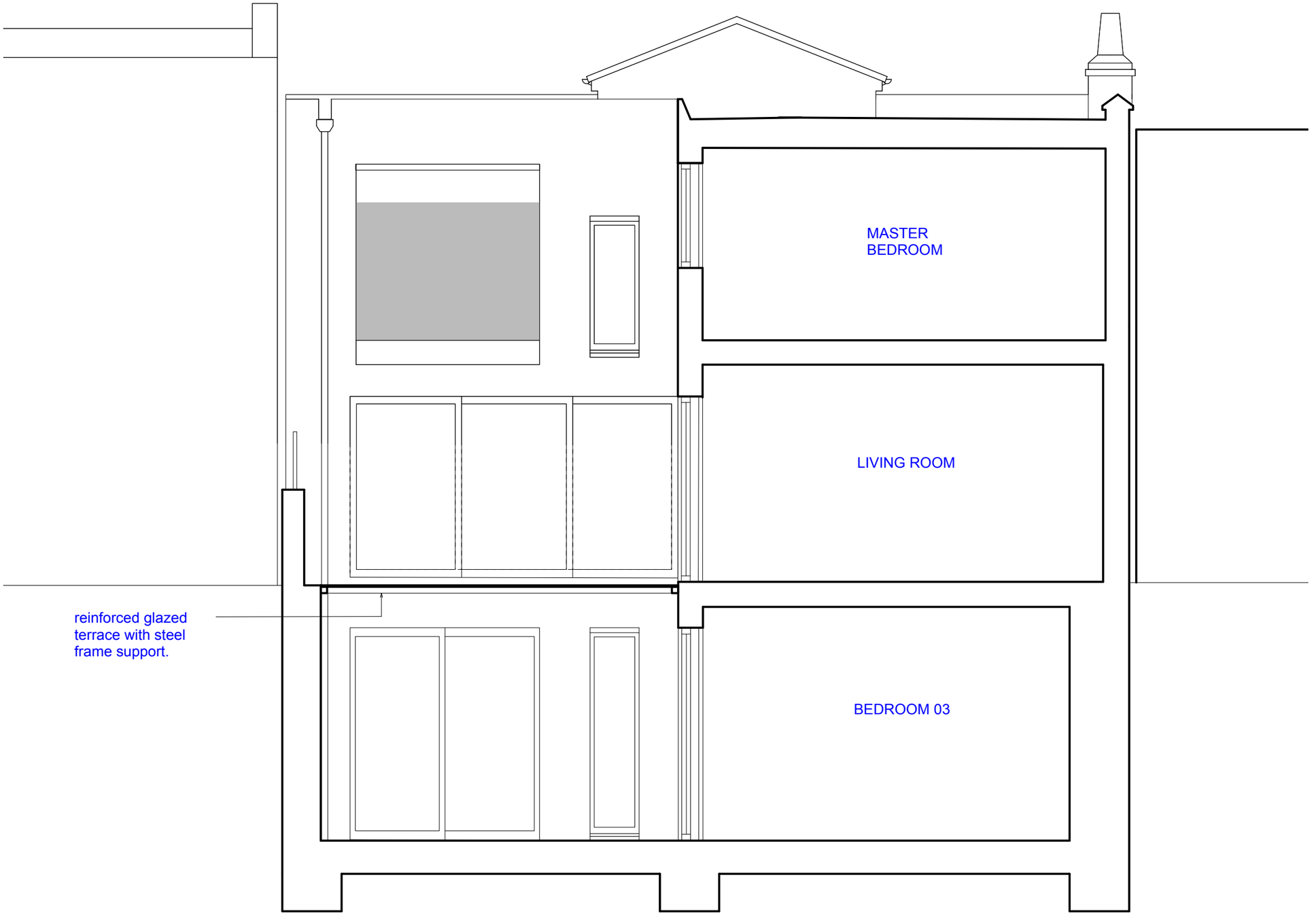
Project
20 ALBERT TERRACE MEWS, NW1

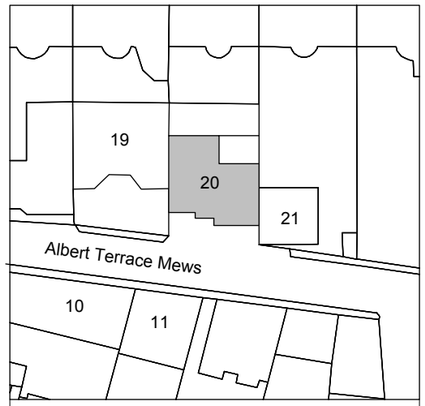
Title
PROPOSED SECTION A

File name
15003_1200

Rev
B

Status
PLANNING





KEY PLAN
nts

N

0 1 2 3 4 5
Metres

REV	Description	Date

Scale	1:50
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Drawn by	ET

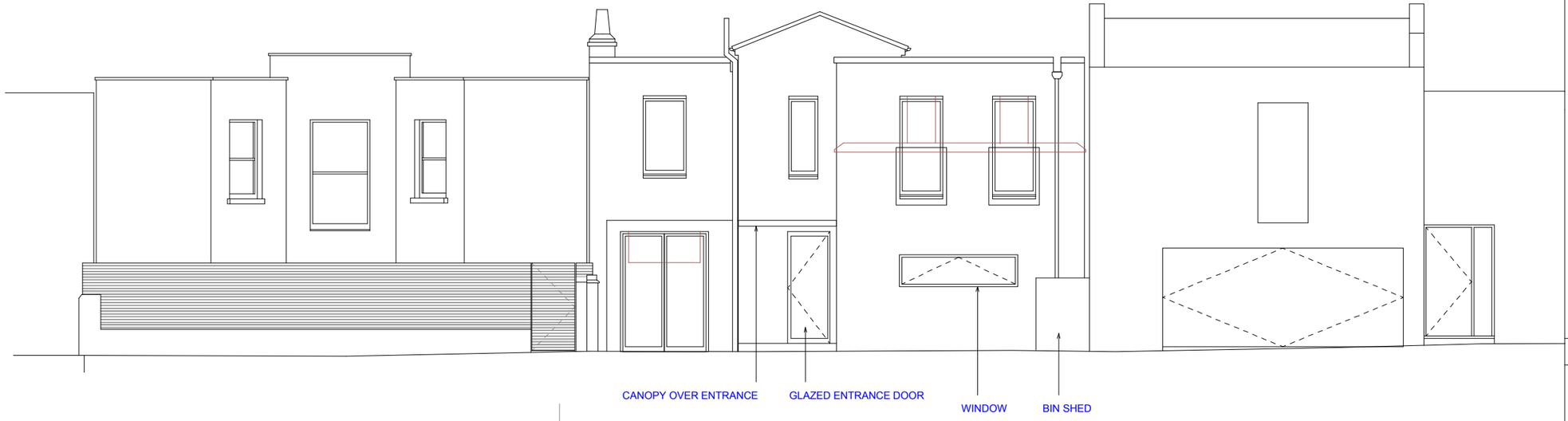
Client
JONATHAN MORLEY

Project
20 ALBERT TERRACE MEWS, NW1

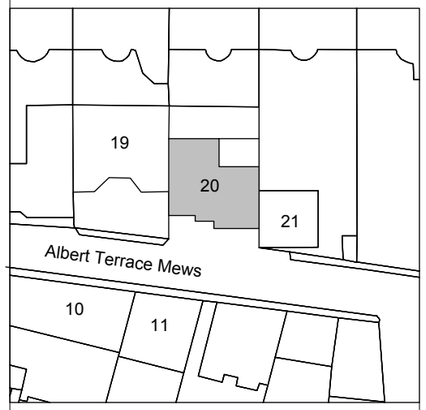
Title
PROPOSED SECTION B

File name	Rev
15003_1201	-

Status
PLANNING



19 ALBERT TERRACE MEWS | APPLICATION SITE | 21 ALBERT TERRACE MEWS



KEY PLAN
nts

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0 1 2 3 4 5
Metres

REV	Description	Date
B	ISSUED FOR INFO	23.10.2016
A	ISSUED FOR PLANNING	30.07.2016

Scale 1:100
Size A3
Drawn by ET

Client
JONATHAN MORLEY

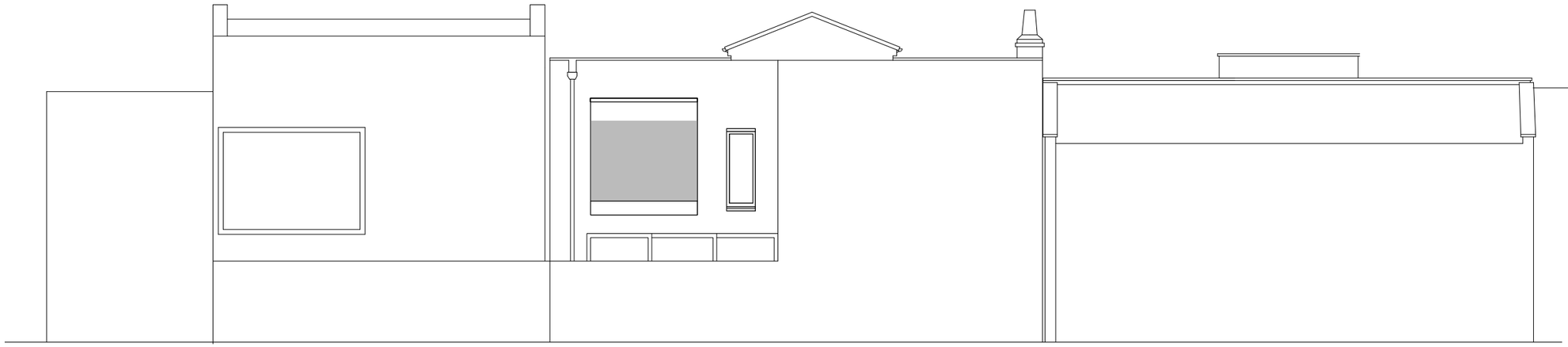
Project
20 ALBERT TERRACE MEWS, NW1

Title
PROPOSED NORTH ELEVATION

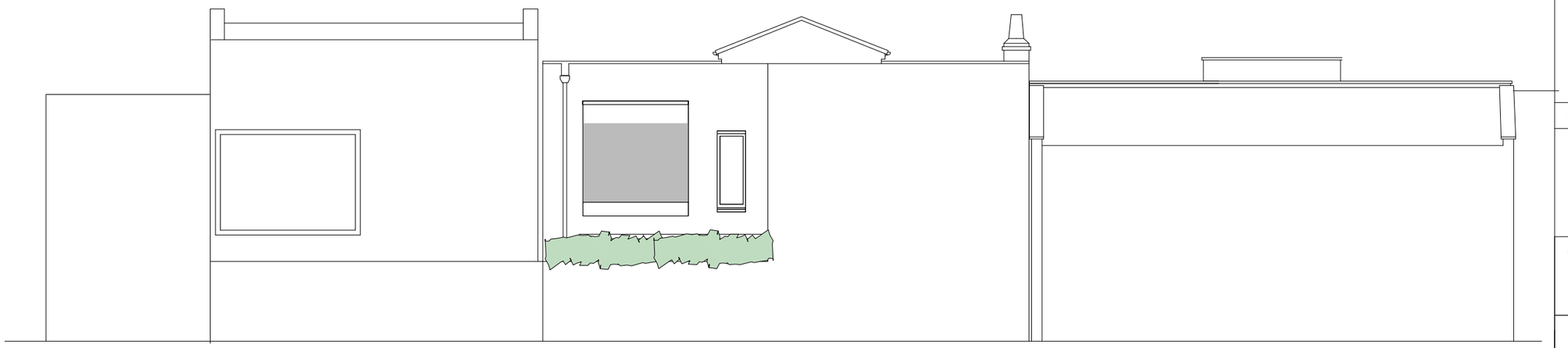
File name
15003_1300

Rev
B

Status
PLANNING



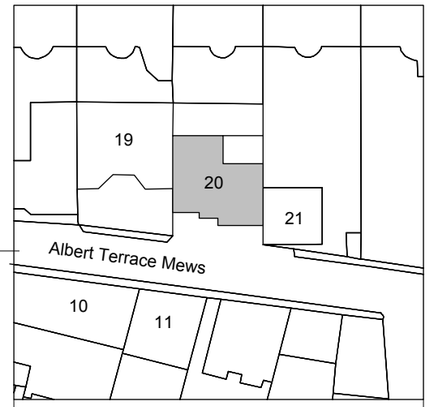
21 ALBERT TERRACE MEWS | APPLICATION SITE | 19 ALBERT TERRACE MEWS



21 ALBERT TERRACE MEWS | APPLICATION SITE | 19 ALBERT TERRACE MEWS

PROPOSED SOUTH ELEVATION WITH EXISTING TIMBER TRELLIS & PLANTING

0 1 2 3 4 5
Metres



KEY PLAN
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REV	Description	Date
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A	ISSUED FOR PLANNING	30.07.2016

Scale	1:100
Size	A3
Drawn by	ET

Client
JONATHAN MORLEY

Project
20 ALBERT TERRACE MEWS, NW1

Title
PROPOSED SOUTH ELEVATION

File name
15003_1301

Rev
B

Status
PLANNING

Appendix B

Rainfall runoff calculations

Critical Storm Duration and volume requirements (whole site)

The table below presents storage volumes for the 1 in 100 year plus climate change (40%) used to assess the impact of the proposed development and calculate the required storage volumes for the critical storm duration for attenuation features, limited to a maximum discharge rate of 1 l/s. According to calculations, the 0.5 hour storm is the critical storm duration when applying a discharge rate of 1 l/s.

Table 5: Critical Storm Durations and storage requirements associated with the development

Rainfall event duration (Hours)	Outflow to 1l/s (m^3)	Inflow from impermeable surfaces (m^3)	Storage Required for Critical Storm Duration (m^3)
0.25	0.90	4.13	3.23
0.5	1.80	5.31	3.51
0.75	2.70	6.00	3.30
1	3.60	6.48	2.88
2	7.20	8.34	1.14
3	10.80	9.49	0

Critical Storm Duration and volume requirements (excluding basement terrace and void space)

The table below presents storage volumes for the 1 in 100 year plus climate change (40%) used to assess the impact of the proposed development and calculate the required storage volumes for the critical storm duration for attenuation features, limited to a maximum discharge rate of 1 l/s. According to calculations, the 0.5 hour storm is the critical storm duration when applying a discharge rate of 1 l/s.

Table 5: Critical Storm Durations and storage requirements associated with the development

Rainfall event duration (Hours)	Outflow to 1l/s (m^3)	Inflow from impermeable surfaces (m^3)	Storage Required for Critical Storm Duration (m^3)
0.25	0.90	3.40	2.50
0.5	1.80	4.38	2.58
0.75	2.70	4.94	2.24
1	3.60	5.34	1.74
2	7.20	6.87	0

Greenfield Site Run-Off Calculations usng the IoH124 method

Greenfield peak run-off rate (QBAR):

Parameters	Input	Units	Comments
Area	50	ha	mimimum 50ha
SAAR	638	mm	FEH CD ROM (NERC, 2009)
SPR	0.47	N/A	Soil run-off coefficient
Region	6	N/A	Region on Hydrological area map

QBAR

$$Q_{BAR(rural)} = 1.08AREA^{0.89}SAAR^{1.17}SPR^{2.17}$$

Where:

$Q_{BAR(rural)}$	is the mean annual flood (a return period of 2.3 years) in l/s
AREA	is the area of the catchment in km² (minimum of 0.5km²)
SAAR	is the standard average rainfall for the period 1941 to 1970 in mm
SPR	is the soil run-off coefficient

$Q_{BAR(rural)}$ can be factored by the UK Flood Studies Report regional growth curves to produce peak flood flows for any return period.

$Q_{BAR(rural)}$	=	216.57	l/s for 50ha site
Divided by 50 to scale down	=	4.33	l/s/ha
Actual Area of the entire Site	=	0.01	ha

Return Periods (Growth curves obtained from DEFRA report)

Return Period		Growth Factor	l/s/ha	Peak site run-off rate (l/s)
1	**$Q_{BAR(rural)}$ x**	**0.85**	**3.68**	**0.034**
2	$Q_{BAR(rural)}$ x	0.88	3.81	0.03
5	$Q_{BAR(rural)}$ x	1.28	5.54	0.05
10	$Q_{BAR(rural)}$ x	1.62	7.02	0.06
25	$Q_{BAR(rural)}$ x	2.14	9.27	0.08
30	**$Q_{BAR(rural)}$ x**	**2.24**	**9.70**	**0.088**
50	$Q_{BAR(rural)}$ x	2.62	11.35	0.10
100	**$Q_{BAR(rural)}$ x**	**3.19**	**13.82**	**0.13**
200	$Q_{BAR(rural)}$ x	3.86	16.72	0.15

Greenfield total run-off volume:

= actual area of the entire site x SPR x 6 hour rainfall depth

Return Period	6 hour rainfall (mm) from FEH CD-ROM	Area (ha)	SPR	Total run-off (m^3)
2.3 (QBAR)	28.82	0.01	0.47	1.2
1	25.74	0.01	0.47	1.1
10	46.54	0.01	0.47	2.0
30	62.11	0.01	0.47	2.7
100	86.38	0.01	0.47	3.7

Summary

Entire site area:	0.009	ha
Climate Change Factor	40%	

	Current	*Proposed*
Permeable Surface (ha)	0.000	0.000
Impermeable Surface (ha)	0.009	0.009

1 in 1 year

Greenfield run-off volume total: 1.10 m^3

RUN-OFF During a 1 in 1 year 6 hour event:	**Greenfield Site**	**Current Development**	**Proposed Development**	**Proposed Development +CC**
From permeable surfaces (using GF total run-off) (m^3)	1.10	0.00	0.00	0.00
From impermeable surfaces (m^3)		2.43	2.43	3.41
TOTAL run-off produced from Site (m^3)	1.10	2.43	2.43	3.41

Difference between greenfield site and proposed +cc development (m^3):	**2.31**
	209%
Difference between current and proposed +cc development (m^3):	**0.97**
	40%
Peak Greenfield run-off rate that must not be exceeded in the run-off from the proposed development (l/s):	**0.03**

1 in 10 year

Greenfield run-off volume total: 1.99 m^3

RUN-OFF During a 1 in 1 year 6 hour event:	**Greenfield Site**	**Current Development**	**Proposed Development**	**Proposed Development +CC**
From permeable surfaces (using GF total run-off) (m^3)	1.99	0.00	0.00	0.00
From impermeable surfaces (m^3)		4.24	4.24	5.93
TOTAL run-off produced from Site (m^3)	1.99	4.24	4.24	5.93

Difference between greenfield site and proposed +cc development (m^3):	**3.94**
	198%
Difference between current and proposed +cc development (m^3):	**1.69**
	40%
Peak Greenfield run-off rate that must not be exceeded in the run-off from the proposed development (l/s):	**0.06**

1 in 30 year

Greenfield run-off volume total: 2.66 m^3

RUN-OFF During a 1 in 30 year 6 hour event:	**Greenfield Site**	**Current Development**	**Proposed Development**	**Proposed Development +CC**
From permeable surfaces (using GF total run-off) (m^3)	2.66	0.00	0.00	0.00
From impermeable surfaces (m^3)		5.80	5.80	8.12
TOTAL run-off produced from Site (m^3)	2.66	5.80	5.80	8.12

Difference between greenfield site and proposed +cc development (m^3):	**5.47**
	206%
Difference between current and proposed +cc development (m^3):	**2.32**
	40%
Peak Greenfield run-off rate that must not be exceeded in the run-off from the proposed development (l/s):	**0.09**

1 in 100 year

Greenfield run-off volume total: 3.69 m^3

RUN-OFF During a 1 in 100 year 6 hour event:	**Greenfield Site**	**Current Development**	**Proposed Development**	**Proposed Development +CC**
From permeable surfaces (using GF total run-off) (m^3)	3.69	0.00	0.00	0.00
From impermeable surfaces (m^3)		8.10	8.10	11.34
TOTAL run-off produced from Site (m^3)	3.69	8.10	8.10	11.34

Difference between greenfield site and proposed +cc development (m^3):	**7.64**
	207%
Difference between current and proposed +cc development (m^3):	**3.24**
	40%
Peak Greenfield run-off rate that must not be exceeded in the run-off from the proposed development (l/s):	**0.13**

From: Sam Cogan (Geosmart)
To: "AmabelLaurie@campbellreith.com"
Subject: RE: 20 Albert Terrace Mews - FRA and SuDS reports
Date: 04 September 2017 09:23:29
Attachments: image001.gif
image002.png
image003.jpg
image004.png
image005.jpg

Good morning Amabel,

I hope all is well with yourself.

The report author who is undertaking the SuDSmart Pro report has asked me to get in touch regarding the above Site.

Using the IoH124 method the Greenfield QBar run-off rate is c. 0.04 l/s and the existing run-off rate for the 1 in 100 year (6 hour) storm event is 0.3 l/s, neither of which are a realistic, feasibly practical discharge rate for the Site (as the underlying geology, supported by a site investigation, is not conductive to discharge to ground and it is very unlikely that discharge into a surface water course would be feasible so discharge to a nearby combined sewer is likely to be the optimum solution).

We would like to ascertain for the report the ideal/maximum discharge rate you would be amenable to for the Site which would be feasible and the method which you would prefer to see implemented on the Site.

Kind Regards

Sam

GeoSmart

Sam Cogan
Flood Risk Consultant

t. +44 (0)1743 298 100
e. samcogan@geosmartinfo.co.uk
@geosmartinfo
www.geosmartinfo.co.uk

Please be advised we are moving offices as of W/C 4th Sept. 2017.
Please make a note of our new address.

Appendix C

STL Regulated Drainage and Water Search

Asset location search

Property Searches

Envirep Ltd
New Zealand House
SHREWSBURY
SY2 6FD

Search address supplied 20
Albert Terrace Mews
London
NW1 7TA

Your reference 70127

Our reference ALS/ALS Standard/2017_3641022

Search date 30 August 2017

Keeping you up-to-date

Knowledge of features below the surface is essential in every development. The benefits of this not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility for any commercial or residential project.

