4409 St Prancras Campus

Drainage Strategy

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Consulting Structural and Civil Engineers

AKT II Ltd

White Collar Factory
1 Old Street Yard
London EC1Y 8AF

T +44 (0)20 7250 7777
F +44 (0)20 7250 7555
info@akt-uk.com

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Prepared by: Martyna Brudlo

Checked by: Alan Yan

Approved by: Michael Duff

Introduction

AKT II have been commissioned to undertake the surface and foul water below ground drainage design in support of the planning application for the proposed development of of St Pancras Campus located in London Borough of Camden in the postcode area of NW1 OBY.

This report is prepared for the exclusive use of AKT II and our clients. All comments and conclusions in this report are based on the assumption that the sources are reliable, AKT II accept no liability for inaccurate conclusions or assumptions resulting from innacurate information.

1 Surface water drainage

1.1 Existing scheme

The available Thames Water record plans indicate that the closest combined public sewers to the site are:

- A 1548 mm combined trunk sewer running under Georgiana Street to the north of the site.
- A 1200 mm suface water sewer running under Georgiana Street to the north of the site.
- A 1372 x 762 mm combined sewer running under Pratt Street to the south of the site.
- A combined trunk sewer which varies from 2134 to 1829 mm running under Royal College Street to the west of the site.

An extract from the record plans is shown Figure 1.2 for reference.

All surface water from the existing buildings currently discharges directly to the public sewers without any form of attenuation. A CCTV drainage survey has been undertaken, which confirms there is a 300 mm surface water connection to the 1200 mm suface water sewer running under Georgiana Street to the north of the site. The CCTV drainage survey findings are contained in Appendix 1.

Based on the Thames Water Asset Map the invert level of the sewer along Royal College Street and Pratt Street is approximately 18.05 m and the invert level of the sewer in Georgiana Street is approximately 18.6 m. Refer to Appendix 2 for Thames Water Asset Map.

The total site area is approximately 4,900m² and approximately 585m² is soft landscape, therefore the hardstanding is 4,315m². In accordance with the Modified Rational Method, the peak existing run-off from the site is calculated from the formula:

$Q = 3.61 \times C_v \times A \times i$

where C_v is the volumetric runoff coefficient, A is the catchment area in hectares and i is the peak rainfall intensity in mm / hr.

For the peak 1-in-1-year return period storm event this gives the following existing discharge rate for the particular areas:

$Q_1 = 3.61 \times 0.75 \times 0.4315 \times 33.5 =$ **39.1 litres / sec**

For the peak 1-in-100-year return period storm event this gives the following existing discharge rate from the particular areas:

$Q_{100} = 3.61 \times 0.75 \times 0.4315 \times 106.8 =$ **124.8 litres / sec**

1.2 Proposed scheme

The early masterplan for the proposed development is 100% impermeable area, which is approximately 4,900m². Again using the Modified Rational Method, the proposed (unattenuated) peak run-off from the site for the 1-in-1-year return period storm for each area would be:

$Q_1 = 3.61 \times 0.75 \times 0.490 \times 33.5 =$ **44.4 litres / sec**

For the peak 1-in-100-year return period storm event the proposed peak run-off rate from the individual areas would be:

$Q_{100} = 3.61 \times 0.75 \times 0.490 \times 106.8 =$ **141.7 litres / sec**

The Environment Agency updated their guidance on climate change allowance in February 2016 to include an upper and lower allowance to be considered depending on the specific site characteristics. Figure 1.3 shows the revised figures based on various building life spans. Therefore, making an allowance for climate change of 40% (assuming a design life of 60 years) this would give the following unattenuated design discharge of:

$Q_{1\,(+40\%)} =$ **62.2 litres / sec** and $Q_{100\,(+40\%)} =$ **198.4 litres / sec**

In accordance with the Environment Agency's guidelines, the Building Regulations and the Water Authority's advice, the preferred means of surface water drainage for any new development is into a suitable soakaway or infiltration drainage system. Sustainable Urban Drainage Systems (SuDS) can reduce the impact of urbanisation on watercourse flows, ensure the protection and enhancement of water quality and encourage recharging of groundwater in a manner which mimics nature.

In addition to this, the National Planning Policy Framework requires that surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic surface water flows arising from the site prior to the proposed development, whilst reducing flood risk to the site itself and elsewhere, taking climate change into account.

Therefore, as an absolute minimum, the proposed site discharge under the 1-in-100-year storm plus climate change should be no greater than the existing 1-in-100-year storm discharge (i.e. mitigate the impact of climate change and any increase in the area of hardstanding). In this case, this would mean that, rather than discharging at 198.4 litres/sec, the maximum permissible discharge rate from the site would be **124.8 litres/sec.**

Further to the above, the London Plan's Policy 5.13 states that "Development proposals should aim to get as close to greenfield run-off rates as possible depending on site conditions" but "recognises that in such a densely built-up city as London this may not always be possible in particular given that the vast majority of development is targeted on brownfield sites". The Environment Agency (EA) also suggests that Developers should aim to achieve greenfield run off from their site. In accordance with the method outlined in the Institute of Hydrology Report 124, the Greenfield runoff for the site is calculated from the formula:

$Q_{BAR} = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$

where AREA is the site area in km² (pro rata of 50 ha if the site is less than 50 ha), SAAR is the Standard Average Annual Rainfall in mm and SOIL is the Soil Index both read from The Wallingford Procedure maps. This gives a greenfield runoff for the site of:

$Q_{BAR} = 0.00108 \times 0.50^{0.89} \times 620^{1.17} \times 0.45^{2.17} =$ **190.6 litres / sec (for 50 ha)**

Scaling this for the actual site area gives:

$Q_{BAR} = (190.6 \times 0.49) \div 50 =$ **1.87 litres / sec**

Using the Hydrological Growth Curve for south east England, the growth factor from Q_{BAR} to Q_{100} is 3.146 which gives a value of $Q_{100} =$ **5.9 litres / sec.**

Following the pre-planning correspondence with Thames Water it has been agreed that a permissible peak discharge rate for the development would be the Greenfield run-off rate (5.9 litres/sec). Refer to Appendix 3 for correspondence with Thames Water.

