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Drainage Strategy Statement
Kidderpore Avenue. Hampstead, NW3

For

Mount Anvil

11316

Engineering at its Best

Report For

Scheme No: 11316

Mount Anvil

Drainage Strategy Statement for Kidderpore Avenue, Hampstead NW3

Main Contributors

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Simon Kaemena

Issued By

Simon Kaemena

Approved By

Dr Paul Tittle

Tully De'Ath Consultants, Sheridan House, Forest Row, East Sussex, RH18 5EA
Tel: 01342 828000 Fax: 01342 828001 Email: info@tullydeath.com Web: **www.tullydeath.com**

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Drainage Strategy Statement

1.0 Introduction

Tully De'Ath have been appointed by Mount Anvil to produce a Drainage Strategy Statement for the proposed residential development proposed for the Kings College London Campus (North) site situated on the northern side of Kidderpore Avenue, Hampstead NW3 7ST. This will accompany a planning application that is shortly to be made with respect to this development.

The purpose of this report is to demonstrate to the local planning authority that the proposed development will have adequate drainage and will not increase the likelihood of flooding elsewhere.

The report includes the London Borough of Camden's Surface Water Drainage Pro-Forma completed with respect to this project. This can be found in Appendix E.

The site is in a Flood Zone 1 (very low risk). However it is greater than a hectare in size. Therefore a detailed flood risk assessment is also required at planning stage. This is being produced by WSP consultants. We understand that this Drainage Strategy Report is to be incorporated into the Flood Risk Assessment.

2.0 Location

The site is located in Hampstead in the London Borough of Camden. The site is bounded along its southern edge by Kidderpore Avenue. There is a church to the west and a residential area to the east. Immediately to the north of the site boundary there is a covered Thames Water reservoir and some sports facilities.

The local post-code is NW3 7ST. A site location plan is provided in Appendix A.

3.0 Existing Conditions

<u>Layout & Topography</u>

A topographic survey of the existing development is shown on Drawing 11316-CIV-100 in Appendix B. The site covers a total area of 1.2255Ha and is approximately rectangular in shape (170mx70m) with the longer east-west axis running parallel with Kidderpore Avenue.

The eastern half of the site contains eight buildings each of which provides student accommodation. The names of the buildings are shown on the above-mentioned drawing. Most of these buildings are to be retained and refurbished as part of the proposed redevelopment. Several of the buildings surround a landscaped courtyard in which protected trees are located.

The western half of the site features some extensive garden areas including more trees that are scheduled for retention. There is an existing chapel in the north western corner of the site and a building known as the Queen Mother Hall which also provides student accommodation in the south western corner.

The total impermeable area within the existing site = 5000m² as can be seen on Drawing 11316-CIV-100 in Appendix B.

Drawing 11316-CIV-100 also shows that the site levels generally reflect the vertical alignment of Kidderpore Avenue and the location of the centre of the site on a "finger" of high ground extending into the site from the north. The highest point along the site frontage is at approximately 97.5m AOD at a location 65m from the south-western corner of the site which lies at approximately 94.0m AOD. To the east levels fall at an increasing gradient away from the high point such that the level of the road adjacent to the south-eastern corner of the site is approximately 90.0m AOD.

On a front to back axis within the site the levels generally also reflect the above regime however there is a level plateau at approximately 97.75m AOD between the chapel and the main buildings. The courtyard surrounded by the main building falls in a south-easterly direction from approximately 94.75m to 93.25mAOD.

Drainage

The local sewer network is shown on the Thames Water sewer mapping provided in Appendix C.

The local sewer network in this part of London consists of combined (foul and surface water) sewers. A 300mm diameter sewer runs westwards along Kidderpore Avenue at a depth to invert of 4m to 5m. The head of this sewer is located at the above-mentioned high-point in the road.

A 900x600 egg-shaped sewer runs eastwards from the high-point in Kidderpore Avenue at a depth to invert of 3m to 4m.

The existing drainage within the site is shown on Drawing 11316-CIV-100 in Appendix B. As can be seen the vast majority of the existing drainage runs southwards and connects to the Thames Water sewers in Kidderpore Avenue. Much of the existing drainage becomes "combined" within the site. To date no surface water connection has been identified for the Queen Mother Hall and no drainage connections have yet been identified for the chapel. No drainage connections have been detected running into the site from adjacent areas.

Whilst there were several water courses passing through the area these have been culverted for many years and now form part of Thames Water's sewer network. The nearest open water course is the River Brent which, at its closest point, runs 2.8km to the north-west of the site.

Ground Conditions

There is no evidence of any existing soakaways within the site. Based upon a Desk Study (Soiltechnics, July 2014) and borehole logs (Soiltechnics, June 2015) received to date the site would appear to be underlain by 6m to 8m of Claygate Member on London Clay. Both materials have a very low soakage potential and will not support the use of soakaways. Evidence of perched water tables was found within the Claygate Member at the time of the site investigation to minimum depth below ground level of 2.7m.