An asset location search provides information on the location of known Thames Water clean and/or wastewater assets, including details of pipe sizes, direction of flow and depth. Please note that information on cover and invert levels will only be provided where the data is available.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

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

0845 070 9148

searchcode

Asset location search

Search address supplied: 20, Albert Terrace Mews, London, NW1 7TA

Dear Sir / Madam

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

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

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

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

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

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

Contact Us

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

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

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

Waste Water Services

Asset location search

Thames Water Property Searches

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.

Asset location search

Property Searches

For your guidance:

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

Payment for this Search

A charge will be added to your suppliers account.

Asset location search

Property Searches

Further contacts:

Waste Water queries

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

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

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

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

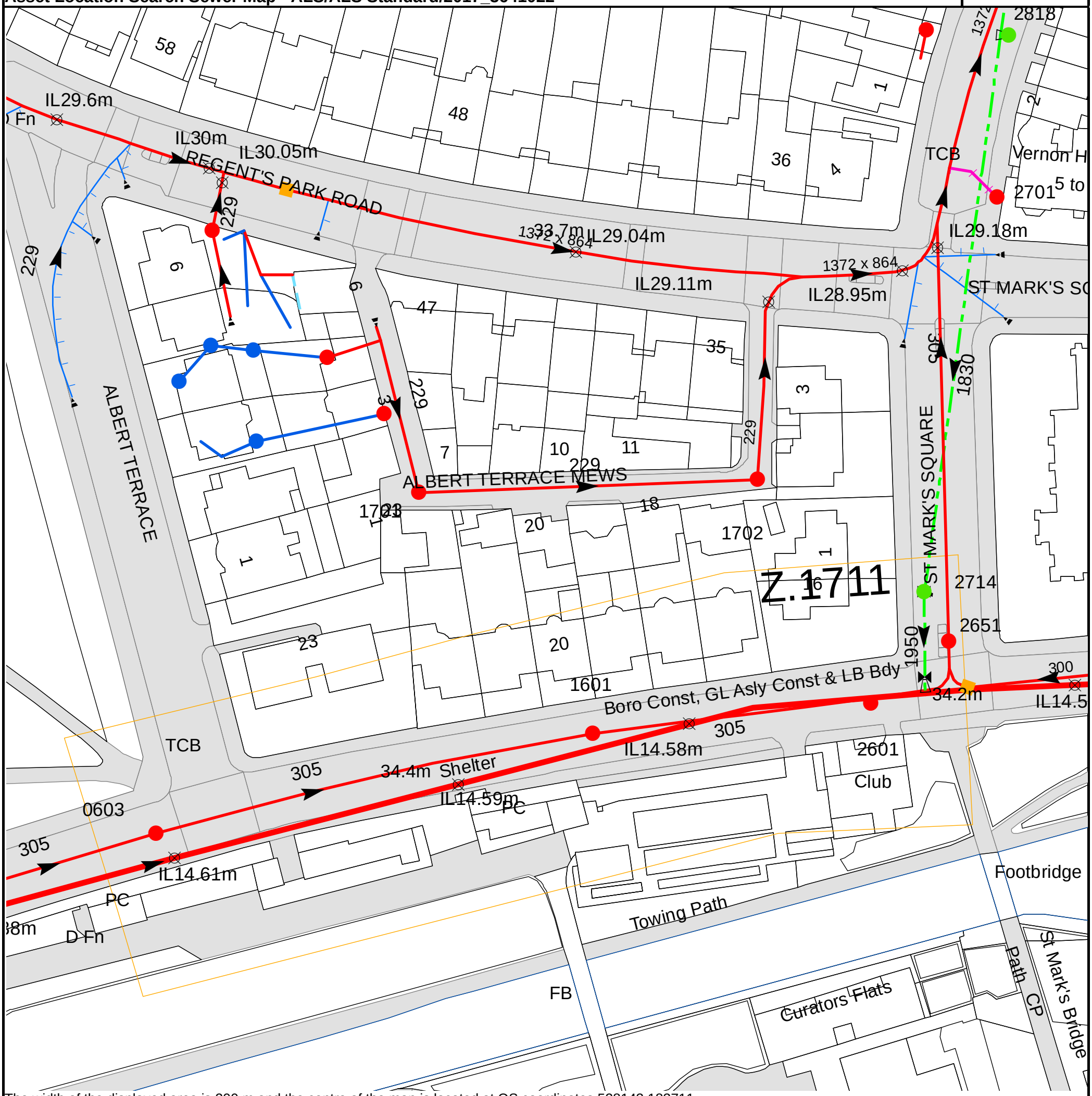
Clean Water queries

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

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

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

Asset Location Search Sewer Map - ALS/ALS Standard/2017_3641022



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 528143,183711

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
28CC	n/a	n/a
2701	n/a	n/a
2818	32.83	20.47
1601	34.42	30.35
2601	34.22	29.87
2651	n/a	n/a
2714	34.07	15.72
1701	32.63	30.11
1702	32.25	29.55
07CC	n/a	n/a
17BB	n/a	n/a
17BE	n/a	n/a
07CG	n/a	n/a
07CF	n/a	n/a
0701	n/a	n/a
0603	34.54	31.05
07CE	n/a	n/a

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

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

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

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

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

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

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

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

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

Control Valve

Drop Pipe

Ancillary

Weir

End Items

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

Outfall

Undefined End

Inlet

Other Symbols

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

Public/Private Pumping Station

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

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

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

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

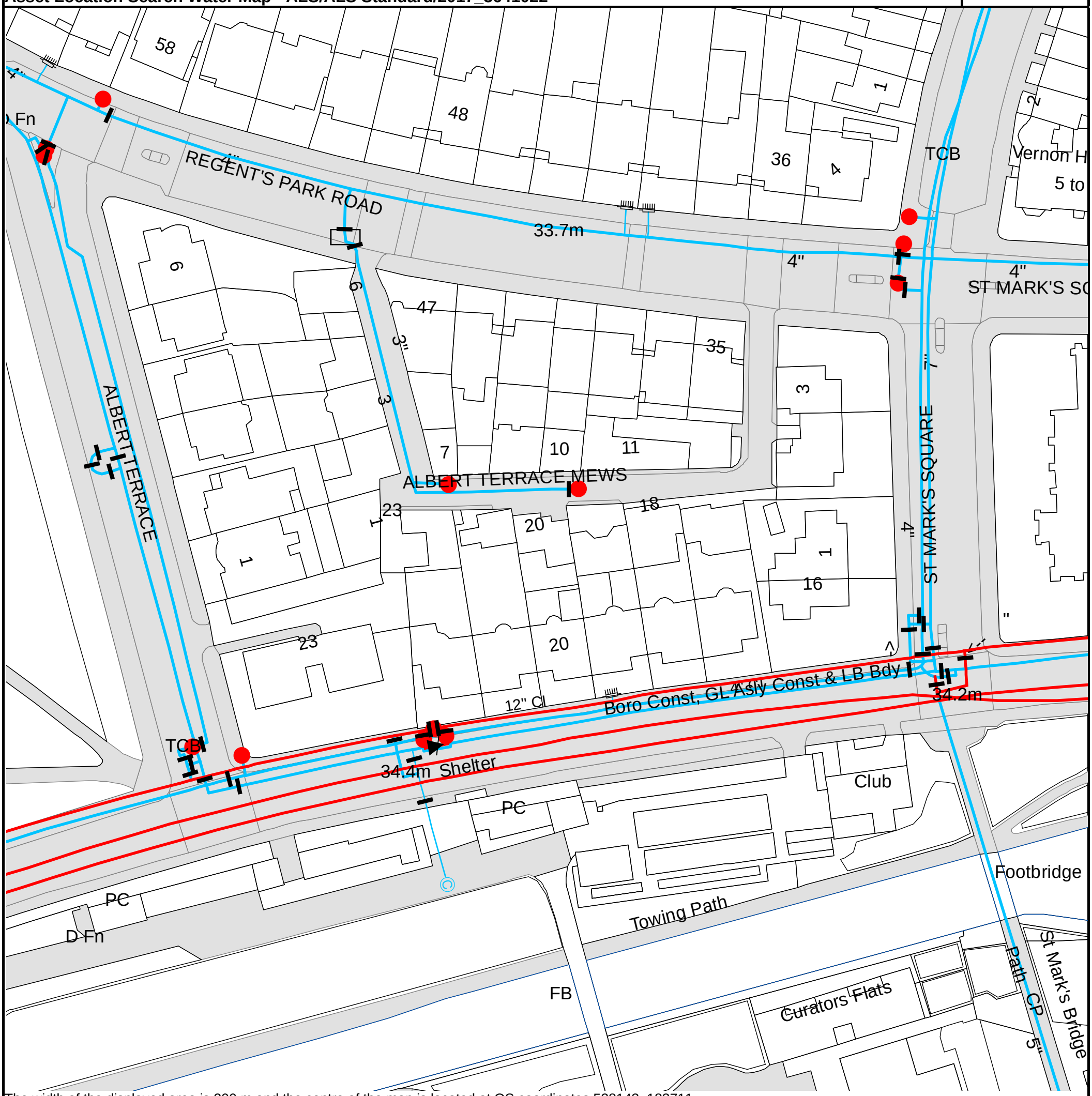
Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Asset Location Search Water Map - ALS/ALS Standard/2017_3641022



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 528143, 183711.

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

ALS Water Map Key

Water Pipes (Operated & Maintained by Thames Water)

4"

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

16"

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

3" SUPPLY

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

3" FIRE

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

3" METERED

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

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

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

Valves

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

Hydrants

- Single Hydrant

Meters

- Meter

End Items

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

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

Operational Sites

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

Other Symbols

- Data Logger

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

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

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

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

Terms and Conditions

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

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

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

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

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

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

Ways to pay your bill

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

Search Code

IMPORTANT CONSUMER PROTECTION INFORMATION

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

The Search Code:

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

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

The Code's core principles

Firms which subscribe to the Search Code will:

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

Complaints

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

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

TPOs Contact Details

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

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

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

GeoSmart Information

Environmental Thinking

FloodSmart

Site address	20 Albert Terrace Mews London NW1 7TA
Site coordinates	528714, 185665
Report prepared for	Progressive Development & Management Ltd 64 Pond Bank Blisworth Northamptonshire NN7 3EL
Report reference	70127R1REV1
Report status	Final report
Date issued	September 2017
Report author	Bob Sargent (CSci, CEnv, CWEM, FCIWEM) Associate Consultant
Report reviewer	Paul Ellis (BSc, PhD, CGeol, FGS) Managing Director

New Zealand House
160 Abbey Foregate
Shrewsbury SY2 6FD

GeoSmart Information Ltd
COPSO EXECUTIVE MEMBER SearchCode™

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Registered office: New Zealand House, 160 Abbey Foregate, Shrewsbury SY2 6FD. Registered in England and Wales, number 5475394.

1. Executive summary

The National Planning Policy Framework (2012) and Planning Practice Guidance (2015) requires that flood risk assessments review flooding from all potential sources. A review has been undertaken of national environmental data sets to assess the potential flood risk to the Site. The review is provided within this concise interpretative report written by an experienced GeoSmart flood risk consultant. GeoSmart have assessed the best available data to determine the potential risk from flooding at the Site, based on professional judgment with recommendations where applicable. An explanation of the various risk categories is provided in the report.

Source of flood risk	Baseline	After mitigation
River and coastal	Low	N/A
Surface water (pluvial) flooding	Moderate-Low	N/A
Groundwater flooding	Negligible	N/A
Other flood risk factors present	No	N/A
Is any other further work recommended?	Yes	Yes (Please see below)

N/A = mitigation not required

Site analysis

The Site is currently used within a residential capacity. Development proposals comprise the formation of a basement floor level and the creation of a rear lightwell to provide a single additional bedroom, a media room, storage, a plant room and a bathroom. Development proposals will also comprise minor alterations to the interior of the existing property.

The Site is located within the Environment Agency's Flood Zone 1 and is classified as being at low risk of fluvial flooding.

According to updated Figure 6 of the SFRA, the Site is located within a Critical Drainage Area (CDA)(Group3_003) and is within the Primrose Hill Local Flood Risk Zone (LFRZ) however the SFRA does not indicate reported incidents of surface water flooding either at the Site or along Albert Terrace Mews or Regents Park Road (URS Ltd, 2014).

Based on the Environment Agency's Risk of Flooding from Surface Water Map, areas of the development to the south and to the west are mapped to be at moderate risk of surface water flooding where depths could range between 0.3m to 0.9m above ground level on

areas of the Site which have an elevation of under 32.7 mAOD along the southern boundary up to and during a 1 in 100 year flood event.

Mitigation measures are included within the development design to prevent the accumulation of surface water and direct inflow of surface water to the basement via the proposed ventilation void in the south of the Site. These measures comprise the construction of a 1.1m high wall, rising to 2m along the southern boundary to prevent the inflow and a cavity drainage system is included within the current specification. The ventilation void itself is also set at 0.15m above surrounding ground levels.

Based on GeoSmart's Groundwater Flood Risk Map, the Site is considered to be at negligible risk of groundwater flooding and no other source of flood risk has been identified.

A Basement Impact Assessment (BIA) undertaken for the Site states that the basement would not affect long-term groundwater conditions.

Next steps

- As the Site is located within a Critical Drainage Area, a reduction in surface water run-off is required even though the Site is not increase impermeable cover. A Sustainable Drainage Report has been undertaken for the Site (GeoSmart, 2017. Ref No: 70127.01R1) to mitigate any flood risk both to and from the Site. The report will propose an attenuation volume with will reduce surface water run-off volumes by 56% - more than 50% of the Site's (prior to re-development) surface water runoff in line with the minimum requirements stated within the London Plan's SDC SPG (2014) and the London Borough of Camden Planning Guidance (CPG 3: Sustainability) (2015).

- Access to the basement is via an internal stairwell and ingress of surface water flooding will therefore be controlled by the building threshold level which should be above the maximum predicted surface water flood level of 33.9 mAOD.

- Regular maintenance of any drains surrounding/on the Site should be undertaken to reduce any residual risk of blockages.

- Flood resilience measures which should be considered for the basement and ground floor levels of the Site include:
    - Silification primers (waterproof paints) and cementitious waterproof grouts and mortars to protect internal walls from damp and any water ingress.
    - Tiling of internal ground floors, instead of using carpets on the floor.
    - Ingress points through walls or floors, such as service ducts, and radiator pipes should be sealed (in our experience these are key areas where floodwater can unexpectedly enter a property).
    - Flood testing of the installation should be conducted to check how waterproof the area is.

- Measures to prevent the accumulation of surface water and direct inflow to the basement via the proposed ventilation void should include the construction of a wall to prevent water entry into internal areas on the Site.

- The basement should be constructed to a tanked and waterproof design to prevent groundwater ingress. An internal sump and pump is also recommended.
- As the Site is located within a CDA and LFRZ which has been identified as being at risk from surface water and sewer flooding, the basement should be protected from sewer flooding by the installation of a positive pumped device.

We recommend that mitigation measures that have been discussed within this report are considered as part of the proposed development where possible and evidence of this is provided to the Local Authority as part of the planning application.

2. Introduction

Background and purpose

This assessment has been undertaken by firstly compiling information concerning the Site and the surrounding area. The information gathered was then used to construct a 'conceptual site model', including an understanding of the appropriateness of the development as defined in the NPPF (2012) and the source(s) of any flood risk present. Finally, a preliminary assessment of the steps that can be taken to manage any flood risk to the development has been undertaken.

This report has been prepared with reference to the National Planning Policy Framework (NPPF, 2012).

"*The National Planning Policy Framework set out the Government's planning policies for England and how these are expected to be applied"* (NPPF, 2012).

The National Planning Policy Framework promotes a sequential, risk based approach to the location of development.

"This general approach is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. The aim should be to keep development out of medium and high risk flood areas (Flood Zones 2 and 3) and other areas affected by other sources of flooding where possible" (NPPG, 2014).

The purpose of this report is to provide clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at the Site.

Report scope

A thorough review of a commercially available flood risk report and Environment Agency supplied data indicating potential sources of flood risk to the Site from rivers and coastal sources, surface run-off (pluvial), groundwater and reservoirs, including historical flood information. Appropriate measures are recommended to manage and mitigate the flood risk to the property.

Information obtained from the Environment Agency and a review of the London Borough of Camden Strategic Flood Risk Assessment (SFRA) (July 2014), London Borough of Camden Surface Water Management Plan (SWMP) (2011) and London Borough of Camden Preliminary Flood Risk Assessment (PFRA) (2011) is used to ascertain local flooding issues and, where appropriate, identify information to support a Sequential and/or Exception test required as part of the National Planning Policy Framework (NPPF, 2012).

Using the available data the existing and future flood risks to and from the Site from all flood sources will be assessed in line with current best practice.

An indication of potential flood risk from the Site to downstream receptors is provided where the proposed development increases run-off from the Site.

Report limitations

It is noted that the findings presented in this report are based on a desk study of information supplied by third parties. Whilst we assume that all information is representative of past and present conditions we can offer no guarantee as to its validity and a proportionate programme of site investigations would be required to fully verify these findings.

This report excludes consideration of potential hazards arising from any activities at the Site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities.

Datasets

The following table shows the sources of information that have been consulted as part of this report:

Source of flooding	Datasets consulted					
	Commercial Flood Report (Appendix B)	SFRA*[1]	SWMP and PFRA*[2]	Environment Agency	Thames Water (Appendix C)	OS Data
Historical	X	X		X		
Fluvial/tidal	X	X		X		
Surface water (pluvial)	X	X	X	X		
Groundwater	X	X				
Sewer		X	X		X	
Culvert/bridges		X	X			X
Reservoir		X		X		

*[1]London Borough of Camden Strategic Flood Risk Assessment (SFRA) (July 2014)
*[2]London Borough of Camden Surface Water Management Plan (SWMP) (2011)
*[3]London Borough of Camden Preliminary Flood Risk Assessment (PFRA) (2011)
(Supporting information on the datasets used is provided in the relevant appendix)

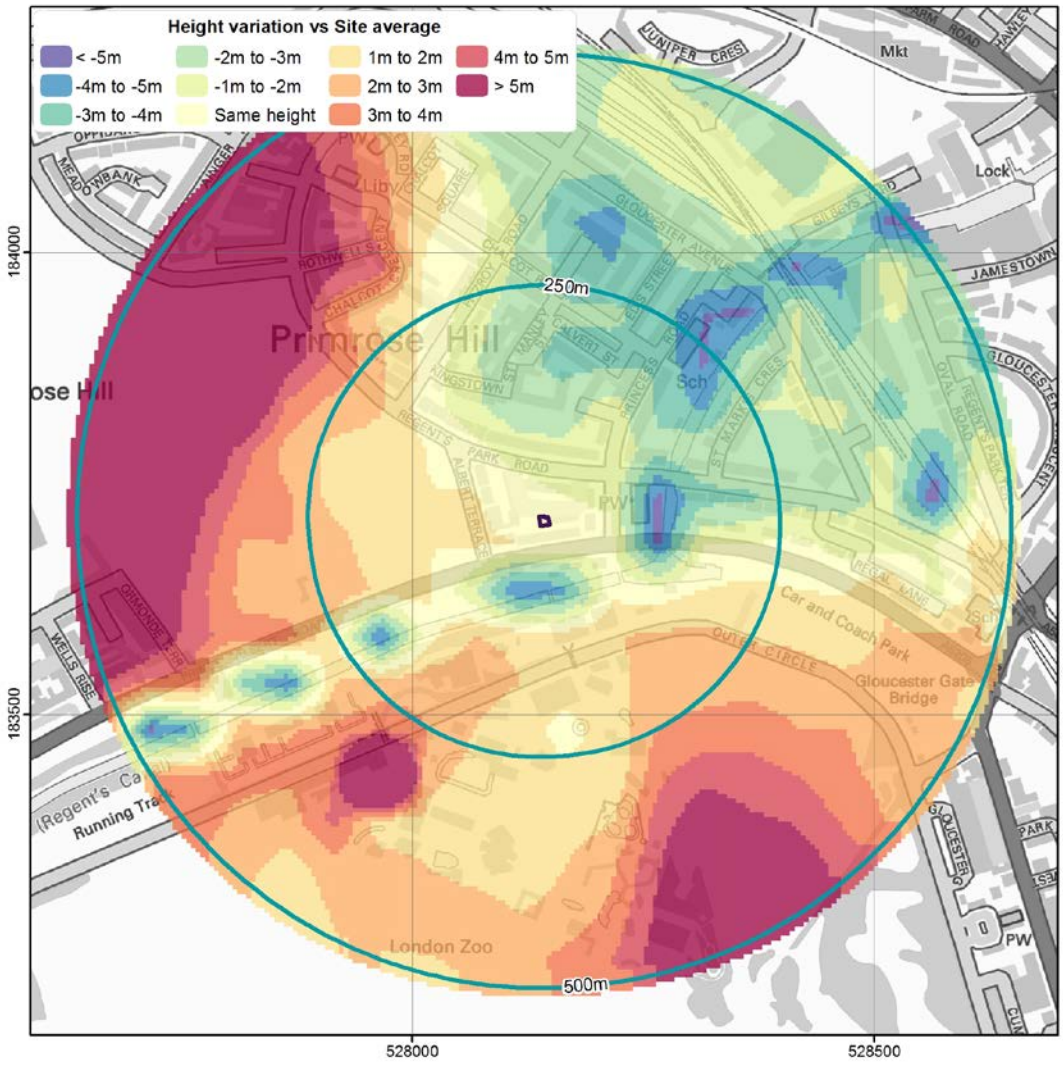
3. Site analysis

Site information

The Site is located in Camden in a setting of predominately residential land use, National Grid Reference TQ 28142 83713 (see Figure 1). According to OS data the immediate area surrounding the Site is located on a gentle slope between 30-35 mAOD. Using a 1 km buffer around the Site, it is noted that to the north and to the south land rises to between 35-40 mAOD. To the west land rises to between 55-60 mAOD before declining to 40-45 mAOD, to the east land declines to between 25-30 mAOD.

The general level of the Site is between 32.84 and 32.34 mAOD with the Site declining gradually in a westerly and easterly direction from a centre point of the Site. This is based on EA elevation data obtained for the Site to a 1m resolution with a vertical accuracy of ±150 mm.