Section 106 Application was submitted with Thames Water and a response with consent to reuse the existing connections has been received. Refer to Appendix 7 for Section 106 application response.

Figure 1.1 Site Aerial View of the site

Figure 1.2 Thames Water Asset Map

Range	Total potential change anticipated for 2010-2039	Total potential change anticipated for 2040-2059	Total potential change anticipated for 2060-2115
Upper end	10%	20%	40%
Central	5%	10%	20%

Figure 1.3 Peak rainfall intensity allowance

1.3 Disposal methods

SuDS management train

A useful concept used in the development of sustainable drainage systems is the SuDS management train (sometimes referred to as the treatment train). Just as in a natural catchment, drainage techniques can be used in series to change flow and quality characteristics of the runoff in stages. There are a variety of measures that can be implemented to achieve these goals:

Site management / Prevention

Site management procedures are used to limit or prevent runoff and pollution and include:

- Minimising the hardened areas within the site
- Frequent maintenance of impermeable surfaces
- Minimising the use of de-icing products

Source control

Source control techniques will be used where possible as they control runoff at source in smaller catchments. They can also provide effective pollution control and treatment, thereby improving the quality of the effluent discharged to the receiving waters.

Site control

Where source control techniques do not provide adequate protection to the receiving watercourses in terms of flood protection and pollution control, site control may be required.

Regional control

Where large areas of public space are available regional control can be incorporated to provide additional 'communal' storage and treatment to runoff from a number of sites. However, in this case, all storage and treatment will be implemented on site.

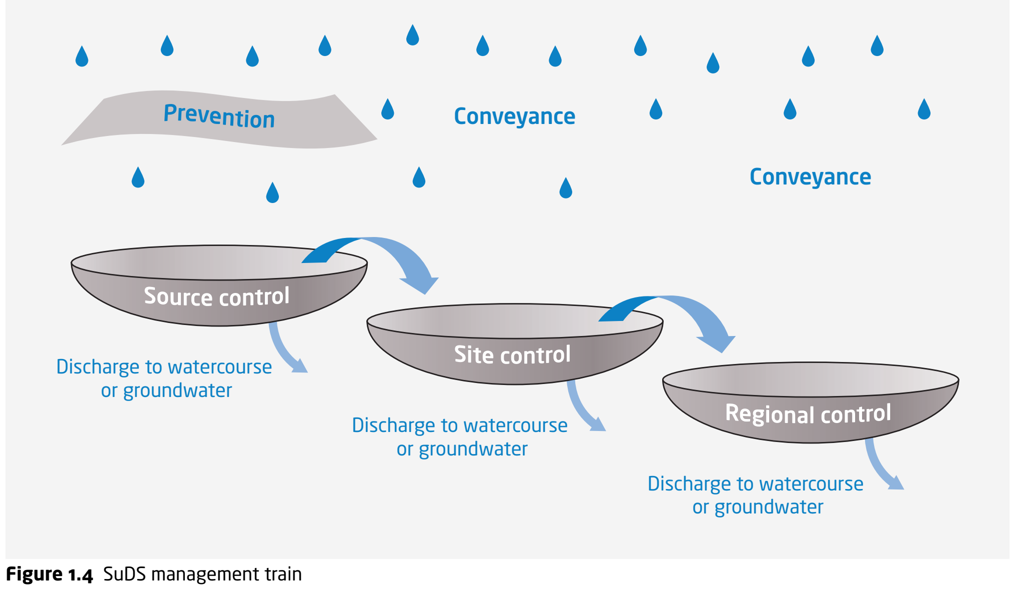

Figure 1.4 SuDS management train

Drainage hierarchy

Based on the above and in line with the London Plan and the Sustainable Drainage Manual published by CIRIA, the following drainage hierarchy will therefore need to be considered when preparing the surface water disposal strategy:

1. Store water for later use
2. Use infiltration techniques such as porous surfaces in non-clay area
3. Attenuate rainwater in ponds or open water features for gradual release to a watercourse
4. Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse
5. Discharge rainwater direct to a watercourse
6. Discharge rainwater to a surface water drain
7. Discharge rainwater to a combined sewer

Assessment of SuDS techniques

Rainwater harvesting

This involves the capture of rainwater into a tank for re-use (usually non-potable) such as irrigation, toilet flushing or vehicle cleaning. Systems are now available which combine rain water harvesting with tanked attenuation. This means that water is stored during dry periods for re-use but released ahead of predicted storms in order to ensure that the full attenuation capacity remains available when it is needed.

Due to the proposed use of the development it is expected that the required water demand would outstrip the available yield. A large portion of the roof both on the residential and office buildings is proposed to be used as a blue roof, however, there is not enough volume available and incorporating rainwater harvesting for water distrubution within the building for toilet flushing etc. would be inefficient. However, it is feasible to incorporate a rainwater harvesting system for irrigation purposes. Part of the surface water collected within the attenuation tank will be pumped to the planting areas located at the ground floor and terraces level for planting irrigation.

Green / brown / blue roofs

These are used on flat or shallow pitched roofs to provide a durable roof covering which also provides thermal insulation, amenity space, biodiversity habitat as well as attenuation of rainwater. Depending on the design, these roofs can attenuate differing volumes of rainwater. The term 'blue roof' is reserved for those roofs designed to maximise water retention. This is a relatively recent area of increased focus and can involve effectively an attenuation tank at roof level which reduces (or avoids) the need for pumping of basement tanks.

It is proposed to incorporate blue roof on the 6th floor of both the office building and the two residential buildings. It is not practicable to install blue roof system on the terrraced areas on the 4th and 5th levels. These areas are remote from the core and in order to route the pipework from the terraces to the building core a siphonic system needs to be provided. The discharge rate from the blue roofs cannot be limited to the pro-rataed Greenfield run-off rate, therefore, the strategy is for the blue roofs to discharge to the attenuation tank located in the basement. For details on the blue roof strategy refer to the Architect's strategy and drawings contained in Appendix 4.

Raingardens

Raingardens are planted areas (usually close to buildings but not immediately adjacent) that allow the diversion of a portion of rainwater from either downpipes or the surrounding paved surfaces. These techniques can be incorporated into the landscaping plans for a site and are most effective where the landscaping regime is designed with the aim of capturing as much rainfall as possible. They can either allow infiltration into the ground or have tanked systems for water retention, depending on the site and soil conditions. There are also a number of vertical raingardens attached to building walls with rainwater downpipes diverted through a stacked series of planters.

As the development consists of a new building with a basement extending across the whole site, there is limited available space for a raingarden. However, new trees and a planting area for conveyance purposes are proposed at the ground floor level by the landscape architect. The tanking system for the planting area is connected to the attenuation tank to discharge excess water. Refer to Appendix 5 for the Landscape Architect's drawings.

Bio-retention

This refers to a chain of landscaped features, potentially including reed beds, filter drains, etc. designed to hold and treat surface water. They are often used where there is a high risk of low-level pollution, for example from road run-off. However, it does require areas of open space. The design of a bio-retention system can vary widely depending on site conditions and available space. At a small scale this could include flow through planters or tree pits.

As the development consists of a new building with a basement extending across the whole site, there would be no external area to incorporate bio-retention into the scheme.

Permeable surfacing

Permeable hard surfaces which work in much the same way as traditional impermeable surfaces apart from the ability to allow rainwater to pass through. Permeable blocks are traditionally used but there are now a range of permeable asphalt and resin bound gravel pavings being used increasingly commonly. Permeable surfaces can either allow infiltration into the ground or have tanked systems for water retention, depending on the site and soil conditions. They are suitable in even the most densely built-up development. However, they're not well suited to roads carrying heavy or fast motor traffic.

As there are limited external areas and the basement extends up to the site boundary, it is therefore not feasible to incorporate permeable paving for infiltration purposes. However, permeable paving is used along with the planting area at the ground floor level as a tanked system for water retention and conveyance purposes. Refer to Appendix 5 for the Landscape Architect's drawings.

Swales

These are dry ditches used as landscape features to allow the storage, carriage and infiltration of rainwater and are often used as linear features alongside roads, footpaths or rail lines. They can also be integrated into the design of many open spaces.

As the development consist of a basement over the whole site and up to the site building boundary, it would not be feasible to incorporate a swale into the scheme.

Detention basin / ponds

Landscape features designed to store and in some cases infiltrate rainwater. Detentions basins are usually dry, whereas a pond should retain water. These features need areas of open space but can often be combined with other sustainable drainage techniques.

As the site is heavily developed with no external areas there is insufficient space to provide a basin or pond.

Infiltration

Geological maps from the British Geological Society indicate that the site is underlain by London Clay and the bedrock geology map is shown in the Figure 1.5. London Clay is classified as an 'unproductive strata' due to its low permeability. Therefore, it is believed it would not be possible to achieve infiltration although this would need to be confirmed by a detailed site investigation. Geology Maps describing the ground confitions within the site have been included in the Appendix 6.

Additionally, the development consists of a new building with a basement extending across the whole site, therefore no infiltration would be possible.

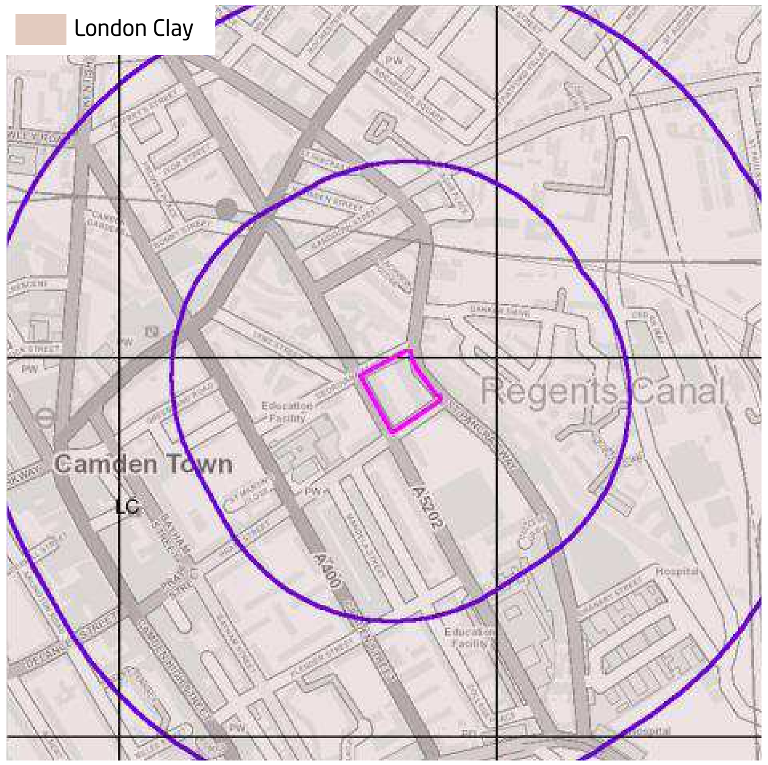

Figure 1.5 Site plan showing bedrock geology

Discharge to tidal river / dock / canals

Discharging clean rainwater directly to tidal rivers, canals or docks isn't normally a sustainable drainage technique. Other more productive techniques should be used first. However, it is generally more sustainable than discharging to the combined or surface drainage systems. Residual surface water can be discharged to tidal / large waterbodies, in some cases with no limitation on volumes. Some storage may be required to allow for outfalls becoming tide locked. Care is needed to prevent scour in the receiving waterbody and potentially to prevent pollution. Consent from the Environment Agency, the asset owner and where applicable the Canal and River Trust is required.