Figure 1 Site Location and Relative Elevations



Development

The Site is currently used within a residential capacity. Development proposals comprise the formation of a basement floor level and the creation of a rear lightwell to provide a single additional bedroom, a media room, storage, a plant room and a bathroom. Access to the basement is via an internal stairwell and according to client provided plans, the basement ventilation void is proposed 0.15m above existing ground levels.

A wall is proposed to a height of between 1.1m, rising to 2m along the southern boundary to prevent the inflow of surface water into the ventilation void and a cavity drainage system is included within the current specification to remove the impacts of surface water to internal areas.

Development proposals will also comprise minor alterations to the interior of the existing property. From the BIA the proposed development comprises the construction of a new basement level below the existing structure. The building will continue to be of residential use. Proposed basement formation level is at approximately +30.5mOD, requiring an excavation of some 3.5m (see Appendix A).

The effect of the overall development will result in an increase in number of occupants and/or users of the building due to the introduction of an additional bedroom and bathroom. However it will not result in the change of use, nature or times of occupation. The estimated lifespan of the development is 100 years.

Hydrological features

Watercourses/surface water features within 1km of the Site:

Grand Union Canal is located approximately 70m south of the Site at its closest point and is located at least 2m below the level of the Site (elevation of between 29-30 mAOD)

Eight standing water features are located within 500m of the Site within London Zoo. The closest is approximately 200m south of the Site.

Boating Lake, located within Regents Park, is located approximately 810m south of the Site.

According to LiDAR ground elevation data and the Environment Agency's Risk of Flooding from pluvial source mapping, potential overland flow routes to the Site could exist from the north, west and east.

According to LiDAR ground elevation data and a comparison of surrounding ground elevations, potential overland flow routes from the Site could exist to the east and west.

Proximity to relevant infrastructure:

A culverted 'Lost River' watercourse (River Fleet) flows south east from Hampstead Ponds and is located approximately 900m north west of the Site at its closest point. All main rivers historically located within London Borough of Camden are now culverted and are classed as 'lost rivers' (URS, 2014).

Hydrogeological features

British Geological Survey mapping indicates that there is no record of superficial deposits recorded on the Site (BGS, 2016)

British Geological Survey mapping indicates that the underlying bedrock geology consists of the London Clay Formation (BGS, 2016) and is not classified as an aquifer (EA, 2016).

There have been boreholes drilled on site for SI as part of the BIA (CGL, August 2017). Site investigation boreholes at the site (CGL, August 2017) Identified ade Ground was identified from ground level (34mOD) with thickness between 0.7m and 0.85m. Approximately the upper 0.35m of the Made Ground was found to be granular material comprising very gravelly sand / slightly clayey sandy gravel.

The Site is not located within a Source Protection Zone.

4. Flood risk to the development

Historical flood events

No historic flood events have been recorded at the Site (EA, 2017).

Guidance

The purpose of historic flood data is to provide information on where and why flooding may have occurred in the past. The absence of any recorded events does not mean that flooding has never occurred on Site or that flooding will never occur at the Site.

Fluvial/coastal flood risk

The Site is located within the Environment Agency's Flood Zone 1 and is classified as being at low risk of fluvial flooding (Figure 2).

According to the Environment Agency's Risk of Flooding from Rivers and the Sea (RoFRAS) mapping, which considers the crest height, standard of protection and condition of defences, the flood risk from Rivers and the Sea is Low.

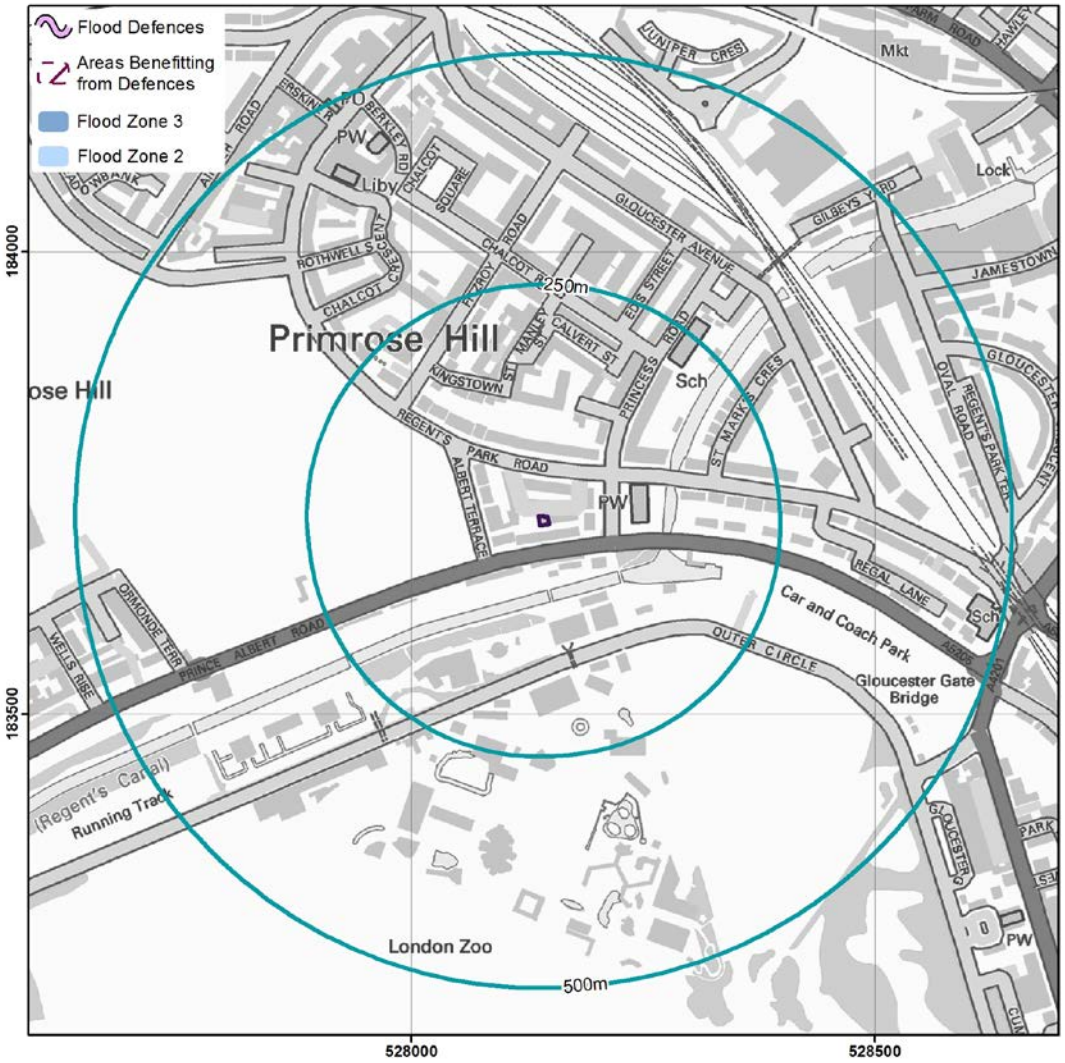
Guidance

As defined in the NPPF (2012):

Ignoring the presence of any defences, land located in a Flood Zone 1 is considered to be at low risk of flooding, with less than a 1 in 1000 annual probability of fluvial or coastal flooding in any one year.

Development of all uses of land is appropriate in this zone (see glossary for terminology).

Figure 2 Environment Agency (EA) Flood Map for Planning Purposes (EA, 2017)



Surface water (pluvial) flooding

According to updated Figure 6 of the SFRA, the Site is located within a Critical Drainage Area (CDA)(Group3_003). The Site is also located within the Primrose Hill Local Flood Risk Zone (LFRZ) (URS Ltd, 2014).

CDA Group3_003 (River Fleet Catchment) modelling indicates deep flooding at Gospel Park, affecting Oak Village, Lamble Street, Grafton Road and Kiln Place. This appears to be caused by the railway embankments creating a 'basin' into which surface water collects. Primrose Hill and the surrounding area also indicates surface water ponding along properties which may increase the possibility to basement flooding. The primary source of flooding for the Group3_003 CDA and the Primrose Hill LFRZ is surface water and sewer flooding (Halcrow, 2011).

Guidance

As defined in the London Borough of Camden Strategic Flood Risk Assessment (SFRA) (July 2014):

A Critical Drainage area:

A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure.

A Local Flood Risk Zone:

Local Flood Risk Zones are defined as discrete areas of flooding that do not exceed the national criteria for a 'Flood Risk Area' but still affect houses, businesses or infrastructure. A LFRZ is defined as the actual spatial extent of predicted flooding in a single location.

According to the Environment Agency's Risk of Flooding from Surface Water (pluvial) mapping (Figure 4), areas of the Site towards the southern, norther and south western boundaries are at high risk of surface water (pluvial) flooding where depths could range between 0m to 0.3m above ground level on areas of the Site which have an elevation of under 32.5 mAOD along the southern boundary which could potentially encroach into the area proposed for the basement lightwell up to and during a 1 in 30 year event. Sections of Albert Terrace Mews road would be impacted during a flood event of this magnitude with flood depths up to 0.6m.

Areas of the development to the south and to the west are mapped to be at moderate risk of surface water flooding where depths could range between 0.3m to 0.9m above ground level on areas of the Site which have an elevation of under 32.7 mAOD along the southern boundary which would encroach into the area proposed for the basement lightwell and the existing development up to and during a 1 in 100 year event. The majority of Albert Terrace

Mews road would be impacted during a flood event of this magnitude with flood depths up to 0.6m.

The remainder of the Site mapped to be at low risk of surface water flooding. Flood depths could range between 0.3m to 1.2m above ground level, with the more severe flood depths mapped towards the south of the Site on areas which have an elevation of under 32.7 mAOD along the southern boundary which would encroach into the area proposed for the basement lightwell and the existing development up to a 1 in 1000 year event. All of Albert Terrace Mews road would be impacted during a flood event of this magnitude with flood depths which could be over 1.20m.

Figure 4 Environment Agency Risk of Flooding from Surface Water Map – 1 in 100 year event (EA, 2017)

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Modelling undertaken as part of the SFRA shows that surface water flooding, during a 1 in 1000 year event, would have a flood hazard rating of 'Significant' to 'Moderate'(Figure 3 vii)(Capita URS, 2013).

Based on inspection of OS data and information included in the SFRA and provided by the EA, the Site is located along a potential overland flow route which is mapped to flow directly onto the Site. (Capita URS, 2013).

The Site itself does not appear to be located within an area of low topography in relation to the surrounding area.

The SFRA does not indicate reported incidents of surface water flooding of either at the Site or along Albert Terrace Mews or Regents Park Road (URS Ltd, 2014).

Guidance

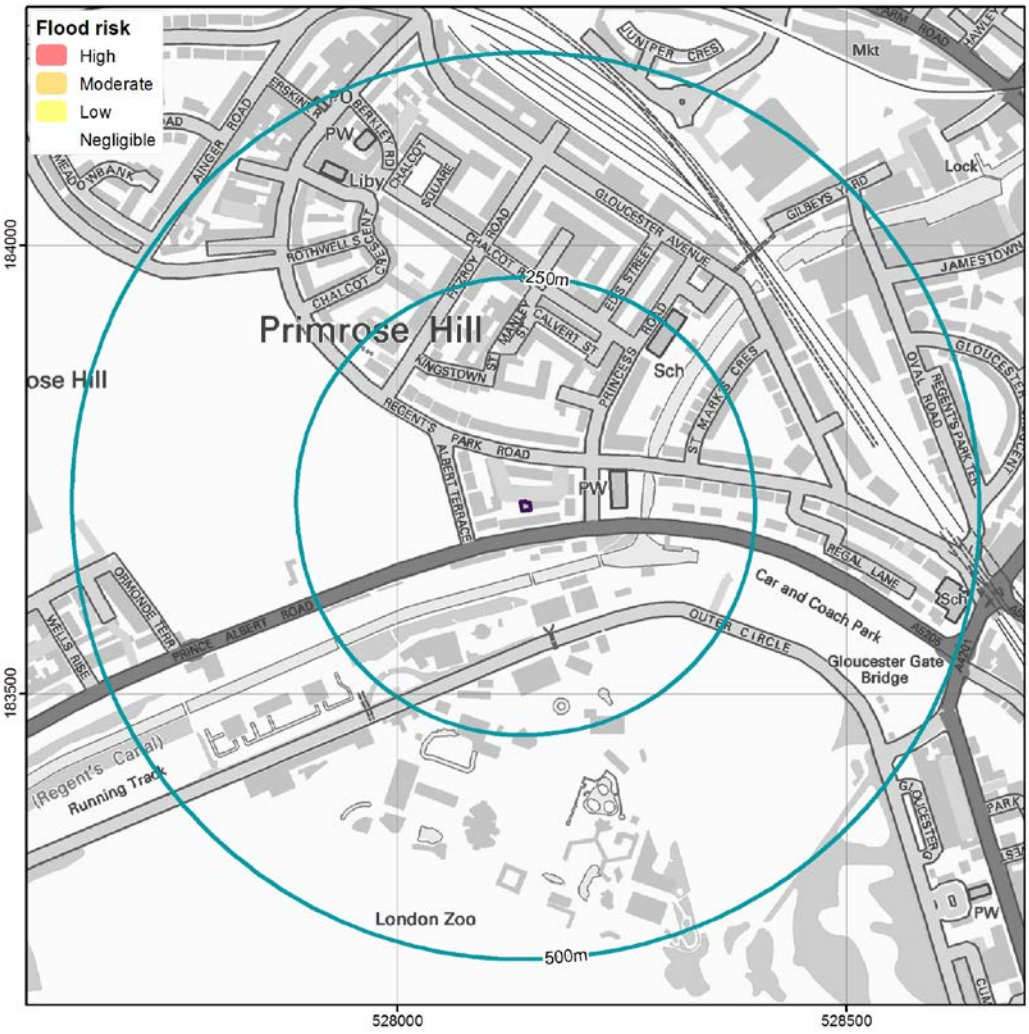
According to EA's surface water flood risk map, a site at high risk has a chance of flooding of greater than 1 in 30 (3.3%)

Groundwater flooding

Based on GeoSmart's Groundwater Flood Risk Map (Figure 4) the Site is considered to be at negligible risk of groundwater flooding as it is located on the London Clay formation. The SFRA does not indicate reported incidents of ground water flooding within 100 m of the Site and the site is not located within an area classed as being more suseptable to elevated groundwater (URS Ltd, 2014).

The risks may be higher for basements and below ground structures and as such mitigation measures such as sumps and pumps may be required.

Figure 4 GeoSmart GW5 Groundwater Flood Risk Map (GeoSmart, 2016)



Guidance

According to GeoSmart (2016) there is a negligible risk of groundwater flooding in this area and any groundwater flooding incidence will be less frequent that 1 in 100 years return period.

Negligible Risk - There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.

Basement flooding

In line with London Borough of Camden's guidance on basements and light wells (CPG4, section 3.51), basement development should not displace ground water or surface water flow so it causes flooding on nearby sites or those further away.

Applicants who wish to build basements in areas which have a risk of surface water flooding should consider the issue and take steps to protect their basements against water ingress as a result of this flooding. Measures such as setting all thresholds to the basement to be above the flood level could be adopted or, if this is not feasible the construction could be designed to be flood resilient.

In order to assess the impacts of the proposed development, a Basement Impact Assessment (BIA) was originally undertaken for the Site in February 2017 by Card Geotechnics Limited Ltd. The report is currently under revision however the report states that the proposed basement is to be constructed within the London Clay stratum, which is typically highly impermeable. Any water encountered is expected to be perched at the surface of the London Clay and of limited extent. It is stated that groundwater encountered within the Made Ground would be controlled using local sump pumping. The report concluded that the basement would not affect long-term groundwater conditions.

The conclusions were supported by a site investigation, undertaken by Card Geotechnics Limited Ltd in June 2017 which excavated two hand-dug trial pits to a depth of 1.8m below ground level and two window sample boreholes to a depth of 7 m below ground level, undertaken in accordance with BS5930 and BS10175. The investigation also included groundwater monitoring. The only ground water encountered was encountered on the monitoring visit in borehole WS2 at 5.04mbgl (28.96mOD), below the basement formation level.

Sewer flooding

Records held by Thames Water indicate that there have been no incidences of flooding related to the surcharging of public sewers at the Site (Thames Water, 2017; Appendix D).

Figure's 5a and 5b of the SFRA has no records of either internal or external sewer flooding incidences within proximity to the Site (URS Ltd, 2014).

Guidance

Properties classified as "at risk" are those that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system either once or twice in the ten year reference period (Thames Water, 2016). Records held by Thames Water provide information relating to reported incidents, the absence of any records does not mean that the Site is not at risk of flooding.

It should be noted that as sewers are designed to surcharge to just below cover level, basement and other subterranean development is at risk of flooding with sewage. In order to protect against flooding the Council are required to ensure that all basement and other subterranean development is protected from sewer flooding by the installation of a positive pumped device.

Culverts and bridges

Culverts and bridges have been identified within 1 km of the Site. Historic 'lost rivers' were culverted and incorporated into the local sewer network in the 19th Century. There is evidence (contained within the SFRA and SWMP) that during the 1975 and 2002 extreme rainfall events caused surcharging of the local sewer network as its capacity was exceeded (URS, 2014 and Halcrow, 2011).

Flood risk from these 'lost rivers' and the sewer network they are now connected is likely to have been reduced due to upgrades in the network by Thames Water since this time and a larger integration of SuDS and the subsequent reduction in runoff from developed Sites.

Grand Union Canal is approximately 70m south of the Site. EA LiDAR indicates that the Site (which has a minimum elevation of 32.34 mAOD) is located at least 2m above the level of the canal (with an elevation of between 29-30 mAOD) and is highly unlikely to be impacted by a flood from this source.

Reservoir flooding

According to the Environment Agency's Risk of Flooding from Reservoir mapping, the Site is not at risk of flooding from reservoirs (EA, 2017).

Guidance

The risk of reservoir flooding is related to the failure of a large reservoir (holding over 25,000 m^3 of water) and is based on the worst case scenario. Reservoir flooding is extremely unlikely to occur (Environment Agency, 2016c).

5. Flood risk from the development

While the proposed development does not involve a change in the cover of impermeable surfaces at the Site, an estimation of run-off has been provided separately (ref: 70127.01R1) to permit effective site water management and prevent any increase in flood risk to off-site receptors from the Site.

London Borough of Camden's planning guidance on basements and lightwells CPG 4 (July, 2015) section 3.51, confirms basement development should not displace ground water or surface water flow so it causes flooding on nearby sites or those further away.

Drainage and run-off

Using FEH 2013 rainfall data from the online Flood Estimation Handbook (FEH), developed by NERC (2009) and CEH (2016), the potential surface water run-off generated from the Site during a 1 in 100 year return period should be calculated. Guidance included within the National Planning Policy Framework (NPPF) recommends that the effects of climate change are incorporated into Flood Risk Assessments (Flood Risk Assessments: Climate Change Allowances Guidance, 2016). As the proposed development is for residential use, the lifespan development of 100 years and requirements for climate change should allow up to the 2115 scenario.

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

A Sustainable Drainage Report has been undertaken separately for the Site (GeoSmart, 2017. Ref No: 70127.01R1).

6. Suitability of the proposed development

The information below outlines the suitability of proposed development in relation to national and local planning policy.

National

The aims of the national planning policies are achieved through application of the Sequential Test and in some cases the Exception Test.

Guidance

Sequential test: The aim of this test is to steer new development towards areas with the lowest probability of flooding (NPPF, 2012). Reasonably available sites located in Flood Zone 1 should be considered before those in Flood Zone 2 and only when there are no reasonably available sites in Flood Zones 1 and 2 should development in Flood Zone 3 be considered.

Exception test: In some cases this may need to be applied once the sequential test has been considered. For the exception test to be passed it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk and a site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Suitability of the proposed development, and whether an Exception Test is required, is based on the Flood Zone the Site is located within and the flood risk vulnerability classification of the development proposals.

Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.

This report has been produced to assess all development types, prior to any development. The vulnerability classification and Flood Zones are compared within the table overleaf (Table 3 of the Planning Practice Guidance).

As the Site is located within Flood Zone 1, all types of development listed within the Table overleaf are acceptable according to National Policy.

Table: Flood risk vulnerability and flood zone 'compatibility (taken from NPPF, 2012)

Flood risk vulnerability classification		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood Zone	Zone 1 – low probability	✓	✓	✓	✓	✓
	Zone 2 – medium probability	✓	✓	Exception test required	✓	✓
	Zone 3a - high probability	Exception test required	✓	X	Exception test required	✓
	Zone 3b – functional flood plain	Exception test required	✓	X	X	X

Local

For this report, the London Borough of Camden Strategic Flood Risk Assessment (SFRA) (July 2014) and the London Borough of Camden Surface Water Management Plan (SWMP) (2011) were consulted. The SFRA was undertaken by URS Ltd in 2014 and the SWMP were undertaken by Halcrow Ltd in 2011. Relevant information contained in this report for the Site area is outlined below:

London Borough of Camden Strategic Flood Risk Assessment

- Historically the sources of the Rivers Fleet, Tyburn, Kilburn and Brent were located in the area of Hampstead Heath. In the present day no main rivers are located in the London Borough of Camden following the incorporation of the reaches into the Thames Water Utilities Ltd (TWUL) sewer network. The borough is located entirely in Flood Zone 1 (URS Ltd, 2014).

- The London Borough of Camden Surface Water Management Plan (SWMP) identified a number of Critical Drainage Areas (CDAs). Specific areas within a CDA are not necessarily at higher risk from surface water than an area outside of a CDA however the location of an area within a CDA indicates that it is within a catchment area which contributes to a flooding hotspot. Within CDAs, surface water management should be a particular focus of new developments. The majority of the borough is located within a CDA (URS Ltd, 2014).

- Mapping shows that for the model scenarios, the surface water flood extent broadly follows the natural topography of the borough, as expected. Potential flooding also follows man-made features such as roads and rail lines. Historic flood records indicate that LBC, particularly to the north of Euston Road, is prone to surface water flooding (URS Ltd, 2014).

- For proposed developments located within a CDA, LBC should consider setting as a requirement a minimum reduction in surface water runoff rates post-development of 50%. The intention of such a requirement would be to reduce surface water runoff and also reduce the strain on the combined sewer network.