Regent's Canal is in close proximity 50m to the east of the proposed site, however constructing a new outfall into the canal would not be possible as the Star Wharf Superior Apartments are in between the development and the canal. Therefore, discharge to a watercourse will not be a viable disposal method.

Storage tanks / geocellular storage

Storage tanks are single GRP units usually located (but not necessarily) below ground level which attenuate rainwater for later slow release back into the drainage system but do not provide the wider benefits of green infrastructure sustainable drainage. They can also have the disadvantage that pumping may be required to empty the tank into the drainage system – especially if the tank is located at or below basement level. Where tanks are designed for large storm events, care is needed to ensure that they still perform a useful sustainable drainage function for low order storms.

Geocellular storage tanks are similar to storage tanks except that the volume is made up from multiple units rather than a single tank meaning they can be more flexible in terms of shape to suit constrained sites.

It is believed that this is the most feasible disposal option for the site and the tables below presents the approximate tank volumes required for a range of discharge rates under the 1-in-100-year (plus 40% climate change) storm event:

Discharge condition	Discharge rate	Storage volume required
Mitigate climate change only (Absolute minimum)	124.8 litres/sec	80 m^3
50% reduction on existing (London Sustainable Drainage Action Plan)	62.4 litres/sec	130 m^3
Pre-development 1-year peak flow rate	39.2 litres/sec	170 m^3
3 x Calculated Greenfield (Sustainable Design and Construction SPG)	17.6 litres/sec	230 m^3
Greenfield (Environment Agency's preferred rate)	**5.9 litres/sec**	**320 m^3**

As per the pre-planning agreement with Thames Water, the permissible peak discharge rate from the site is the Greenfield run-off rate (5.9 litres/sec). Therefore the required attenuation volume for the development would be a minimum of 320m^3.

The proposal is to locate attenuation tank in the basement above the slab, which would allow the connection to the public sewer by gravity.

Oversized piping

Using larger than necessary pipework creates more room to store rainwater. Potentially more sustainable than storage tanks / geocellular storage if the pipes drain by gravity and do not require pumping. However, lacks the wider benefits of the green infrastructure based techniques.

Due to the restricted nature of the site the pipework would become impractically large to provide the volume of storage required to achieve the required run-off rate.

Design for exceedance

This involves designing areas within a site such that they will flood and hold water during rare storm events (typically a frequency of once in ten years or longer).

As the attenuation tank has been sized to accommodate the 1-in-100-year plus climate change event there is no need to design for excedance.

Summary of proposed SuDS strategy

A rainwater harvesting tank for planting irrigation purposes will be incorporated within the development.

Blue roofs are proposed on the 6th floor of the office building and the two residential buildings.

An attenuation volume of 320 m^3 is proposed which will reduce the peak discharge rate from the site to the calculated Greenfield runoff rate per Local Authority, Thames Water and EA's requirements (5.9 litres/sec).

The outfall from the site will connect to the public surface water sewer via an existing connection. As the existing sewer is located at a lower level than the proposed level of the attenuation tank, gravity discharge is feasible.

Element	Management stage	Water quantity	Water quality	Amenity & biodiversity	Proposed in scheme
Rainwater harvesting	Prevention	✓	✗	✗	✓
Green / brown / blue roof	Source control	✓	✓	✓	✓
Raingardens	Source control	✓	✓	✓	✓
Bio-retention	Source control	✓	✓	✓	✗
Permeable surfacing	Source control	✓	✓	✗	✓
Swales	Source control	✓	✓	✓	✗
Detention basin / ponds	Source control	✓	✓	✓	✗
Discharge to tidal river / dock / canals	Site control	✓	✗	✗	✗
Storage tanks / Geocellular storage	Site control	✓	✗	✗	✓
Oversized piping	Site control	✓	✗	✗	✗
Design for exceedance	Site control	✓	✗	✗	✗

Figure 1.6 Summary of proposed SuDS devices

2 Flood risk assessment requirements

The Environment Agency's Indicative Floodplain Map (see Figure 2.1) shows that the site lies in Zone 1 - an area assessed as having 1 in 1000 or less annual probability of river or sea flooding (<0.1%). A detailed FRA has been carried out by AKT II, which concludes that the site is at a low risk fo flooding from all the sources and has an acceptable flood risk within the terms and requirements of the National Planning Policy Framework.

This report should be read in conjunction with the FRA. The main findings of the FRA have been listed below:

- In accordance with the National Planning Policy Framework, the Site would be categorised as lying within Flood Zone 1 - an area assessed as having 1 in 1000 or less annual probability of river or sea flooding (<0.1%).
- The Site has been assessed as being at very low probability of flooding from fluvial and tidal sources.
- The Site has been assessed as being at low risk of flooding from sewers and other drainage networks as long as they are adequately maintained.
- The Site has been assessed as being at a low risk of flooding from groundwater sources.
- The Site has been assessed as being at low risk of flooding from artificial sources.
- The proposed development has an acceptable flood risk within the terms and requirements of the National Planning Policy Framework.