London Borough of Camden Surface Water Management Plan

- London Borough of Camden falls within the Counters Creek hydraulic catchment. It is known that several Boroughs within this area experience basement flooding as a result of sewer surcharge following heavy rainfall.

- The River Fleet, which is formed from two springs on Hampstead Heath, is the largest of London's subterranean rivers and historically drained the Camden area. The Fleet has long since been incorporated into the London sewer network although the traditional route of the Fleet and the large sewer in its place can still be traced in the south of the Borough as it passes into the City of London. Highgate and Hampstead Ponds were constructed to increase London's water supply.
- Surface water flooding mainly occurs when high intensity rainfall is not able to enter into the combined sewers. This mechanism of flooding can be combined with

overflows from the combined sewers (out of gullies or blown out manhole covers) as a result of the storm event. Surface water builds up locally if the ground terrain is flat or travels following prevailing terrain gradients. Surface water flooding then occurs at locations where surface water flow paths converge, at local dips in the ground and/or due to overland obstructions. In particular, basement properties are vulnerable. Mechanism of surface water flooding can be combined with surcharge from the combined sewer network (see Section 3.6). Surface water may not be able to enter the combined system because it is already full or overflowing as a result of the same storm event or a previous storm event

- Surface water modelling indicates a widespread vulnerability to surface water flooding across the Borough and most of central London. This is in part due to the flat gradient and 'noisy' digital terrain data. In consultation with the London Borough of Camden, seven LFRZs have been identified, corroborated by modelling data (to a degree), local knowledge and records of historical incidents.

- Developments all across London should reduce surface water discharge in line with the Sustainable Drainage Hierarchy set out in Policy 5.13 of the draft replacement London Plan.

Guidance

Strategic Flood Risk Assessments are carried out by local authorities, in consultation with the Environment Agency, to assess the flood risk to the area from all sources both now and in the future due to climate change. They are used to inform planning decisions to ensure inappropriate development is avoided (NPPF, 2012).

7. Resilience and mitigation

Based on the available information mitigation measures outlined in the following table are likely to help protect the development from flooding.

Emergency evacuation/safe egress routes

As the development is in a Flood Zone 1 a safe access route is not usually required as the Site is located outside the 1 in 100 year and 1 in 1000 year flood event extents.

Fluvial/coastal mitigation measures

As the Site is located in Flood Zone 1, fluvial mitigation measures are not required.

Surface water mitigation measures

As the Site has been identified as at risk of pluvial flooding which is likely to increase with the development of a subterranean basement, mitigation measures will be required.

Mitigation measures are included within the development design to prevent the accumulation of surface water and direct inflow of surface water to the basement via the proposed ventilation void in the south of the Site. These measures comprise the construction of a 1.1m high wall, rising to 2m along the southern boundary to prevent the inflow and a cavity drainage system is included within the current specification.

Areas of the development to the south and to the west are mapped to be at moderate risk of surface water flooding where depths could range between 0.3m to 0.9m above ground level on areas of the Site which have an elevation of under 32.7 mAOD along the southern boundary up to and during a 1 in 100 year flood event.

During this event, surface water may encroach into the area proposed for the basement lightwell and the existing development, resulting in internal flooding.

- As the Site is located within a Critical Drainage Area, a reduction in surface water run-off is required even though the Site will not increase impermeable cover. A Sustainable Drainage Report has been undertaken for the Site (GeoSmart, 2017. Ref No: 70127.01R1) to mitigate any flood risk both to and from the Site. The report will propose an attenuation volume with will reduce surface water run-off volumes by 56% - more than 50% of the Site's (prior to re-development) surface water runoff in line with the minimum requirements stated within the London Plan's SDC SPG (2014) and the London Borough of Camden Planning Guidance (CPG 3: Sustainability) (2015).

- Access to the basement is via an internal stairwell and ingress of surface water flooding will therefore be controlled by the building threshold level which should be above the maximum predicted surface water flood level of 33.9 mAOD.

- Regular maintenance of any drains surrounding/on the Site should be undertaken to reduce any residual risk of blockages.

- Flood resilience measures which should be considered for the basement and ground floor levels of the Site include:
    - Silification primers (waterproof paints) and cementitious waterproof grouts and mortars to protect internal walls from damp and any water ingress.
    - Tiling of internal ground floors, instead of using carpets on the floor.
    - Ingress points through walls or floors, such as radiator pipes should be sealed (in our experience these are key areas where floodwater can unexpectedly enter a property).
    - Flood testing of the installation should be conducted to check how waterproof the area is.
- Measures to prevent the accumulation of surface water and direct inflow to the basement via the proposed ventilation void should include the construction of a wall to prevent water entry into internal areas on the Site.
- The basement should be constructed to a tanked and waterproof design to prevent groundwater ingress.
- As the Site is located within a CDA and LFRZ which has been identified as being at risk from surface water and sewer flooding, the basement protected from sewer flooding by the installation of a positive pumped device. Measures to prevent the accumulation of surface water via raising the wall around the light well/site should be considered to prevent water entry onto the Site.

Groundwater mitigation measures

As the Site is not identified as being at risk of groundwater flooding, mitigation measures are not required.

Other Flood Risk mitigation measures

As the Site is not identified as at risk from other sources, mitigation measures are not required.

8. Conclusions and recommendations

A LOW fluvial flood risk has been identified.

A MODERATE-LOW surface water flood risk has been identified

A NEGLIGIBLE groundwater flood risk has been identified.

According to updated Figure 6 of the SFRA, the Site is located within a Critical Drainage Area (CDA)(Group3_003) and is within the Primrose Hill Local Flood Risk Zone (LFRZ) however the SFRA does not indicate reported incidents of surface water flooding of either at the Site or along Albert Terrace Mews or Regents Park Road (URS Ltd, 2014).

The site itself does not appear to be located within an area of low topography in relation to the surrounding area but the development of a basement will result in a topographic low point at the Site which could result in shallow surface water ponding.

No other sources of flood risk have been identified to impact the Site, based on the data currently available.

The table below provides a summary of where the responses to key questions are discussed in this report.

Key sources of flood risks identified	Pluvial (see Section 3).
Are standard mitigation measures likely to provide protection from flooding to/from the Site?	Yes, see Section 7.
Is any further work recommended?	As the Site is located within a Critical Drainage Area, a reduction in surface water run-off is required even though the Site is not increase impermeable cover. A Sustainable Drainage Report has been undertaken for the Site (GeoSmart, 2017. Ref No: 70127.01R1) to mitigate any flood risk both to and from the Site. The report will propose an attenuation volume with will reduce surface water run-off volumes by 56% - more than 50% of the Site's (prior to re-development) surface water runoff in line with the minimum requirements stated within the London Plan's SDC SPG (2014) and the London Borough of Camden Planning Guidance (CPG 3: Sustainability) (2015). Access to the basement is via an internal stairwell

	and ingress of surface water flooding will therefore be controlled by the building threshold level which should be above the maximum predicted surface water flood level of 33.9 mAOD. Regular maintenance of any drains surrounding/on the Site should be undertaken to reduce any residual risk of blockages. Flood resilience measures which should be considered for the basement and ground floor levels of the Site include: o Silification primers (waterproof paints) and cementitious waterproof grouts and mortars to protect internal walls from damp and any water ingress. o Tiling of internal ground floors, instead of using carpets on the floor. o Ingress points through walls or floors, such as service ducts, and radiator pipes should be sealed (in our experience these are key areas where floodwater can unexpectedly enter a property). o Flood testing of the installation should be conducted to check how waterproof the area is. Measures to prevent the accumulation of surface water and direct inflow to the basement via the proposed ventilation void should include the construction of a wall to prevent water entry into internal areas on the Site. The basement should be constructed to a tanked and waterproof design to prevent groundwater ingress. An internal sump and pump is also recommended. As the Site is located within a CDA and LFRZ which has been identified as being at risk from surface water and sewer flooding, the basement should be protected from sewer flooding by the installation of a positive pumped device.

	We recommend that mitigation measures that have been discussed within this report are considered as part of the proposed development where possible and evidence of this is provided to the Local Authority as part of the planning application.

9. Further information

The following table includes a list of products by GeoSmart:

Recommendations for next steps		
✓	Additional assessment: SuDSmart Report 	The SuDSmart Report range assesses which drainage options are available for a Site. They build on technical detail starting from simple infiltration screening, and work up to more complex SuDS Assessments detailing alternative options and designs. Please contact info@geosmartinfo.co.uk for further information.
	Additional assessment: FloodSmart Report 	The FloodSmart Report range provides clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at a site. Our consultants assess available data to determine the level of risk based on professional judgement and years of experience. Please contact info@geosmartinfo.co.uk for further information.
	Additional assessment: EnviroSmart Report 	Provides a robust desk-based assessment of potential contaminated land issues, taking into account the regulatory perspective. Our EnviroSmart reports are designed to be the most cost effective solution for planning conditions. Each report is individually prepared by a highly experienced consultant conversant with Local Authority requirements. Ideal for pre-planning or for addressing planning conditions for small developments. Can also be used for land transactions. Please contact info@geosmartinfo.co.uk for further information.

10. References and glossary

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Glossary

General terms

BGS	British Geological Survey
EA	Environment Agency
GeoSmart groundwater flood risk model	GeoSmart's national groundwater flood risk model takes advantage of all the available data and provides a preliminary indication of groundwater flood risk on a 50m grid covering England and Wales. The model indicates the risk of the water table coming within 1 m of the ground surface for an indicative 1 in 200 year return period scenario.
Dry-Island	An area considered at low risk of flooding (eg. In a Flood Zone 1) that is entirely surrounded by areas at higher risk of flooding (eg. Flood Zone 2 and 3)
Flood resilience	Flood resilience of wet-proofing accepts that water will enter the building, but through careful design will minimise damage and allow the re-occupancy of the building quickly. Mitigation measures that reduce the damage to a property caused by flooding can include water entry strategies, raising electrical sockets off the floor, hard flooring.
Flood resistance	Flood resistance, or dry-proofing, stops water entering a building. Mitigation measures that prevent or reduce the likelihood of water entering a property can include raising flood levels or installation of sandbags.
Flood Zone 1	This zone has less than a 0.1% annual probability of river flooding
Flood Zone 2	This zone has between 0.1 and 1% annual probability of river flooding and between 0.1% and 0.5 % annual probability sea flooding
Flood Zone 3	This zone has more than a 1% annual probability of river flooding and 0.5% annual probability of sea flooding
Functional Flood Plain	An area of land where water has to flow or be stored in times of flood.
Hydrologic model	A computer model that simulates surface run-off or fluvial flow. The typical accuracy of hydrologic models such as this is ±0.25m for estimating flood levels at particular locations.
OS	Ordnance Survey
Residual Flood Risk	The flood risk remaining after taking mitigating actions.
SFRA	Strategic Flood Risk Assessment. This is a brief flood risk assessment provided by the local council
SuDS	A Sustainable drainage system (SuDS) is designed to replicate, as closely as possible, the natural drainage from the Site (before development) to ensure that the flood risk downstream of the Site does not increase as a result of the land being developed. SuDS also significantly improve the quality of water leaving the Site and can also improve the amenity and biodiversity that a site has to offer. There are a range of SuDS options available to provide effective surface water management that intercept and store excess run-off. Sites over 1 Ha will usually require a sustainable drainage assessment if planning permission is required. The current proposal is that from April 2014 for more than a single dwelling the drainage system will require approval from the SuDs Approval Board (SABs).

Aquifer Types

Principal aquifer	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.
Secondary A aquifer	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
Secondary B aquifer	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
Secondary undifferentiated	Has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
Unproductive Strata	These are rock layers or drift deposits with low permeability that has negligible significance for water supply or river base flow.

NPPF (2012) terms

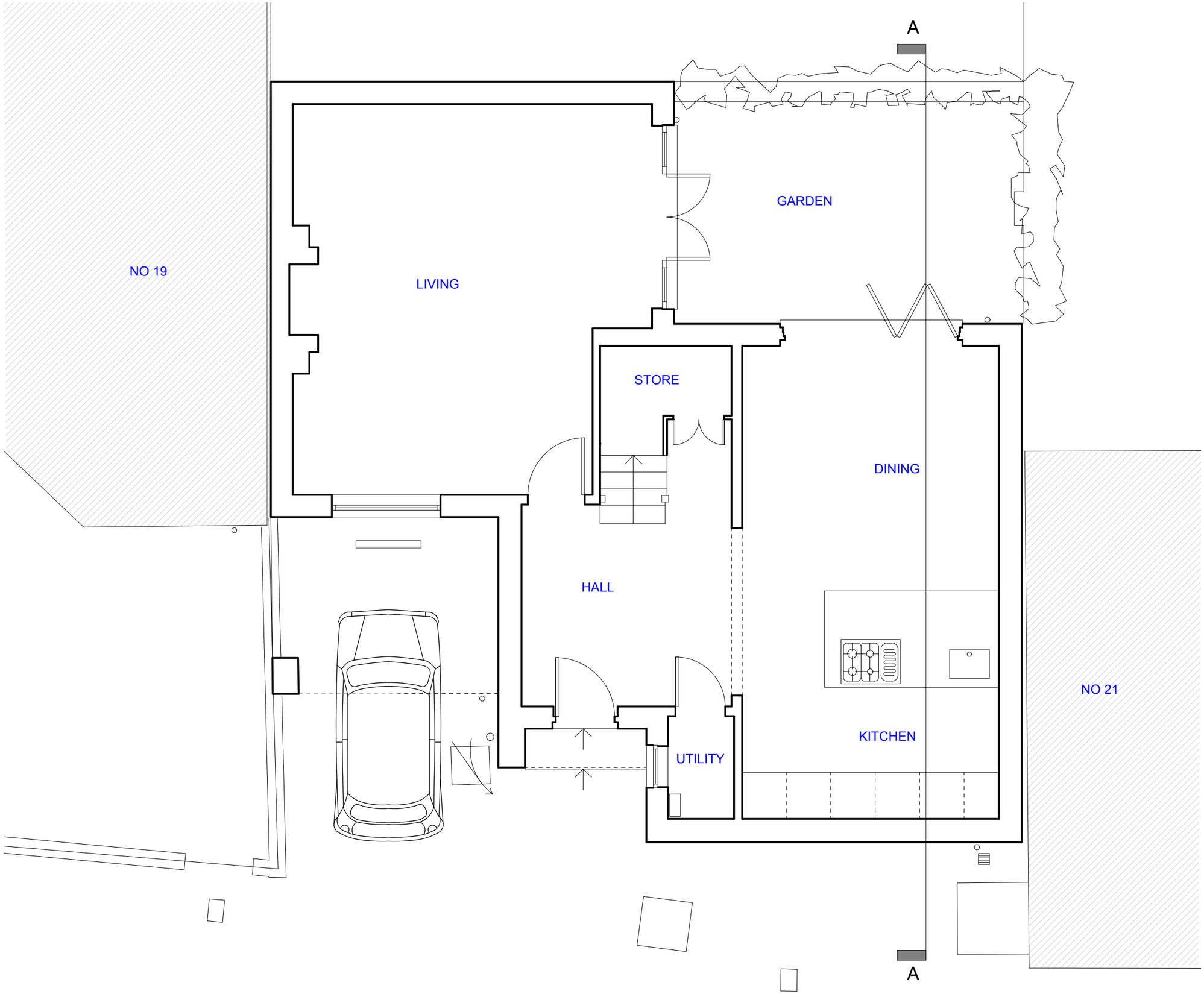
Exception test	Applied once the sequential test has been passed. For the exception test to be passed it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk and a site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.
Sequential test	Aims to steer new development to areas with the lowest probability of flooding.
Essential infrastructure	Essential infrastructure includes essential transport infrastructure, essential utility infrastructure and wind turbines.
Water compatible	Water compatible land uses include flood control infrastructure, water-based recreation and lifeguard/coastal stations.
Less vulnerable	Less vulnerable land uses include police/ambulance/fire stations which are not required to be operational during flooding and buildings used for shops/financial/professional/other services.
More vulnerable	More vulnerable land uses include hospitals, residential institutions, buildings used for dwelling houses/student halls/drinking establishments/hotels and sites used for holiday or short-let caravans and camping.
Highly vulnerable	Highly vulnerable land uses include police/ambulance/fire stations which are required to be operational during flooding, basement dwellings and caravans/mobile homes/park homes intended for permanent residential use.

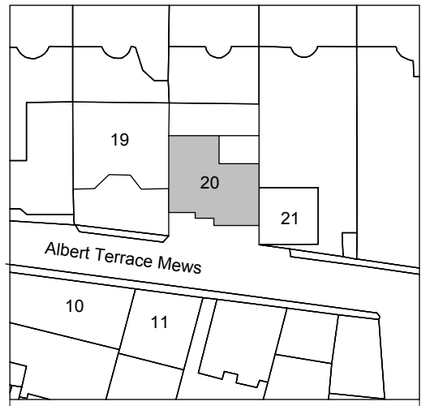
Appendices

Appendix A

Existing and proposed development plans

t. +44(0)1743 298 100 e. info@geosmartinfo.co.uk www.geosmartinfo.co.uk





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Client
JONATHAN MORLEY

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File name
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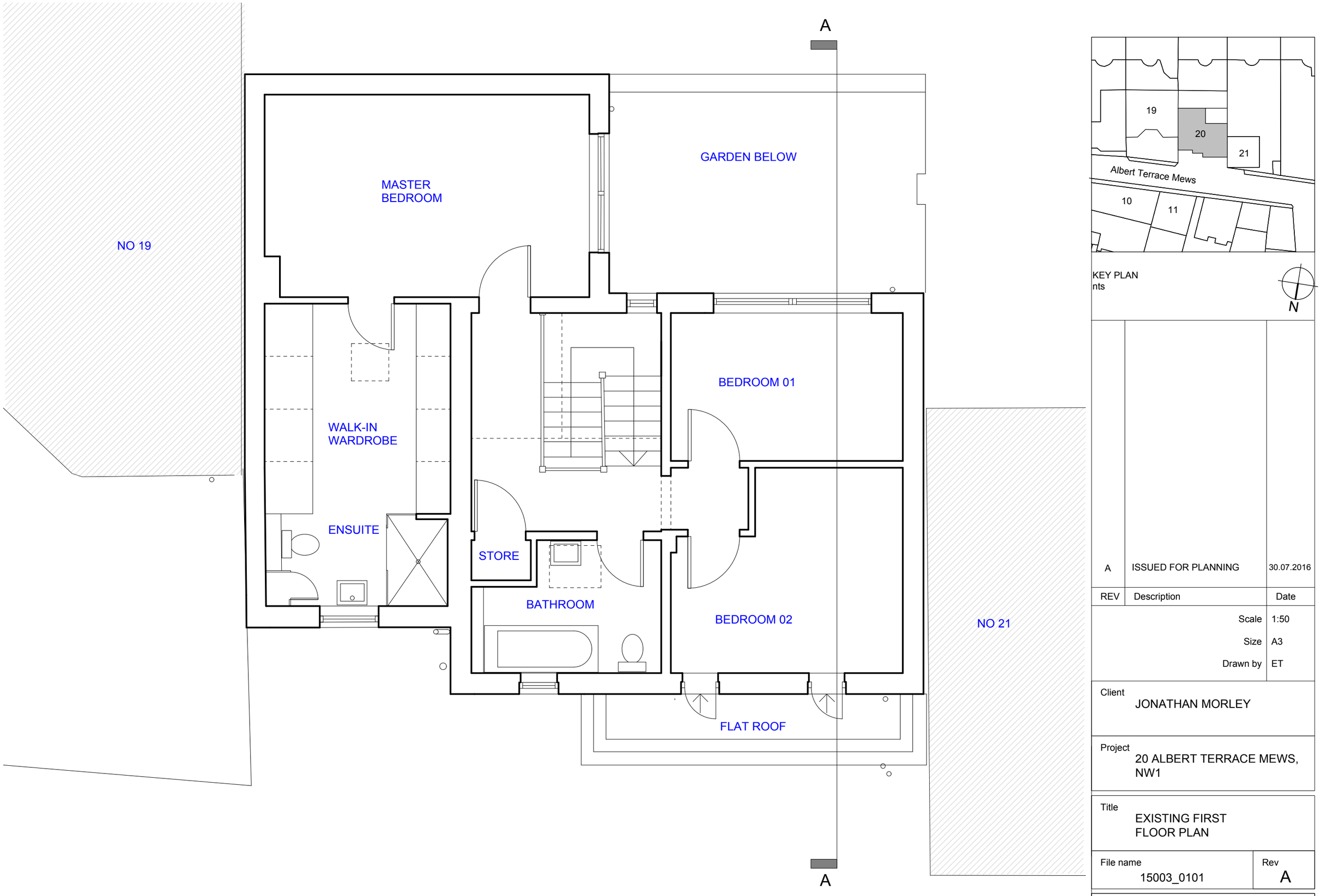
Rev
A