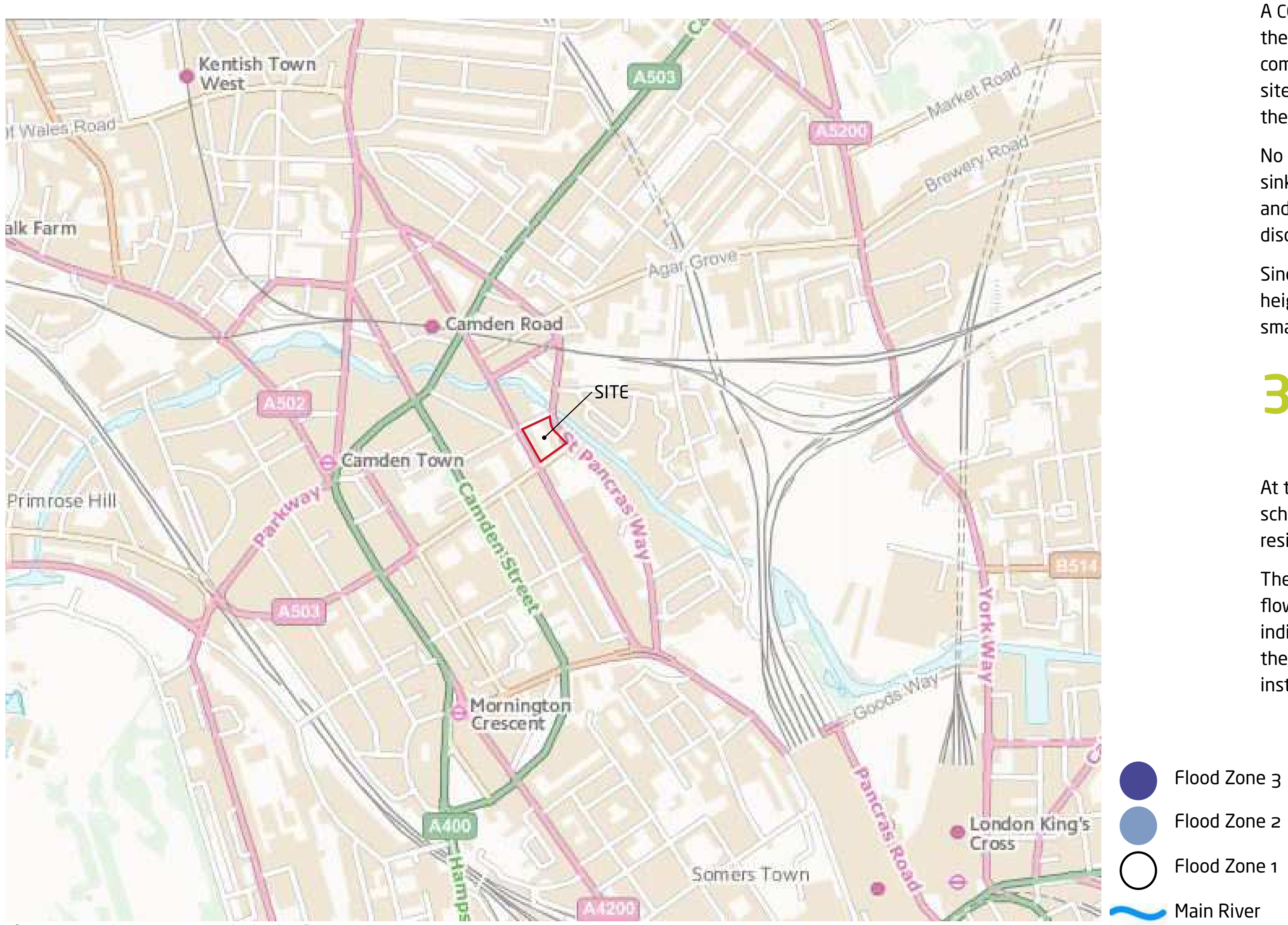

Figure 3.1 Environment Agency indicative flood map

3 Foul water drainage

3.1 Existing scheme

The available Thames Water record plans indicate that the closest combined public sewers to the site are:

- A 1548 mm combined trunk sewer running under Georgiana Street to the north of the site.
- A 1372 x 762 mm combined sewer running under Pratt Street to the south of the site.
- A combined trunk sewer which varies from 2134 to 1829 mm running under Royal College Street to the west of the site.

An extract from the record plans is shown Figure 1.2 for reference.

A CCTV drainage survey has been undertaken, which confirms there is a 225 mm foul water connection to the 1372 x 762 mm combined sewer running under Pratt Street to the south of the site. The CCTV drainage survey findings have been contained in the Appendix 1.

No information on the type and number of foul appliances such as sinks and toilets in the existing building has been made available and so it has not been possible to assess the current foul water discharge rate from the site.

Since the current development consist of 12 units of 2 storey in height, it is believed the existing foul water flow rate would be smaller compared to the proposed.

3.2 Proposed scheme

At the current stage the architectural layout for the proposed scheme is a mixture of retail, light industrial units, office and residential but predominately office and residential.

The architectural layouts have been used to estimate the foul flow from appliances. Not all the fixtures in development were indicated on the plans, thus, the figures quoted below account on the conservative assumption of the units that are expected to be installed in these areas.

Using the guidelines for commercial developments given in BS EN 12056-2:2000 - "Gravity Drainage Systems Inside Buildings - Part 2: Sanitary Pipework, layout and calculation", the proposed foul flow is calculated from the formula:

$Q = K \times \sqrt{DU}$

For 'intermittent use' (representing dwellings, offices, etc.) K has a value of 0.5 giving:

Appliance	No.	Discharge units per appliance	Total number of discharge units
Washbasin	152	0.5	76.0
Shower	53	0.6	31.8
Urinals	25	0.5	12.5
Bath	34	0.8	27.2
Kitchen Sink	49	0.8	39.2
Dishwasher	44	0.8	35.2
House Hold Washing Machine	34	0.8	27.2
WC	158	2.0	316.0
		Total discharge units for site =	**565.1**
		Therefore, total flow from site =	**11.88 litres/sec**

The MEP engineer has proposed to discharge 254 DUs via gravity, which equates to 8 litres/sec with a frequency factor of 0.5. The discharge units for the basement level equate to 315.1 as per the MEP engineer's layout. Assuming the frequency factor of 0.5 this amounts to to 8.9 litres/sec. However, due to the requirement for a separate pumping stations for the residential and the office blocks, the basement drainage would be discharged via pumping at 21.5 litres/sec. Therefore, the total discharge for the development would be **29.5 litres/sec**.

This is a considerable increase compared with previous estimates based on the architectural layouts, resulting from the change in the drainage strategy. A larger portion of the foul water needs to be pumped from the basement to high level rather than discharged by gravity due to the requirement to route drainage to the south of the development. Here the foul water can be discharged via the existing foul water connection as no new connections can be made to the combined trunk sewer running under Georgiana Street to the north of the site or the combined trunk sewer running under Royal College Street to the west of the site.

The increase in the foul water flow rate was agreed with Thames Water. Refer to Appendix 3 and Appendix 7 for correspondence.

3.2.1 Trade Effluent Agreement

Based on the current scheme, there are light industrial units proposed at basement and ground level. Further understanding of the proposed use would be required as depending upon their use, the discharge from these units may be classified as Trade Effluent and Thames Water would need to approval the discharge via Trade Effluent Agreement.

4 BREEAM

Pol 03: Flood and surface water management

Prerequisite

1. An appropriate consultant is appointed to carry out and demonstrate the development's compliance with all criteria.

Up to two credits – Flood resilience

Two credits - Low flood risk

2. A site specific flood risk assessment (FRA) confirms the development is in a flood zone that is defined as having a low annual probability of flooding. The FRA takes all current and future sources of flooding into consideration.

One credit - Medium or high flood risk

3. A site specific FRA confirms the development is in a flood zone that is defined as having a medium or high annual probability of flooding and is not in a functional floodplain. The FRA must take all current and future sources of flooding into consideration.
4. To increase the resilience and resistance of the development to flooding, one of the following must be achieved:
   - **a.** The ground level of the building and access to both the building and the site, are designed (or zoned) so they are at least 600 mm above the design flood level of the site's flood zone; **OR**
   - **b.** The final design of the building and the wider site reflects the recommendations made by an appropriate consultant in accordance with the hierarchy approach outlined in Section 5 of BS 8533 : 2017.

Two credits – Surface water run-off

Prerequisite for surface water run-off credits

5. Surface water run-off design solutions must be bespoke, i.e. they must take account of the specific site requirements and natural or man-made environment of and surrounding the site. The priority levels detailed in the Methodology must be followed, with justification given by the appropriate consultant where water is allowed to leave the site.

One credit - Surface Water Run-Off - Rate

6. Drainage measures are specified so that the peak rate of run-off from the site to the watercourses (natural or municipal) shows a 30 % improvement for the developed site compared with the pre-developed site. This should comply at the 1-year and 100-year return period events.
7. Relevant maintenance agreements for the ownership, long term operation and maintenance of all specified Sustainable Drainage Systems (SuDS) are in place.
8. Calculations include an allowance for climate change. This should be made in accordance with current best practice planning guidance.

One Credit - Surface Water Run-Off - Volume

9. Flooding of property will not occur in the event of local drainage system failure (caused either by extreme rainfall or a lack of maintenance); **AND EITHER**
10. Drainage design measures are specified so that the post-development run-off volume, over the development lifetime, is no greater than it would have been prior to the assessed site's development. This must be for the 100-year 6-hour event, including an allowance for climate change.
11. Any additional predicted volume of run-off for this event is prevented from leaving the site by using infiltration or other SuDS techniques.

OR (only where Criteria 10 & 11 cannot be achieved)

12. Justification from the appropriate consultant indicating why the above criteria cannot be achieved, i.e. where infiltration or other SuDS techniques are not technically viable options.
13. Drainage design measures are specified so that the post-development peak rate of run-off is reduced to the limiting discharge. The limiting discharge is defined as the highest flow rate from the following options:
    - **a.** The pre-development one-year peak flow rate **OR**
    - **b.** The mean annual flow rate Q_{BAR} **OR**
    - **c.** 2 litres / sec / ha

    For the one-year peak flow rate, the one year return period event criterion applies.
14. Relevant maintenance agreements for the ownership, long-term operation and maintenance of all specified SuDS are in place.
15. For either option, above calculations must include an allowance for climate change; this should be made in accordance with current best practice planning guidance.

One credit – Minimising watercourse pollution

One credit

16. There is no discharge from the developed site for rainfall up to 5 mm (confirmed by the appropriate consultant).
17. Areas with a low risk source of watercourse pollution, an appropriate level of pollution prevention treatment is provided, using appropriate SuDS techniques.
18. Areas with a high risk of contamination or spillage of substances, such as petrol and oil, have separators (or an equivalent system) installed in surface water drainage systems.
19. Chemical or liquid gas storage areas have a means of containment fitted to the site drainage system (i.e. shutoff valves). This is to prevent the escape of chemicals to natural watercourses in the event of a spillage or bunding failure.
20. All water pollution prevention systems have been designed and installed in accordance with the recommendations of documents such as the SuDS Manual and other relevant industry best practice. They must be bespoke solutions taking account of the specific site requirements and natural or man-made environment of and surrounding the site.
21. A comprehensive and up-to-date drainage plan of the site will be made available for the building or site occupiers.
22. Relevant maintenance agreements for the ownership, long term operation and maintenance of all specified SuDS must be in place.
23. All external storage and delivery areas designed and detailed in accordance with the current best practice planning guidance.

Up to two credits – Simple buildings – Surface water run-off

Two credits

For "simple buildings", the criteria below should be applied to award one or two credits. Alternatively, two credits and an Exemplary credit is awarded where criteria 5-15 are achieved.