Status
PLANNING



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Rev
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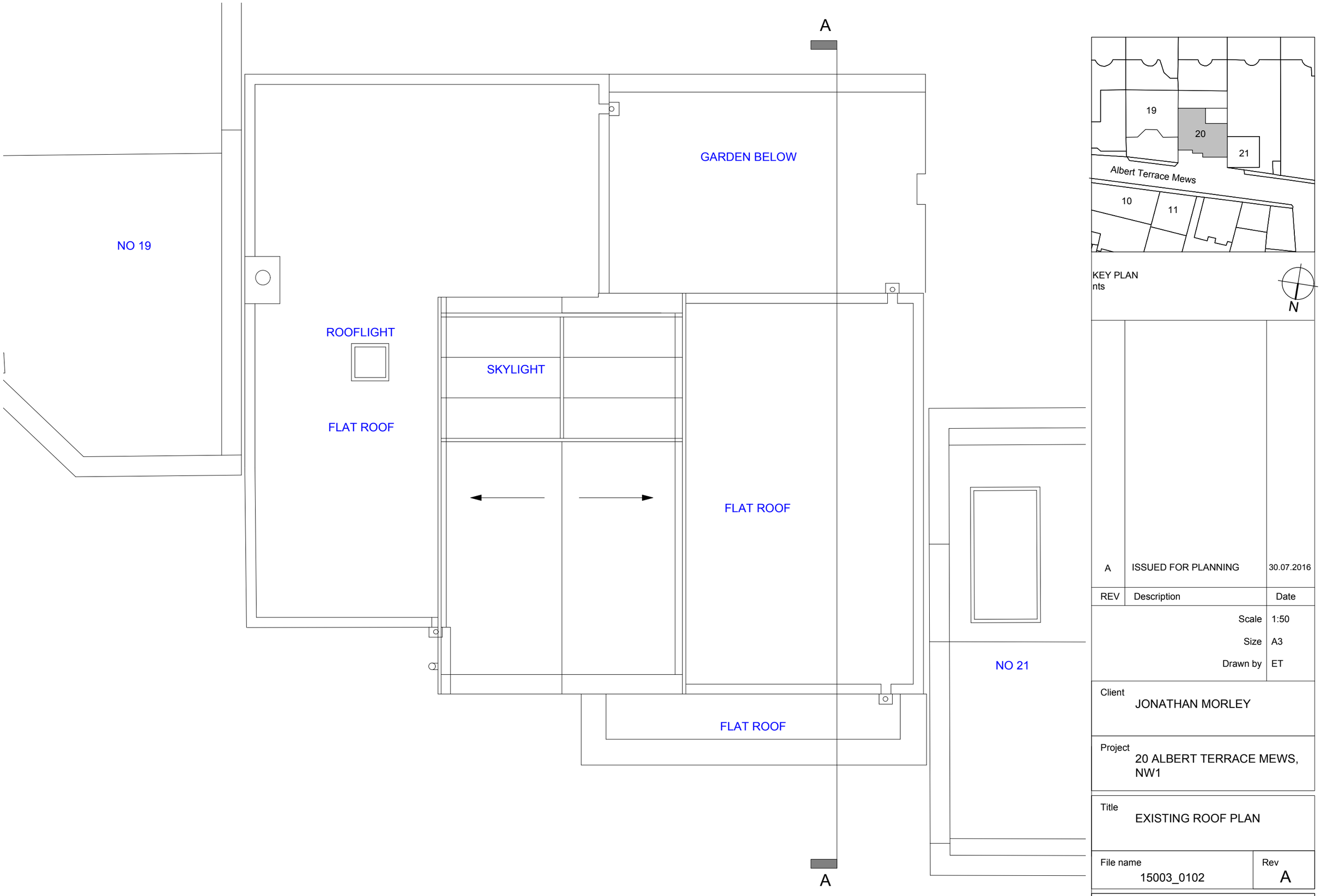

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Title
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Status
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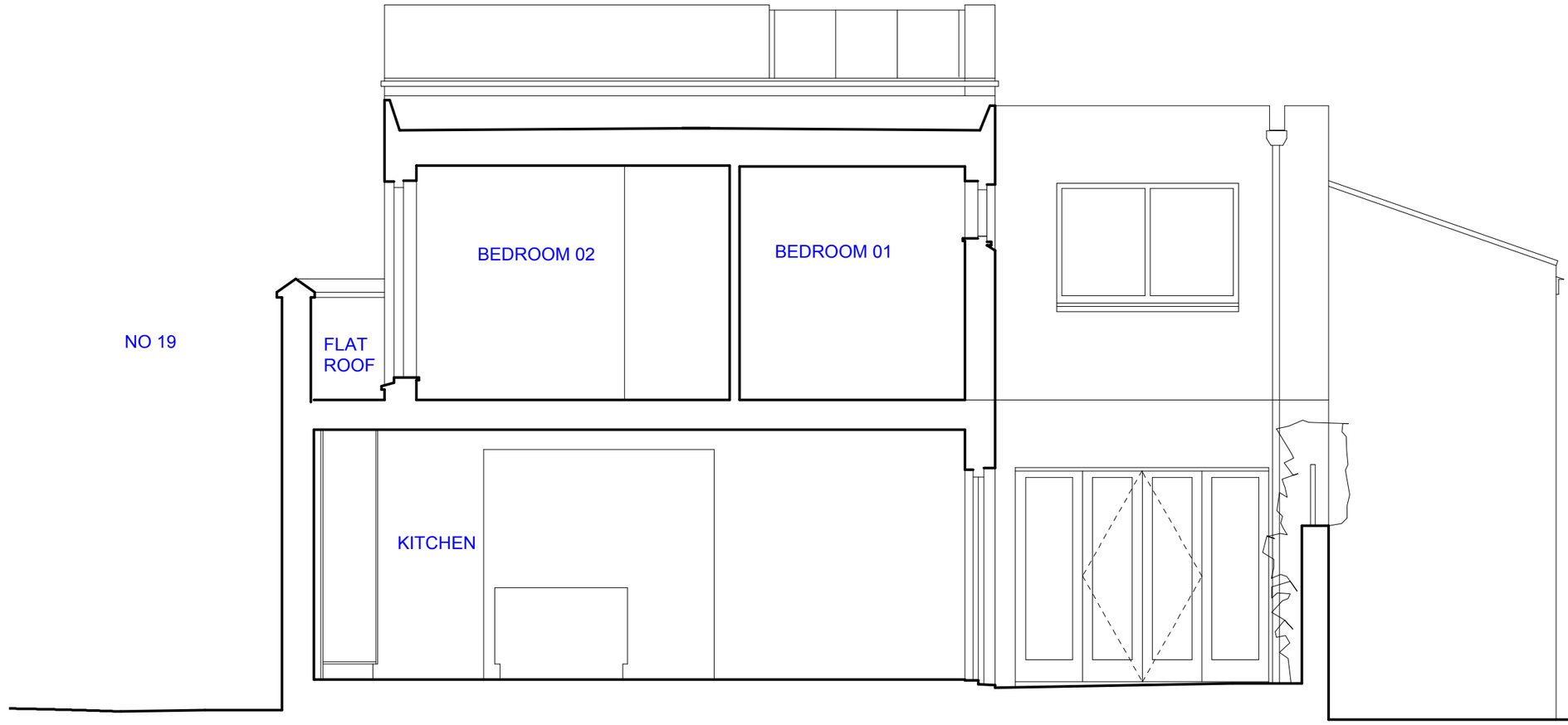

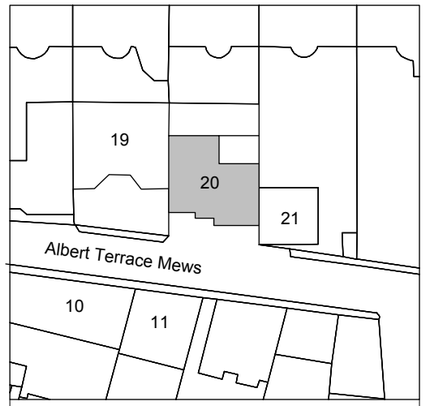

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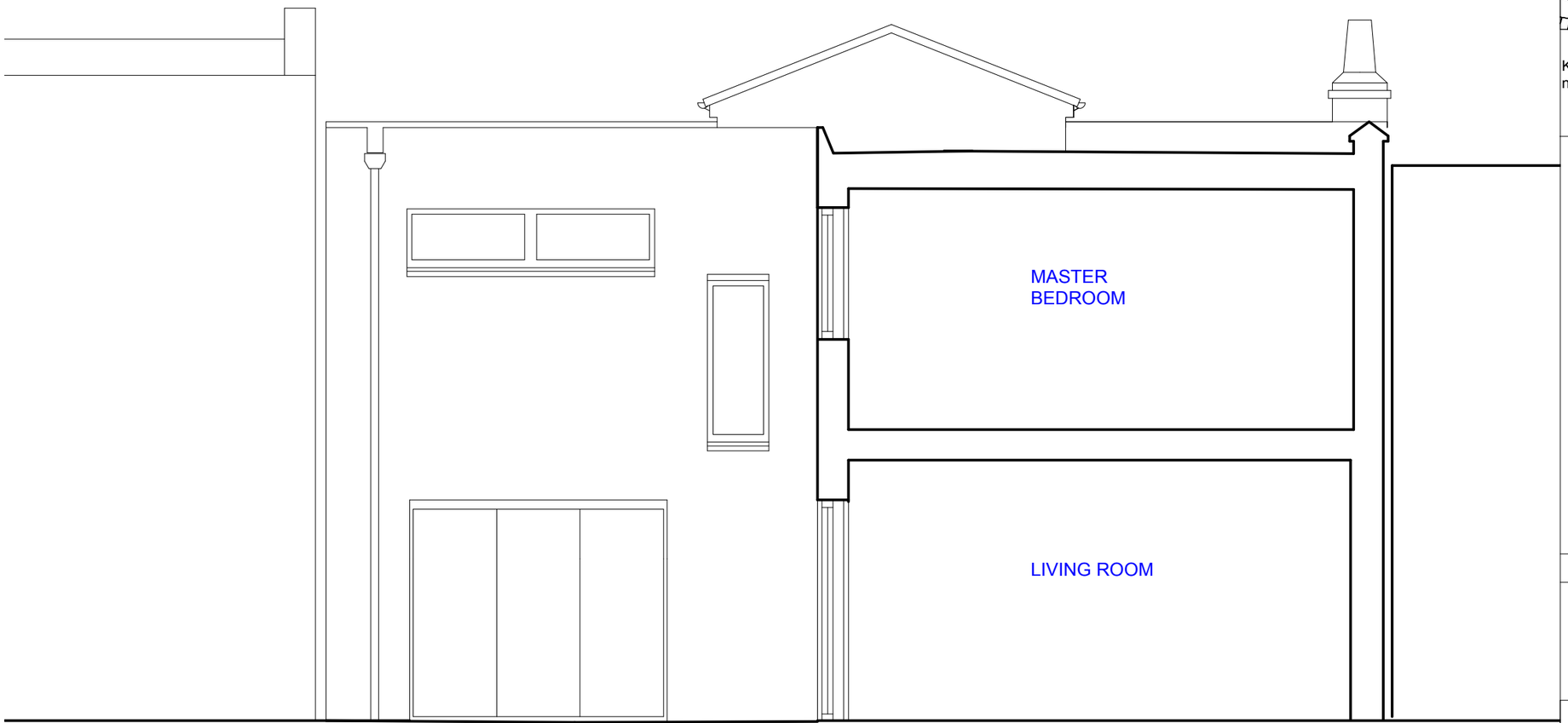

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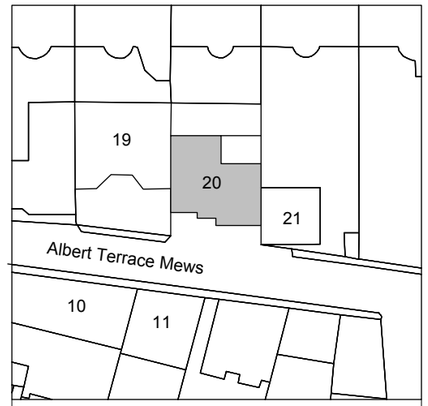

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Title
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File name	Rev
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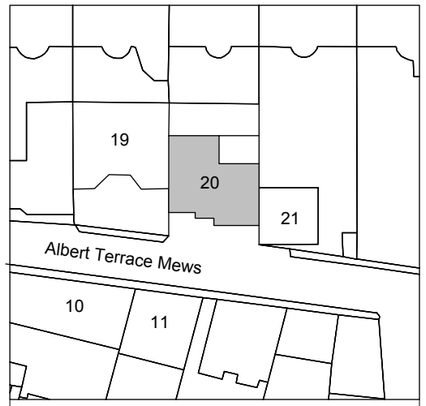

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Rev
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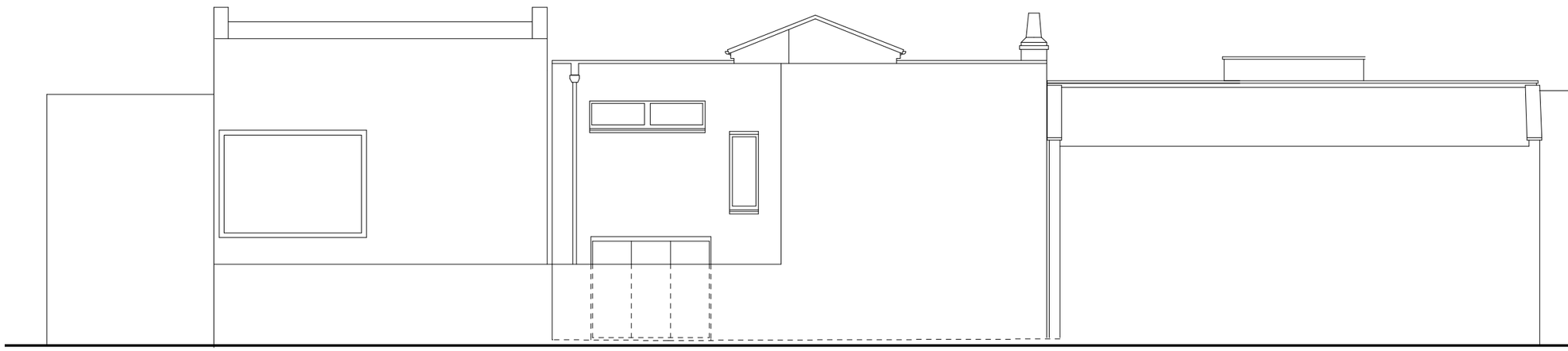

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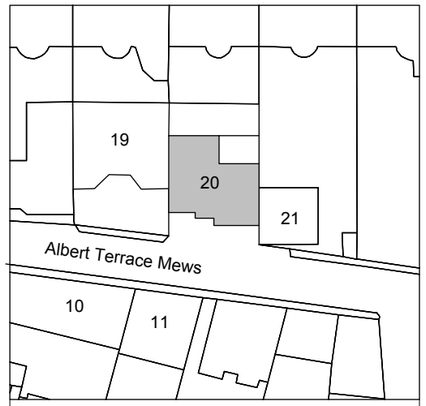

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Title
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File name
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Rev
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Status
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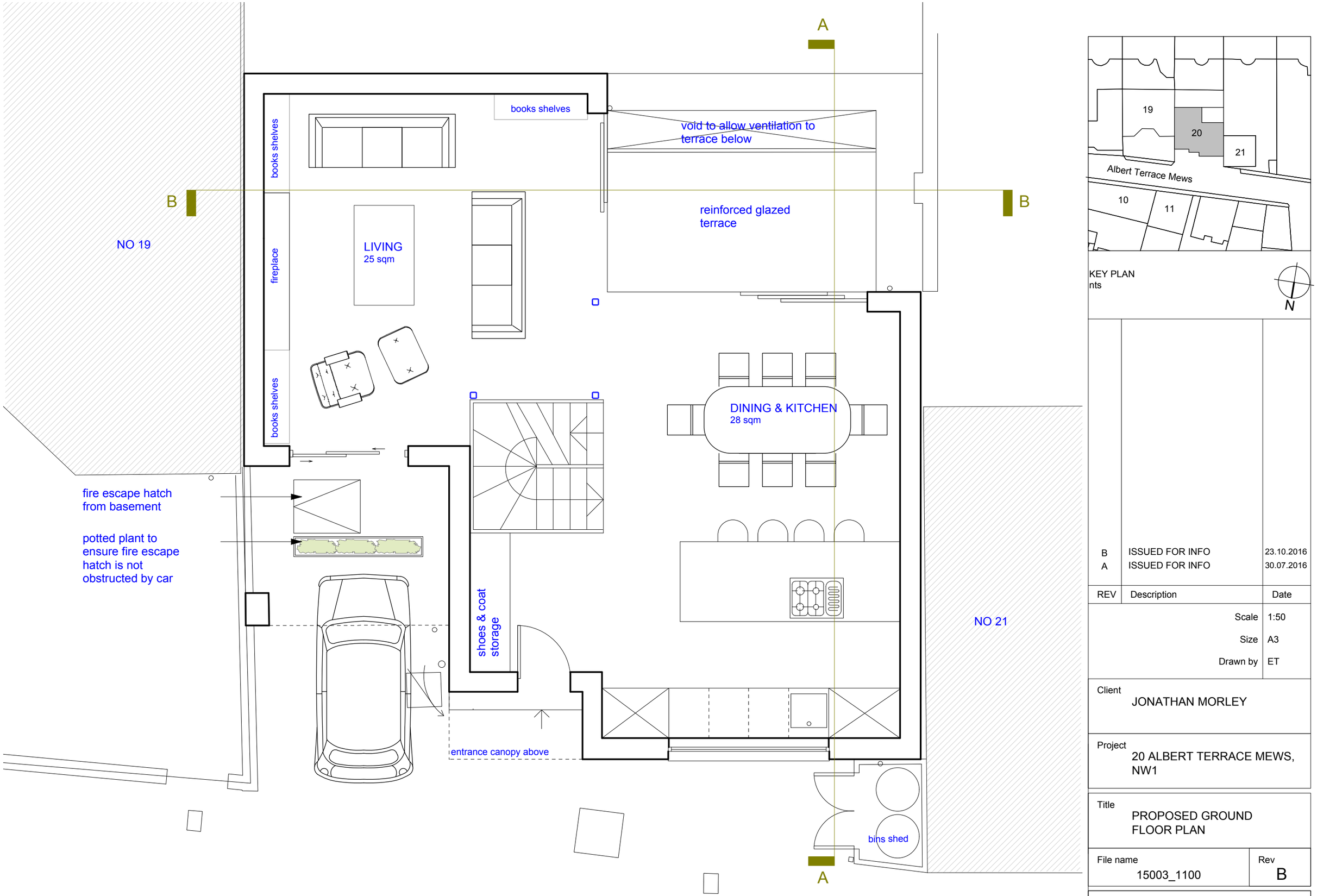

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Rev
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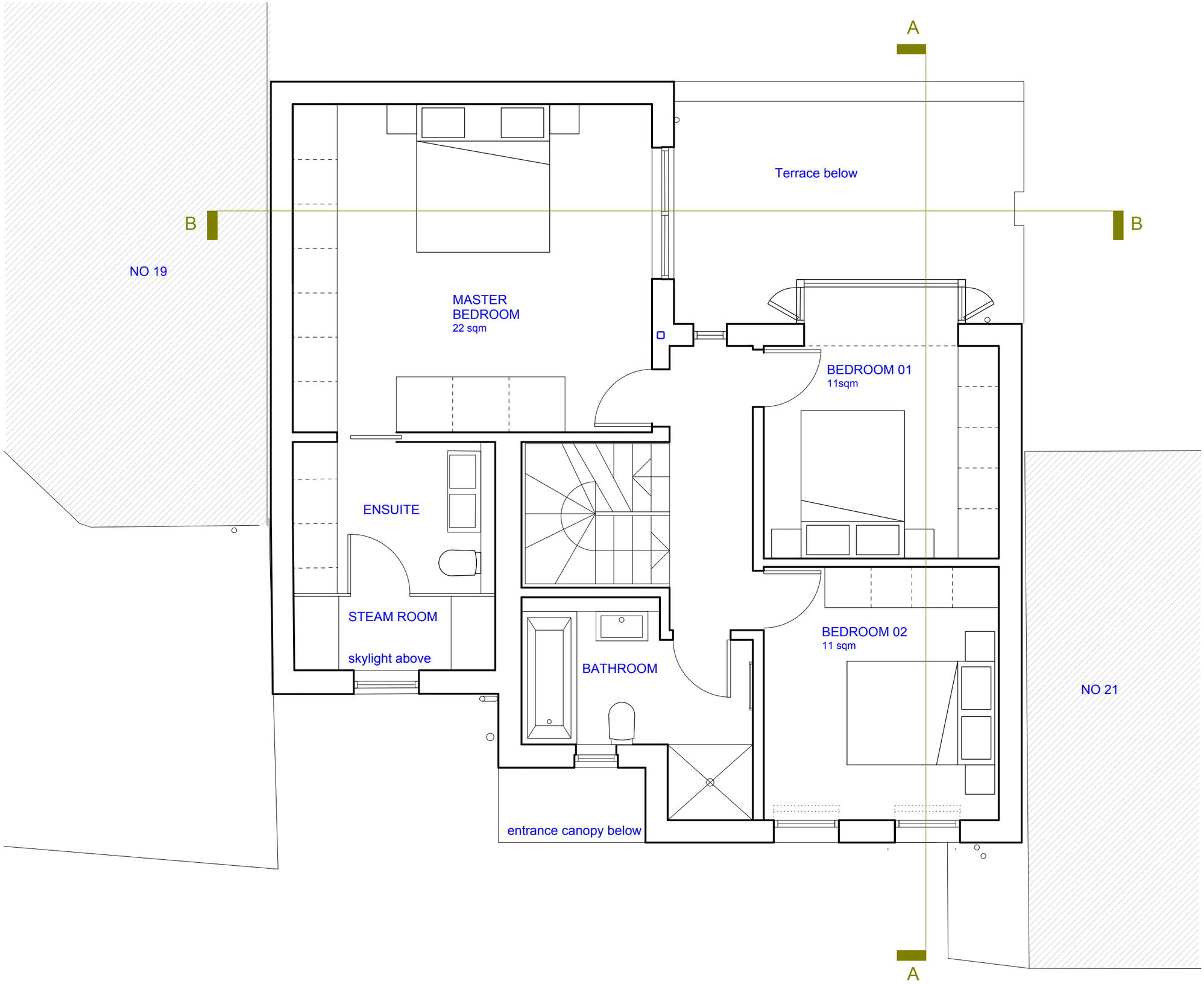

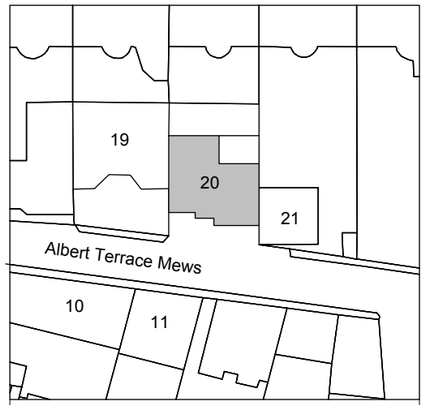

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Project
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Title
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File name
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Rev
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Status
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Metres

A

B

B

Terrace below

NO 19

Oriel window below

FLAT ROOF

SKYLIGHT

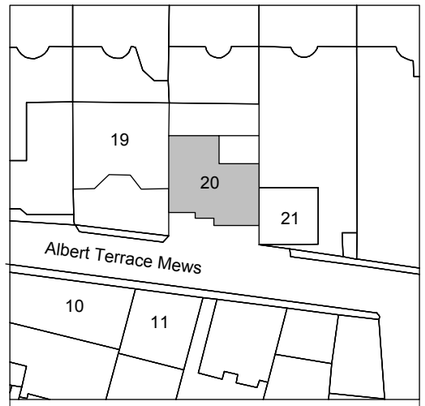
ROOFLIGHT

FLAT ROOF

entrance canopy below

NO 21

A



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Project
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Title
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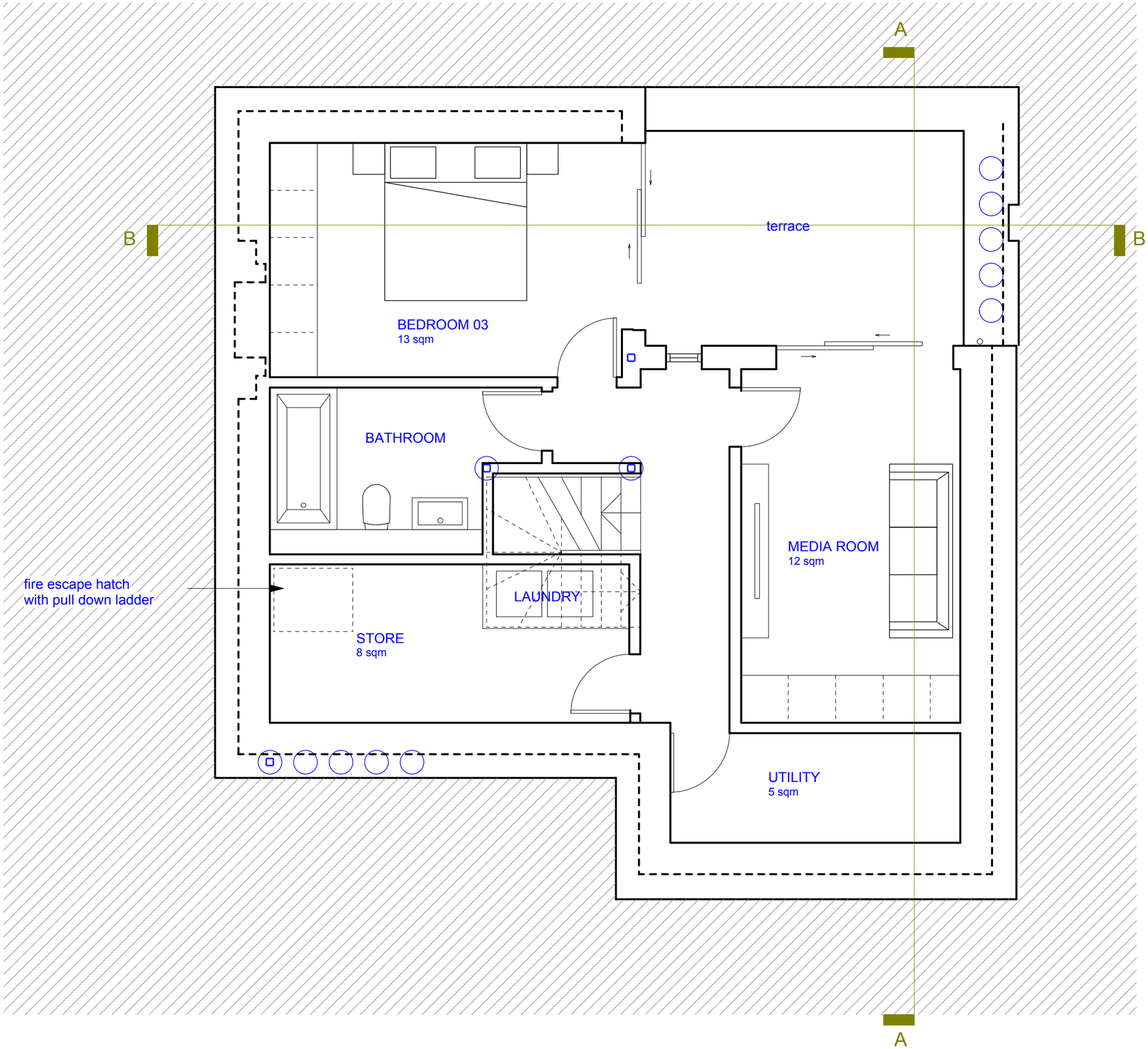

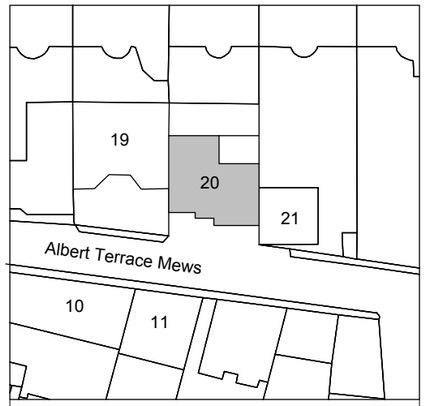

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File name	Rev
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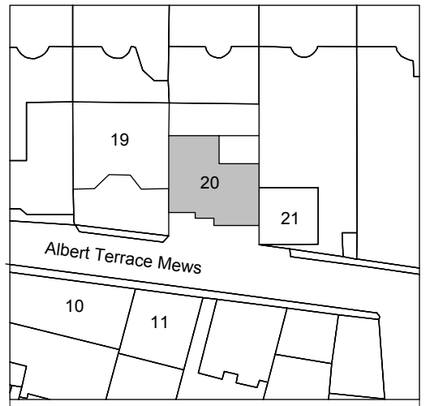

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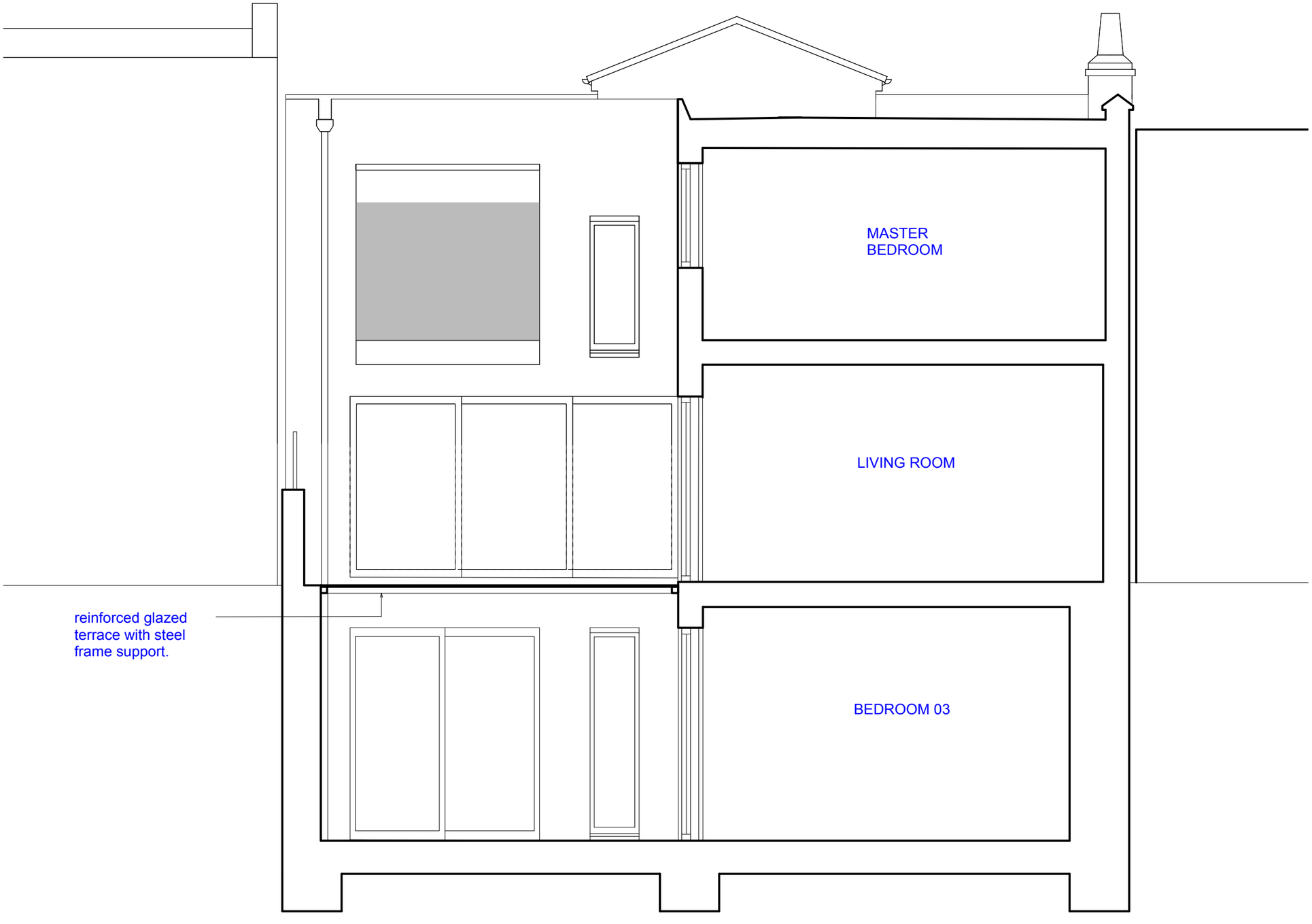

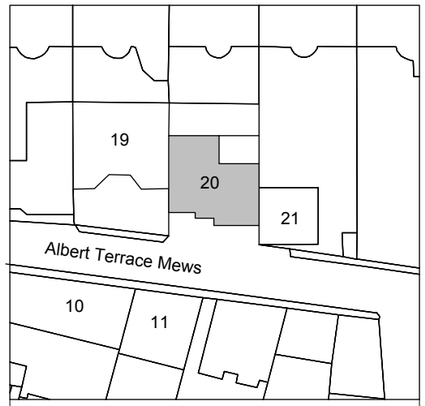

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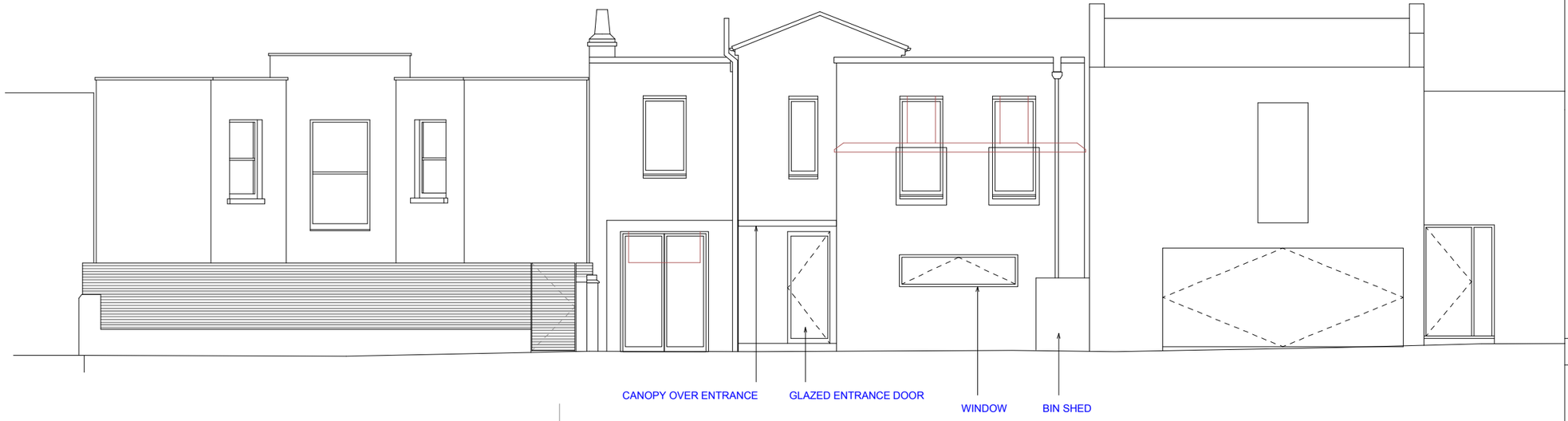

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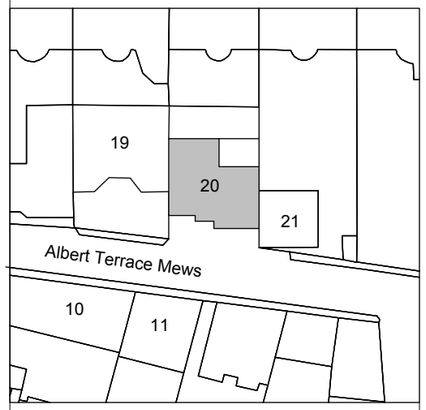

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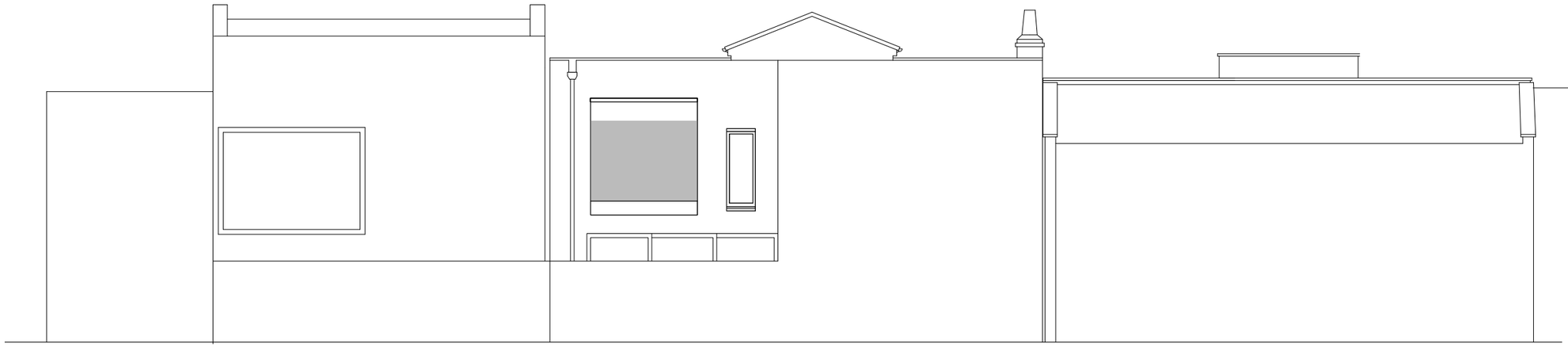

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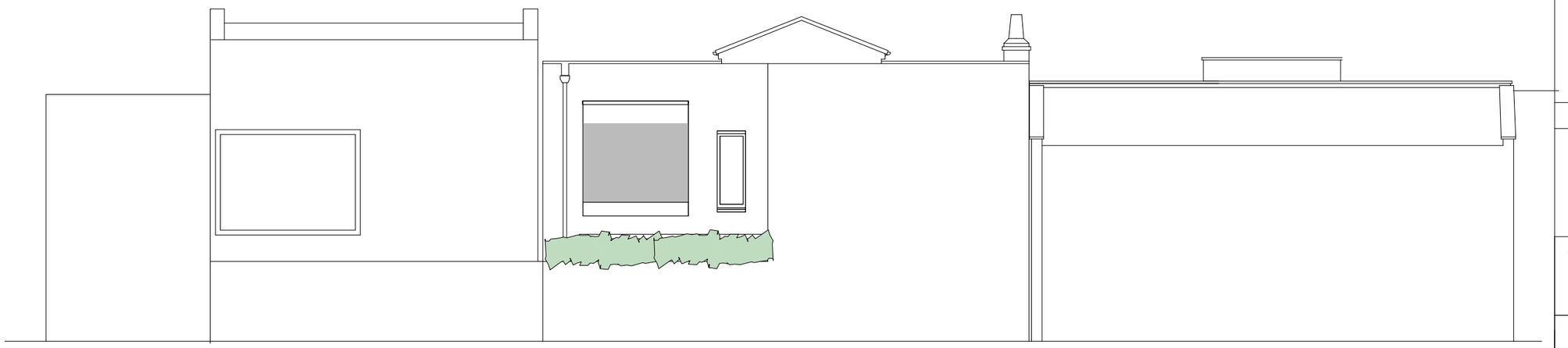

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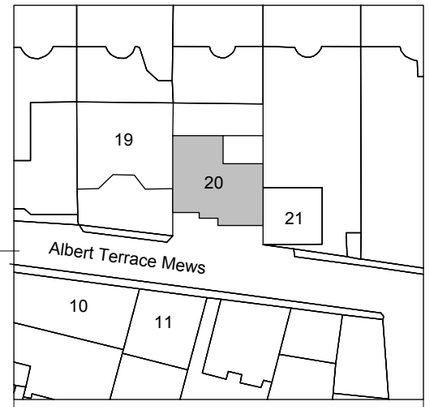

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Client
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Project
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Title
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Rev
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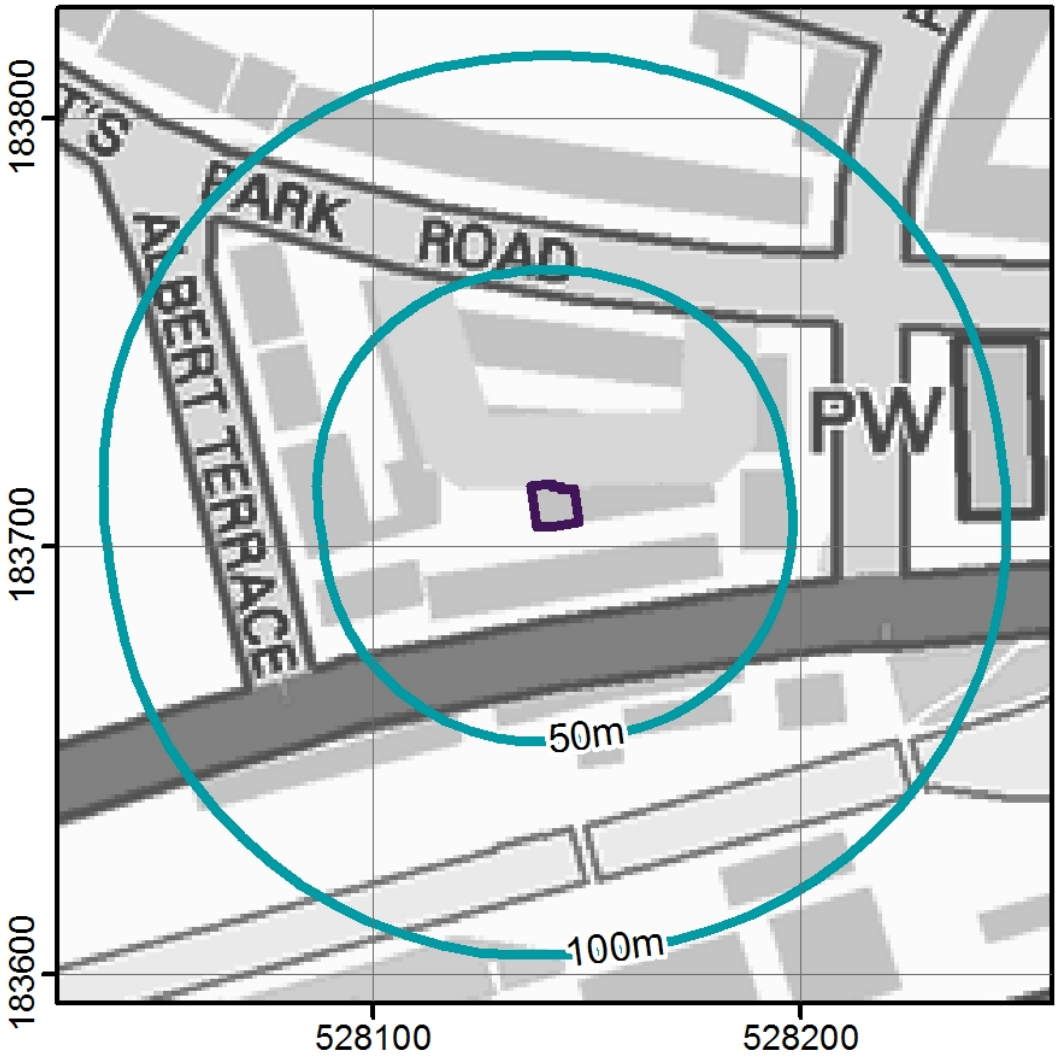
Status
PLANNING