24. Either 24a below or 24b below is met:
    - **a.** There is a decrease in the impermeable area by 50 % or more, from the pre-existing impermeable hard surfaces; **OR**
    - **b.** All run-off from the roof, including new and existing parts of the building, has been managed on site using source control methods. This must be achieved for rainfall depths up to 5 mm.

One credit - Simple buildings - Surface water run-off

25. Either 25a below or 25b below is met:
    - **a.** There is no increase in the impermeable surfaces as a result of the new construction; **OR**
    - **b.** If there is an increase in the impermeable surface as a result of the new construction then the following must be met:
      - **i.** Hard standing areas: additional (or equivalent area of) hardstanding must be permeable or be provided with on-site SuDS to allow full infiltration of the additional volume. The permeable hardstanding must include all pavements and public rights of way, car parks, driveways and non-adoptable roads. Small garden paths which will drain onto a naturally permeable surface can be excluded.
      - **ii** Building (new-build or extension): for an increase in building footprint, extending onto any previously permeable surfaces, the additional run-off caused by the area of the new construction must be managed on site using an appropriate SuDS technique for rainfall depths up to 5 mm.

Assessment of available credits

Prerequisite

Criterion	AKT II assessment	
1.	AKT II are appropriate consultants with the relevant qualifications and experience to design SuDS and flood prevention measures and completing peak rate of run-off calculations.	✓

Flood resilience

Criterion	AKT II assessment	
2.	The site is situated in Zone 1 - an area with a low probability of flooding according to the Environment Agency's Indicative Floodplain Map. The site specific FRA comissioned by the AKT II confirms the site is at low risk of flooding from all other current and future sources	✓
3.	Not applicable - the site is located in Flood Zone 1.	N/A
4a.	Not applicable - the site is located in Flood Zone 1.	N/A
4b.	Not applicable - the site is located in Flood Zone 1.	N/A

Based on this we believe that potentially two credits out of a possible two can be awarded under these criteria subject to the findings of the FRA report.

Surface water run-off

Run-off criteria	AKT II assessment	
5.	The drainage strategy has been prepared in line with the London Plan drainage hierarchy and the priority levels detailed in the BREEAM Methodology.	✓
6.	As confirmed in section 1.3, it is proposed to reduce the peak discharge rate by more than 30% at the 1-year and 100-year event to greenfield rate, 5.9 litres/sec.	✓
7.	The ownership, operation and maintenance requirements for each SuDS device will be written into the O&M Manual for the site.	✓
8.	An allowance of 40% has been made for climate change in all calculations in line with the Environment Agency's guidance.	✓
9.	The site-specific FRA carried out by AKT II has confirmed the site is at low risk of flooding from local drainage system failure.	✓
10.	As the post development hardstanding area is greater than the pre development the volume would increase over the life time of the building due to increase of hardstanding area and climate change. Since the basement footprint is up to the site boundary, infiltration techniques would not be feasible to compensate the additional volume during the lifetime of the buidling. Therefore, this criteria cannot be met.	✗
11.	Since the site is 100% impermeable and no infiltration or other SuDS techniques would be possible to prevent the additional runoff volume from leaving the site. This criteria cannot be met.	✗
12.	The results of the site investigation will confirm and justify why the use of infiltration or other SuDS techniques can or cannot be used. It is currently not believed to be possible to use infiltration due to the underlying soil conditions and the site at the current stage is 100% impermeable.	✓ / ✗
13.	Pre-development 1-year peak flow rate = 39.1 litres/sec Mean annual flow rate Q_{bar} = 1.87 litres/sec 2 litres / sec / ha = 0.98 litres/sec The site is proposed to discharge at Greenfield runoff rate at 5.9 litres/sec which is less than the pre-development 1 year peak flow. Therefore, this critera can be achieved	✓
14.	The ownership, operation and maintenance requirements for each SuDS devices will be written into the O&M Manual for the site.	✓
15.	An allowance of 40% has been made for climate change, as included in the Environment Agency's guidelines.	✓

Based on this we believe that potentially two credits out of a possible two can be awarded under these criteria subject to the Soil Investigation Report.

Minimising watercourse pollution

Pollution criteria	AKT II assessment	
16.	As confirmed in Section 1.3, no infiltration is possible and there is insufficient green roof coverage therefore this criterion cannot be achieved.	✗
17.	SuDS devices will be specified where possible within the limitations of the development.	✓
18.	Not applicable as no loading bat or service yard has been proposed	✓
19.	It is unknown whether the light industrial units would have any chemical or liquid gas storage. However, if they were to have any chemical or liquid storage, containment will be provided.	✓ / ✗
20.	All water pollution prevention and SuDS devices will be designed in accordance with the SuDS Manual.	✓
21.	An up-to-date drainage plan will be made available to the site occupiers upon completion.	✓
22.	The ownership, operation and maintenance requirements for each SuDS device will be written into the O&M Manual for the site.	✓
23.	There are no external storage or delivery areas proposed as part of the scheme.	N/A

Based on this we believe that it is unlikely that a credit be awarded under these criteria.

Simple buildings – Surface water run-off

Pollution criteria	AKT II assessment	
24.	The proposed development does not meet simple buildings criteria.	✗
25.	The proposed development does not meet simple buildings criteria.	✗

Based on this we believe that it is not possible to obtain the one credit under these criteria.

Overall, we believe that potentially four credits out of a possible five can be awarded under the Pol03 criteria outlined above.

5 Maintenance and operation

Before cleaning, final testing and immediately before handover the Contractor will:

- Lift covers to manholes, inspection chambers and access points. Remove mortar droppings, debris and loose wrappings.
- Thoroughly flush pipelines with water to remove silt and check for blockages. Rod pipelines between access points if there is any indication that they may be obstructed.
- Carry out a CCTV of the pipework to ensure that it is free of silt and blockages.