Appendix B

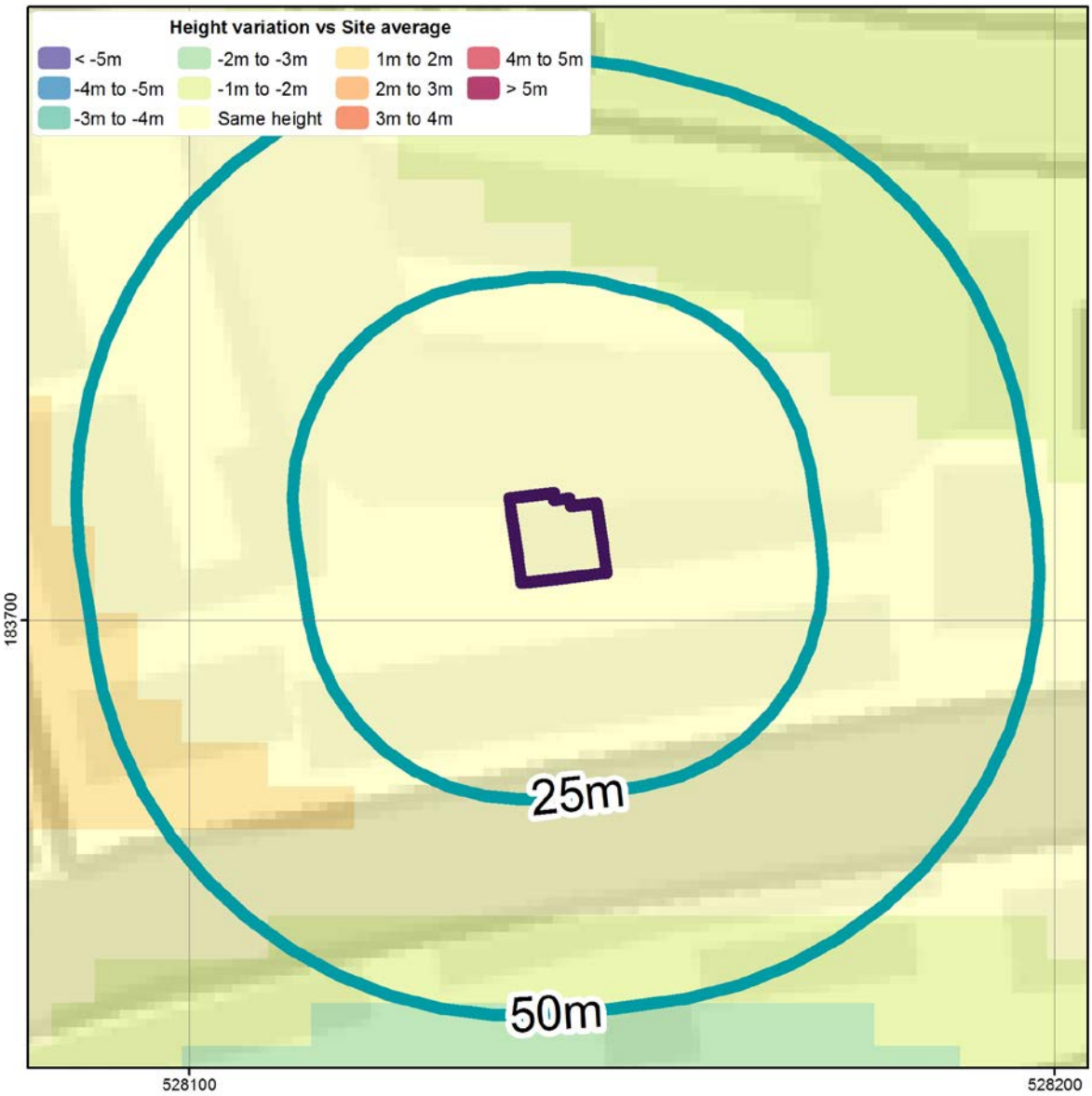
Commercial flood mapping

Site Location Plan (OS, 2017)

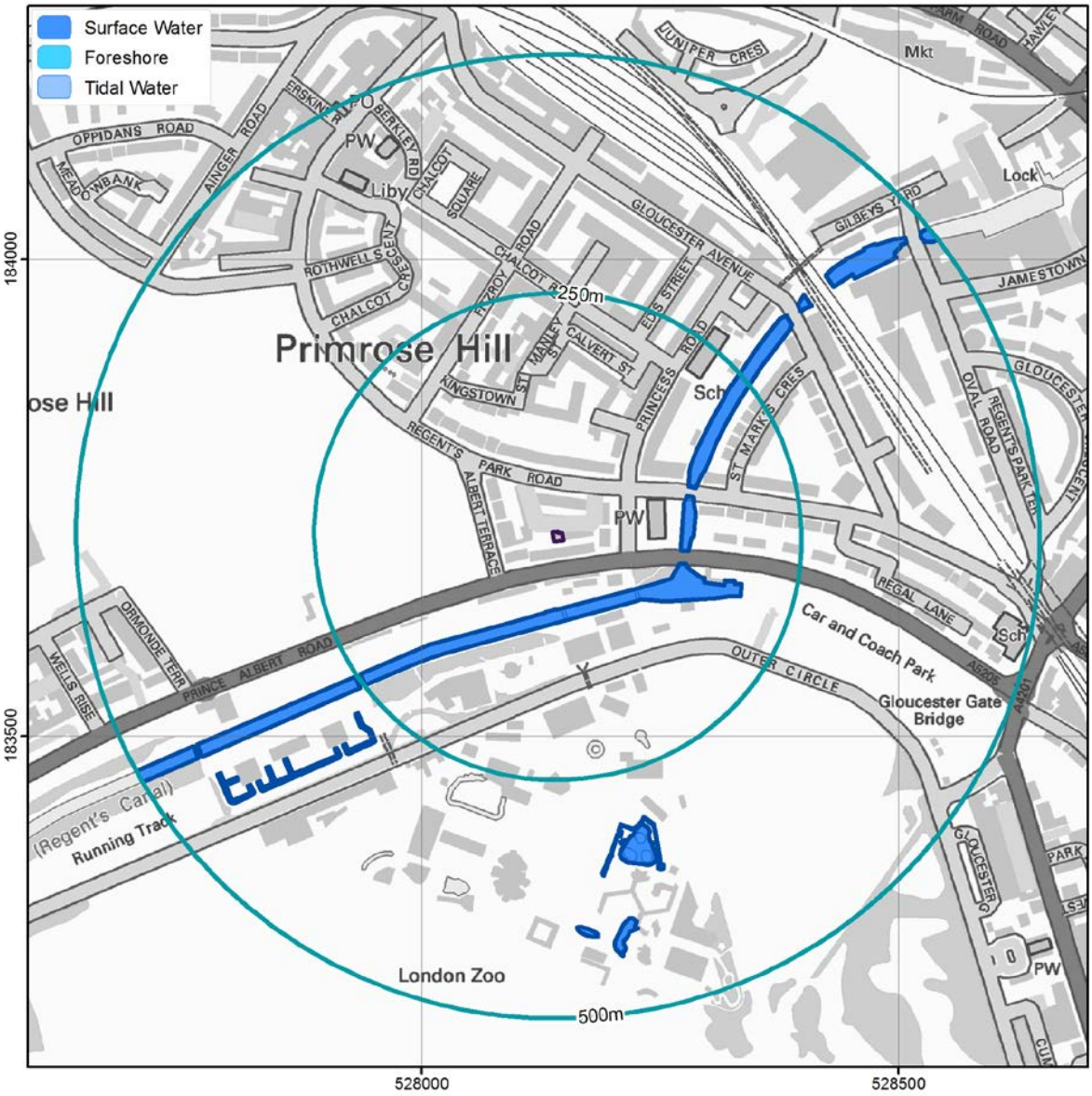


t. +44(0)1743 298 100 e. info@geosmartinfo.co.uk www.geosmartinfo.co.uk

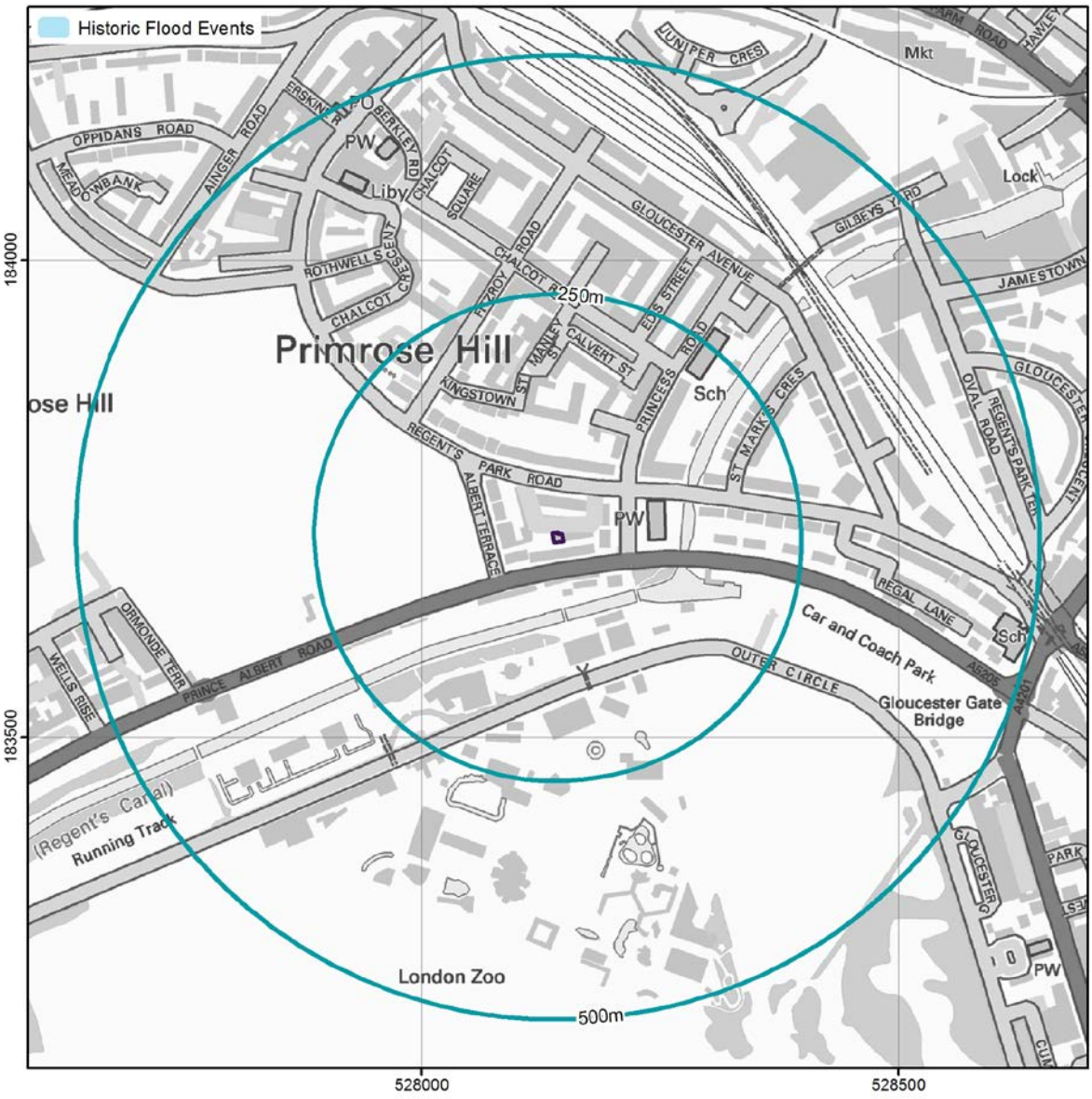
GeoSmart DTM5 (5m) map (EA, 2017)



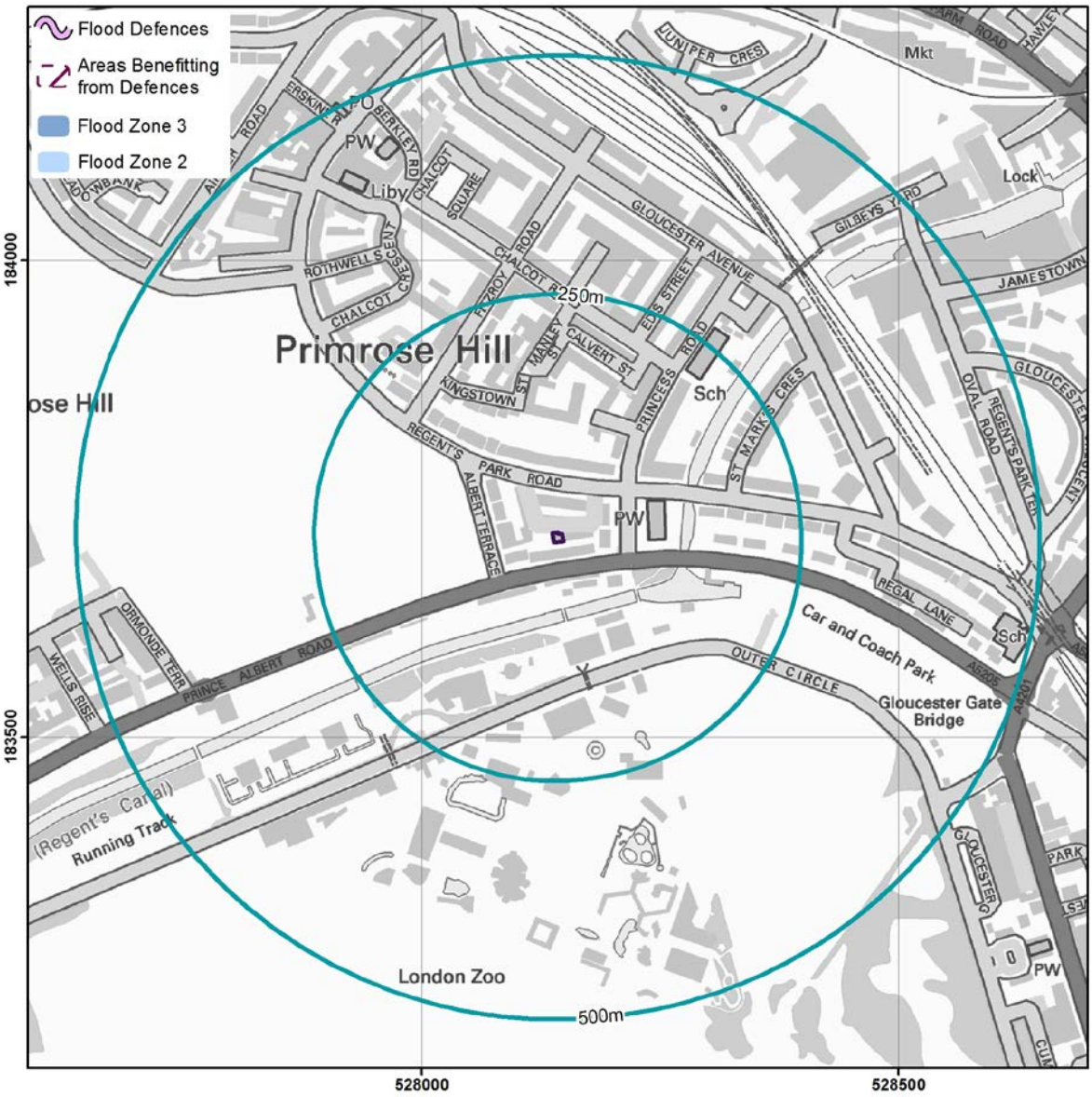
Ordnance Survey Surface Water Feature Vector Map (OS, 2017)



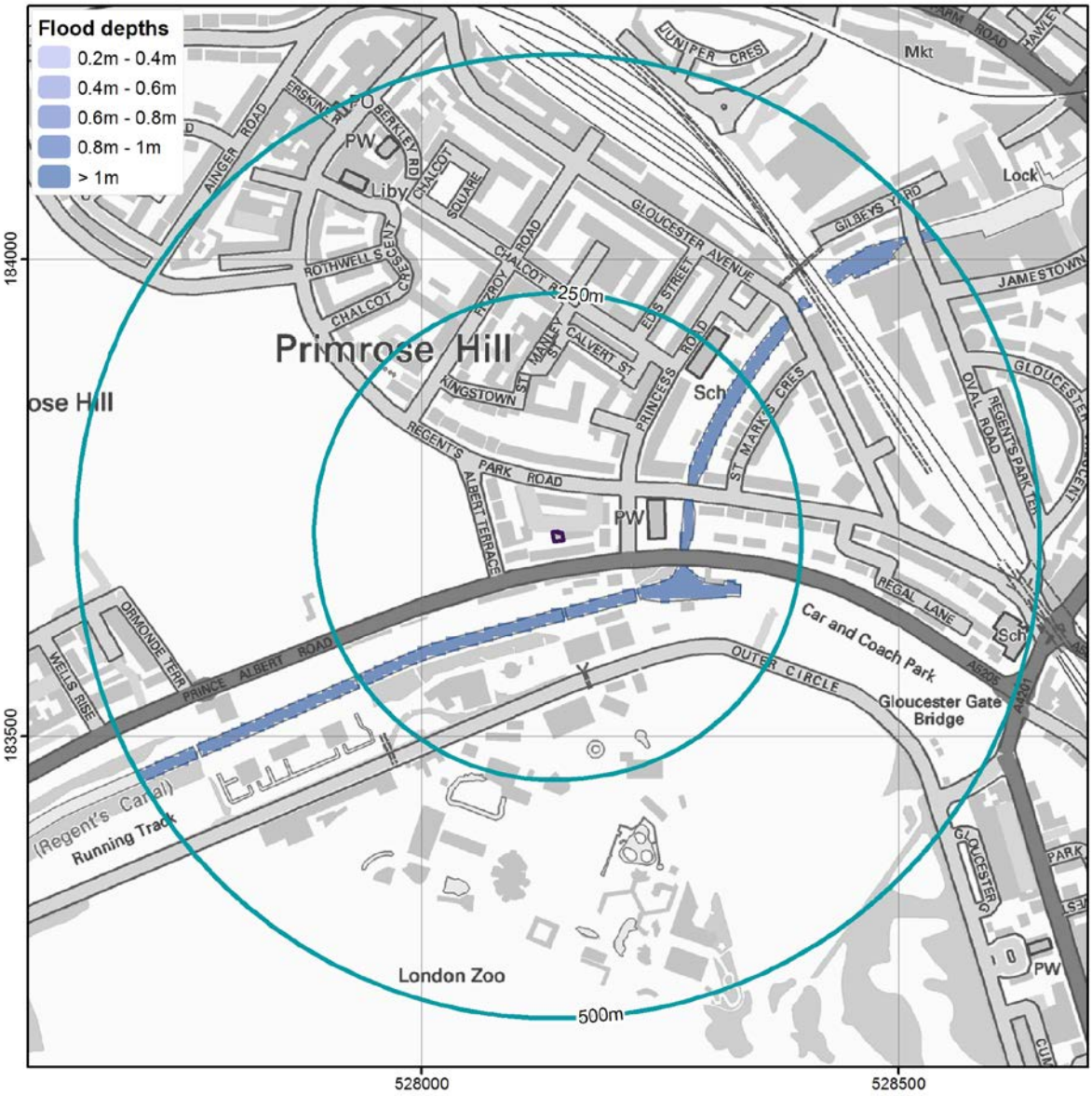
Environment Agency Historic Flood Map (EA, 2017)



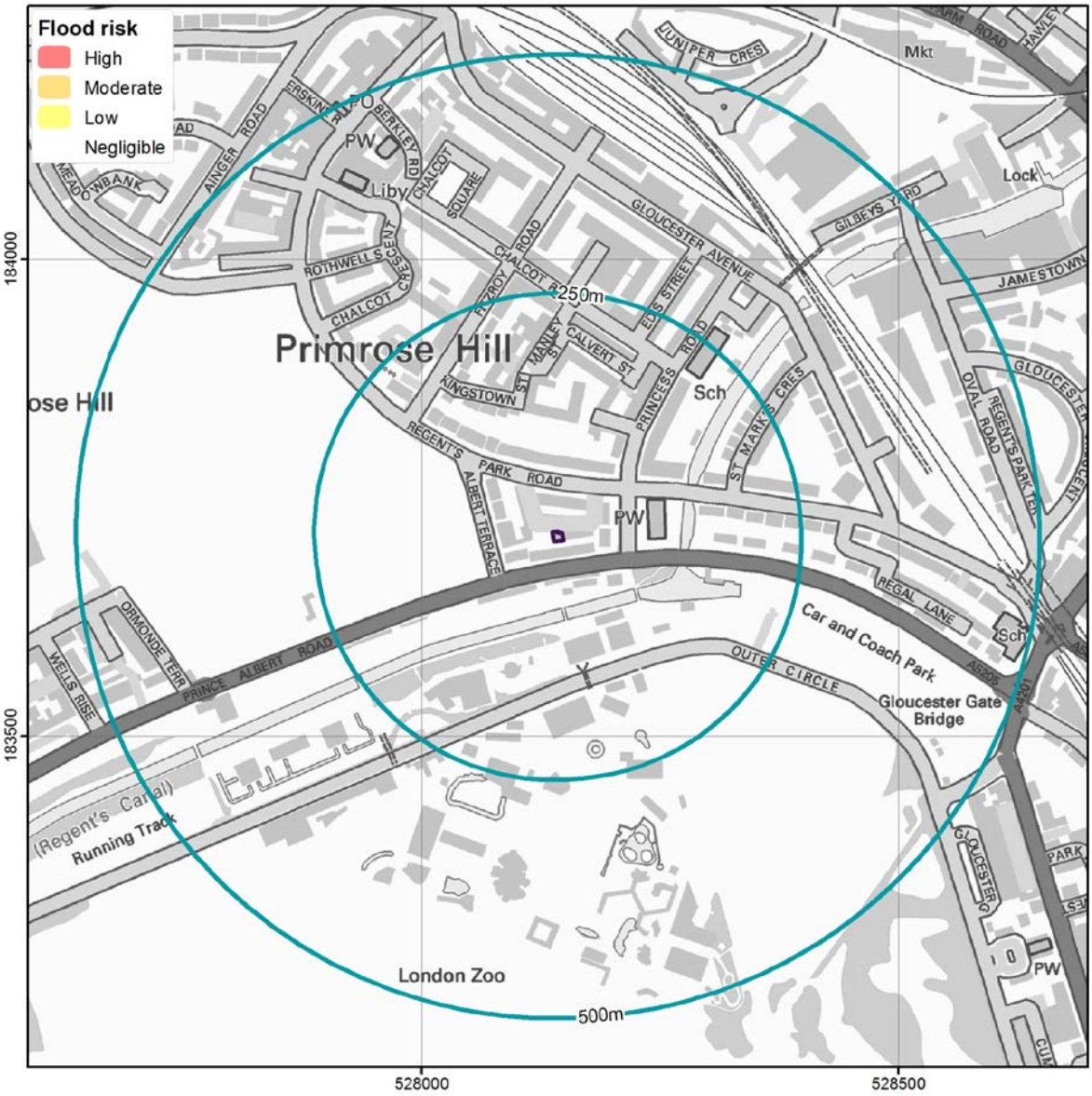
Environment Agency's Flood Map for Planning Purposes (EA, 2017)



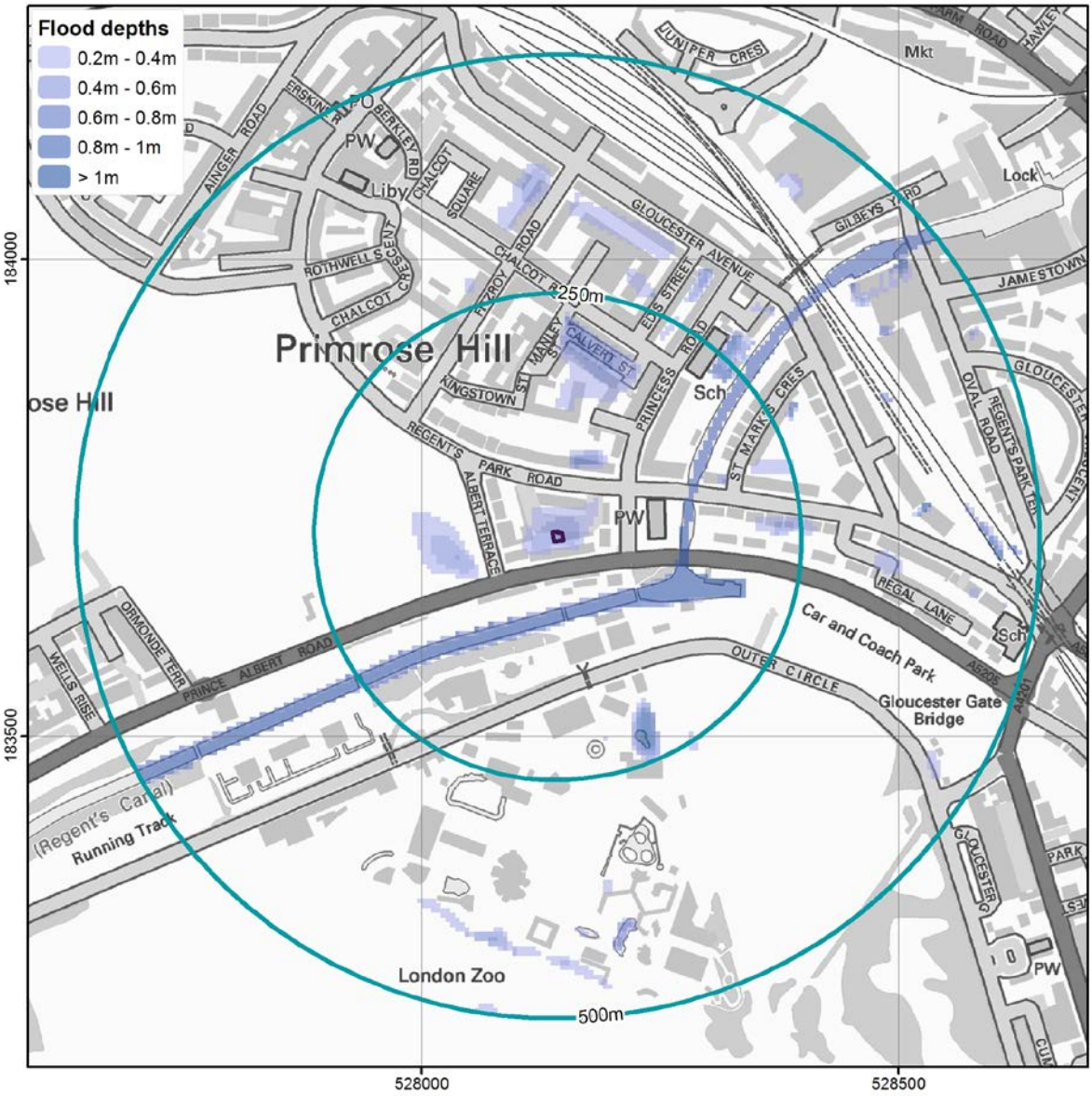
UKFloodMap4TM 1 in 100 year Fluvial/Tidal Flood Depth Map (Ambiental, 2017)



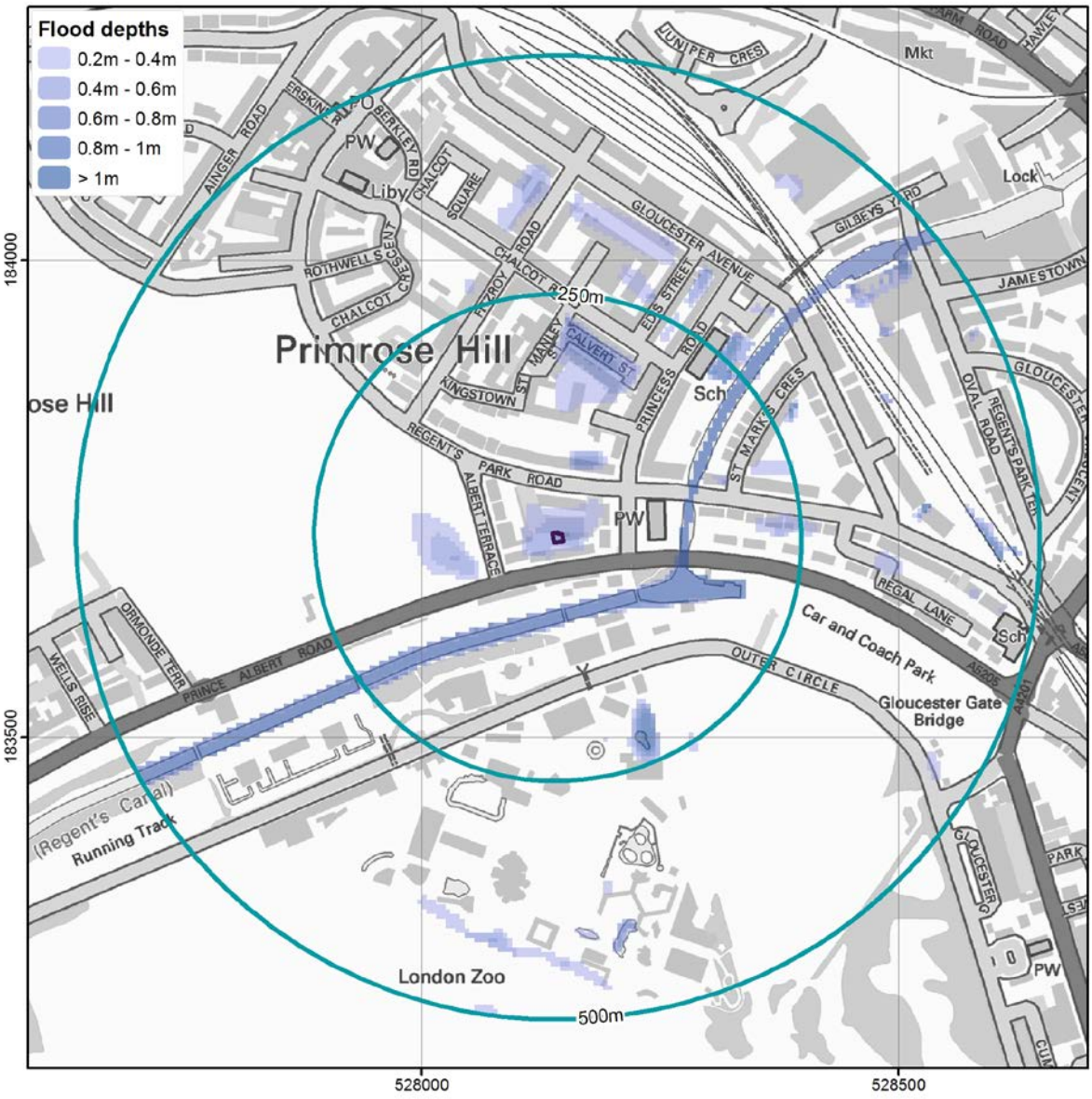
GeoSmart Groundwater Flood Risk (GW5, v2.1) Map (GeoSmart, 2017)



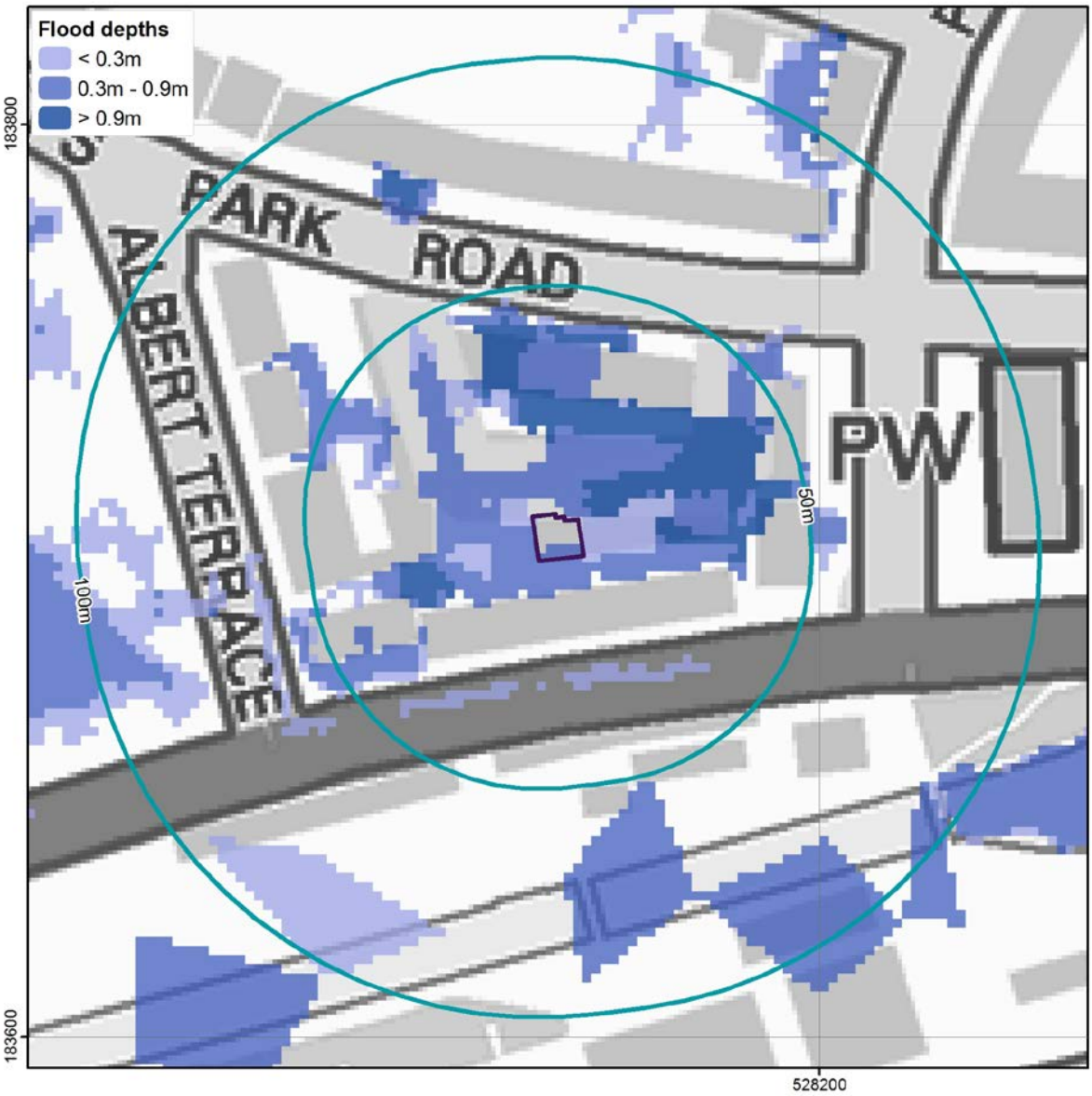
UKFloodMap4^{TM} Pluvial 1 in 75 year Pluvial Flood Depth Map (Ambiental, 2017)



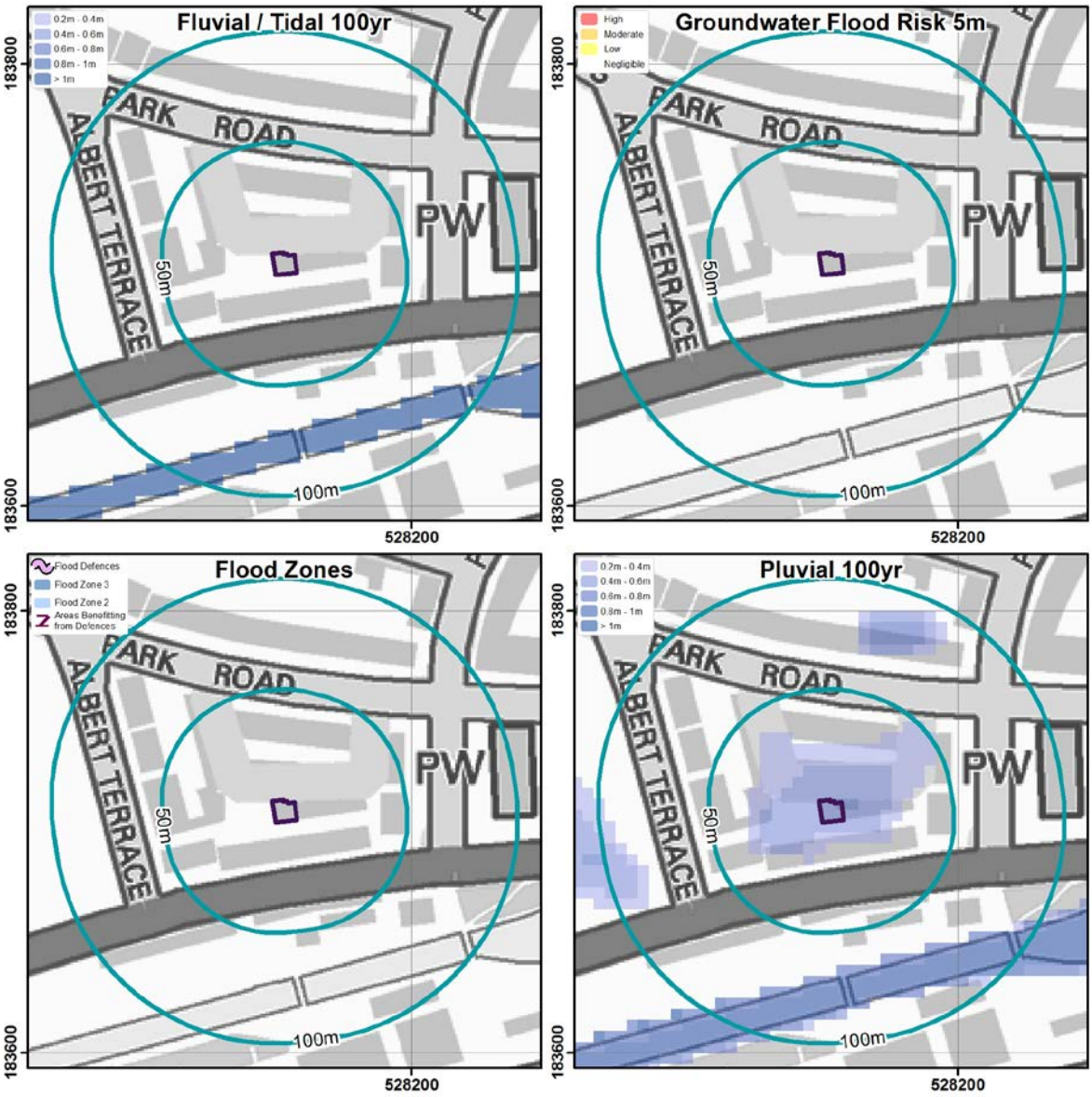
UKFloodMap4TM Pluvial 1 in 100 year Pluvial Flood Depth Map (Ambiental, 2017)

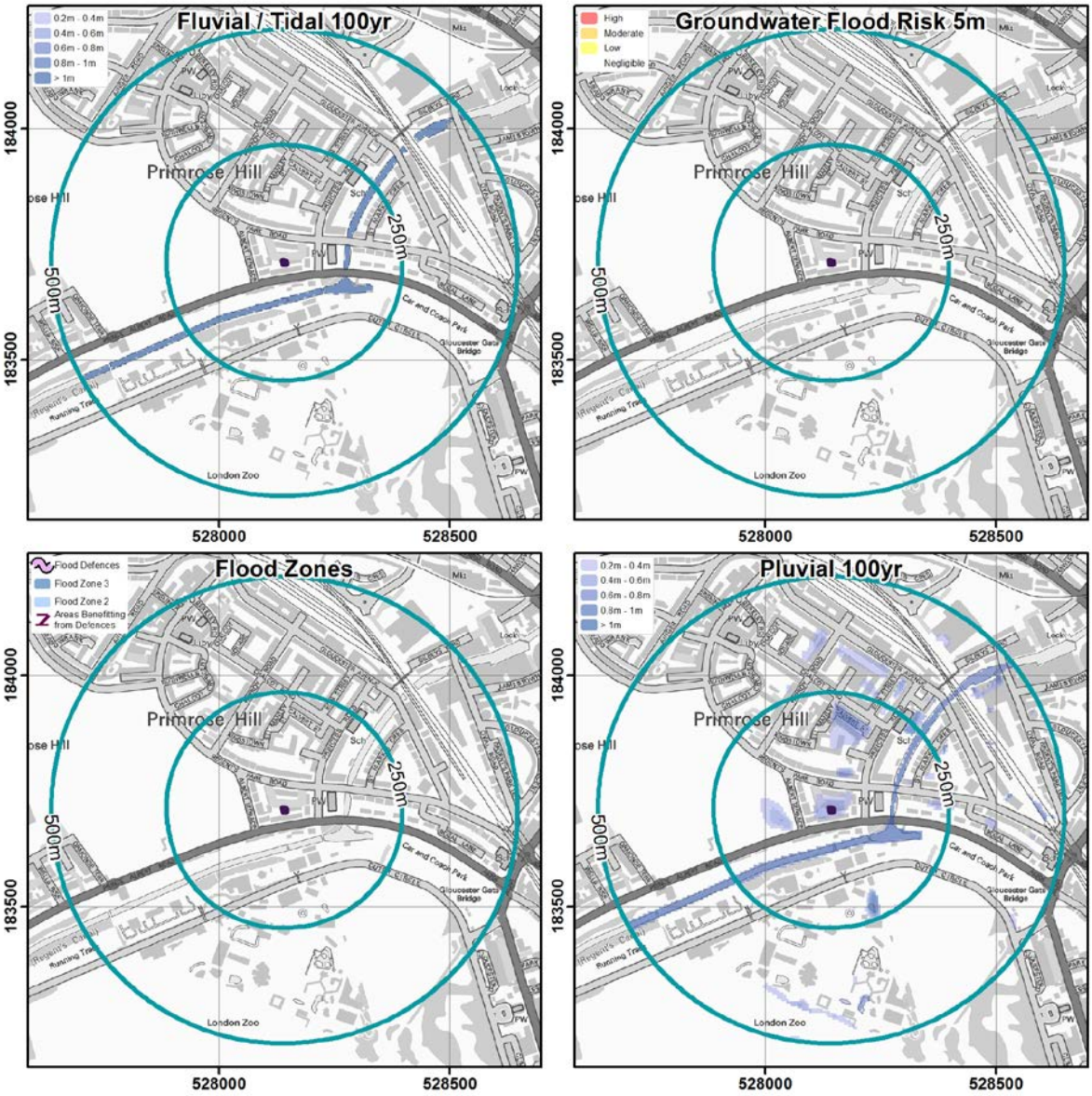


Environment Agency Risk of Flooding Surface Water (pluvial) Depth map 1 in 100 year (EA, 2017)



Quad Map (EA and Ambiental Data, 2017)




Fluvial / Tidal 100yr
0.2m - 0.4m
0.4m - 0.6m
0.6m - 0.8m
0.8m - 1m
> 1m
Groundwater Flood Risk 5m
High
Moderate
Low
Negligible
Flood Zones
Flood Defences
Flood Zone 3
Flood Zone 2
Areas Benefitting from Defences
Pluvial 100yr
Primrose Hill
250m
500m
London Zoo
Car and Coach Park
Gloucester Gate Bridge
184000
183500
528000
528500

Appendix C

Thames Water Data

Sewer Flooding
History Enquiry

Property Searches

GeoSmart Information Ltd

Search address supplied	20 Albert Terrace Mews London NW1 7TA
Your reference	70127
Our reference	SFH/SFH Standard/2017_3641023
Received date	**30 August 2017**
Search date	**30 August 2017**

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

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

0845 070 9148

Sewer Flooding
History Enquiry

Property Searches

Search address supplied: 20,Albert Terrace Mews,London,NW1 7TA

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

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

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

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

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

(iv) compensation payments

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0845 070 9148

Sewer Flooding
History Enquiry

Thames Water Property Searches

History of Sewer Flooding

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

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

For your guidance:

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

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

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

0845 070 9148

Disclaimer

This report has been prepared by GeoSmart in its professional capacity as soil and groundwater specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client, and is provided by GeoSmart solely for the internal use of its client.

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to GeoSmart at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

This report is confidential to the client. The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, GeoSmart may, by prior written agreement, agree to such release, provided that it is acknowledged that GeoSmart accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. GeoSmart accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against GeoSmart except as expressly agreed with GeoSmart in writing.

For full T&Cs see http://geosmartinfo.co.uk/terms-conditions

Important consumer protection information

This search has been produced by GeoSmart Information Limited, New Zealand House, 160-162 Abbey Foregate, Shrewsbury, SY2 6FD.

Tel: 01743 298 100

Email: info@geosmartinfo.co.uk

GeoSmart Information Limited is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom
- sets out minimum standards which firms compiling and selling search reports have to meet
- promotes the best practice and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.
- By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

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

Complaints

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

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

TPOs contact details:

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

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

Please ask your search provider if you would like a copy of the search code

Complaints procedure

GeoSmart Information Limited is registered with the Property Codes Compliance Board as a subscriber to the Search Code. A key commitment under the Code is that firms will handle any complaints both speedily and fairly.

If you want to make a complaint, we will:

- Acknowledge it within 5 working days of receipt.
- Normally deal with it fully and provide a final response, in writing, within 20 working days of receipt.
- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

If you are not satisfied with our final response, or if we exceed the response timescales, you may refer the complaint to The Property Ombudsman scheme (TPOs): Tel: 01722 333306, E-mail: admin@tpos.co.uk.

We will co-operate fully with the Ombudsman during an investigation and comply with his final decision.

Complaints should be sent to:

Jemma Prydderch
Operations Manager

GeoSmart Information Limited
New Zealand House
160 Abbey Foregate
Shrewsbury
SY2 6FD

Tel: 01743 298 100
jemmaprydderch@geosmartinfo.co.uk