The End User shall then follow the "Waste Management, The Duty of Care – A Code of Practice (Revised 1996)" and shall ensure that their waste does not escape from their control and is transferred only to a registered waste carrier to be sent for recycling or disposal at a suitably licensed facility.

All waste arising from the maintenance of the drains and sewers shall be handled, stored and disposed of correctly to avoid pollution. Waste may be designated as hazardous / special waste and, as such, the End User shall ensure that they comply with the Hazardous Waste (England and Wales) Regulations 2005.

Reference shall be made to CIRIA publication C753 - The SuDS Manual by the Contractor and the End User. A suitable maintenance schedule must be developed, maintained, followed and updated as required to reflect observed performance. The following items are highlighted for guidance.

5.1 General drainage

The below ground drainage network has been designed in accordance with the requirements of the Building Regulations whilst acknowledging the need to limit the number of inspection chambers within "front of house" areas. To this end, all main runs have rodding eyes, manholes or inspection chambers at the head of the run and at all changes of direction to provide access to rod or jet the main pipework.

Where possible, connections from stacks or gullies have been made directly to these manholes or inspection chambers to allow the connection to be rodded or jetted from the downstream end. Where this is not possible, each stack has been detailed to have an access hatch provided just above floor level (see Figure 5.1) to allow the connection to be rodded or jetted from the upstream end. Similarly, the gullies have a rodding access provided within their body allowing the pipework to be rodded or jetted from the gully downstream.

Gullies and channels have been specified with silt buckets and silt trap manholes have been provided upstream of all tanks and infiltration structures to prevent the ingress of silts into the drainage network and impairing the performance of the system.

Maintenance schedule	Required action	Recorded frequency
Regular maintenance	Inspect and identify areas that are not operating correctly. If required, take remedial action.	Monthly for the first three months then six-monthly
	Remove sediment from pre-treatment structures (e.g. gullies, channels, silt traps).	Six-monthly or as required
Occasional maintenance	Debris removal from catchment surface where this may cause risks to performance.	Monthly
Remedial actions	Repair / rehabilitation of inlets, outlets, overflows and vents.	As required
Monitoring	Inspect all manholes, inspection chambers, inlets, outlets, overflows and vents to ensure they are in good condition and operating as designed.	Annually and after large storms

5.2 Pumped systems

Pumps have been designed as duplex units operating on a duty / standby based on hours run, pump failure and high / high water level. A suitable BMS interface shall be provided monitoring each pump system for the following status points:

- Pump 1 running / Pump 2 running – These statuses shall be provided to the BMS in the form of a volt free contact that is closed when the pump is running.
- Pump 1 failed / Pump 2 failed – These statuses shall be provided to the BMS in the form of a volt free contact that is closed when the pump has deemed to have failed, i. e. failed to run when requested. This shall cause a latched general alarm on the BMS.
- High water level – This status shall be provided to the BMS in the form of a volt free contact that is closed when a high water level is breached. The level shall set at a level that is higher than the normal pump control level switch. This shall cause a latched general alarm on the BMS.
- High / High water level – This status shall be provided to the BMS in the form of a volt free contact that is closed when a high / high water level is breached. The level shall set at a level that is higher than the high water level switch. This shall cause a critical latched alarm on the BMS.
- System not in automatic / not available – This status shall be provided to the BMS in the form of a volt free contact that is open (failsafe) when the system is not available to operate. This shall operate should any event occur that could prevent the system from operating, such as power loss to the control panel, hand / off / auto switches not in Auto, isolators opened. This shall cause a critical latched alarm on the BMS.

The BMS shall be capable of raising the following alarms:

- Excessive Pump Running Alarm – The BMS shall monitor the running status of each pump. Should any pump run for longer than 20 minutes, a general alarm shall be raised on the BMS.
- Excessive Pump Starts Alarm – The BMS shall calculate from the running status the number of starts per hour. Should the number of starts per hour exceed 4, a general alarm shall be raised on the BMS.

A control panel local to each pump station shall be provided to monitor the same status points and alarms as defined for the BMS Interface above.

5.3 Attenuation tanks

Inspection of the tank is recommended at six-monthly intervals and after every major storm. Should the inspection reveal a build up of silt at the base of the tank, jetting should be provided to the tank structure to clear the system.

Silt traps prior to inlet pipework should be routinely inspected and cleaned out to minimise debris reaching the tank. It is important to prevent construction silt from entering the tank structure.

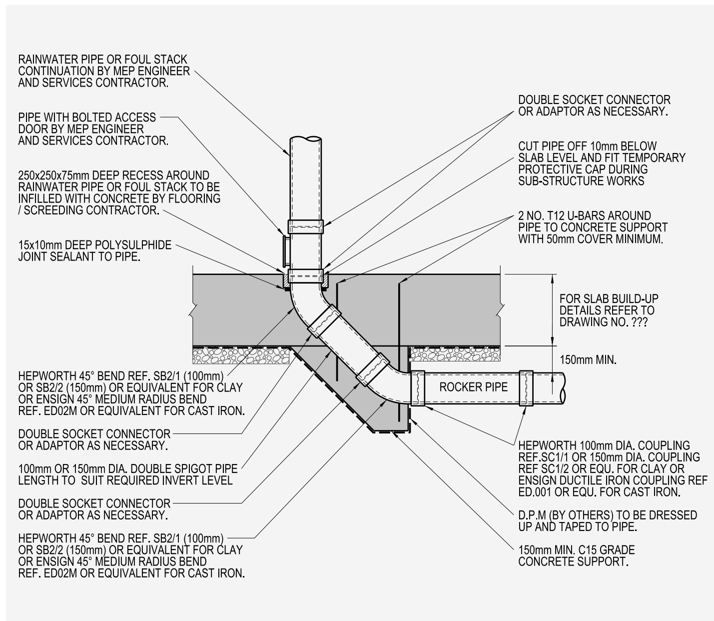

Figure 5.1 Rodding / jetting access detail