Soiltechnics' Desk Study also suggested that there are possible sources of gaseous contamination within the site albeit to a relatively low extent. We await the results of the recent intrusive investigation work and subsequent laboratory testing in order to clarify this scenario.

4.0 Development Proposals

The proposed development will provide 156 dwellings. The proposals involve the retention of the site's five Grade II statutorily listed buildings. Kidderpore Hall, the Maynard Wing, the Chapel and the old Skeel Library will all be sensitively converted to residential use, and the Summerhouse will be restored in a new location on the site close to the Chapel.

Other unlisted buildings will also be retained and sensitively converted to residential use, namely Bay House, Dudin Brown, and Lady Chapman Hall.

Three existing buildings will be demolished and replaced with new residential buildings. These are Lord Cameron, Rosalind Franklin and the Queen Mother's Hall. All of these buildings will include basement facilities. The replacement buildings will retain the names of the demolished buildings.

Integrated in the Kidderpore Avenue elevation of the reconstructed Queen Mother's Hall will be an access to a basement area where car parking for residents and visitors will be provided. In total 95 spaces are proposed on two basement levels.

A row of seven town houses will be located along the northern side of the car park with an additional town house to be located to the west of the chapel. A row of three residential units known as the Pavillions will be located along the western side of the car park. These will be two-storey in height and will be completely submerged below ground level at the same levels as the basement car park.

The proposed development will also include residents' facilities and a concierge.

In terms of both the trees and the existing buildings the site is considered to have a very high conservation value and this is reflected in the proposals as agreed to date between the project team and the London Borough of Camden. Accordingly, along with the listed buildings, many of the existing trees will be retained within the proposed site layout. The cobbled terrace area immediately to the east of Maynard House is also to be retained.

The proposed layout is shown on Drawing 11316-CIV-101 in Appendix D. This illustrates that the total impermeable area created by the new development will be 8180m² This figure includes the landscaped areas over the basement car park which for the purposes of drainage design will be considered as impermeable green-roof areas.

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5.0 Drainage Proposals

5.1 Discharge of Surface Water

The most favourable form of surface water discharge involves the retention of surface water within the development, where it is allowed to soak into the underlying ground. This requires suitable permeable and un-contaminated ground conditions beneath the site. In addition maximum ground water levels should be at least 8m to 10m below ground level. However in view of the poor ground infiltration conditions as reported in Section 3, above ground infiltration will not be feasible and the new development will need to drain away from the site. This will replicate the existing surface water regime.

As there are no water courses available within the vicinity the proposed development will need to drain into the existing sewer networks as is the case with the existing site.

5.2 Flows, Volumes and Attenuation

5.2.1 Comparison of Impermeable Areas

The relative existing and proposed impermeable areas (see Appendices B and D) are as stated below.

Existing Impermeable Area = 5000m^2

Proposed Impermeable Area = 8180m^2

Therefore the total impermeable area associated with the proposed development will represent an increase of 3180m² (63.6%) from that associated with the original development.

5.2.2 Requirements for the Control of Surface Water Flows from the Development

In line with the London Borough of Camden's current guidance, designers should aim for surface water runoff rates not to exceed the calculated greenfield run-off rate for each respective storm event up to and including the critical 1in100 year event. The guidance further advises that, as an absolute maximum, discharge rates associated with the proposed development should not exceed 50% of the existing run–off rate for each respective storm event. This will apply to all storm events falling on the proposed development up to and including the 1in100 year event with an additional 30% intensity added for climate change.

The greenfield discharge rates for this site (1.2255Ha) have been calculated using Micro Drainage software's Source Control programme IH124. The greenfield rates and absolute maximum permitted outfall rates are:

Table 5A

Storm Return Period	Greenfield Rate	Absolute Max Outfall Rate (50% of existing)
Qbar	4.7l/s	/
1 in 1 year	4.0l/s	34.7l/s
1 in 30 year	10.7l/s	78.5l/s
1 in 100 year	15.1l/s	100.0l/s

The above details are also included in Section 3 of the London Borough of Camden's Drainage Assessment Form as included in Appendix E. The calculation details are shown on MD/01 and Hand/01, 02 as included in Appendix F.

Design modelling will also need to show that the above 1in100 year maximum flow rate is not exceeded by all 1in100 year storm events with an additional 30% intensity to allow for climate change.

Flow control that complies with the above parameters is normally provided by a "complex control". This would be located within a man-entry chamber with a vortex flow control device such as a Hydrobrake located at invert level and an orifice plate located at a higher level within the chamber.

As discussed in Section 4.0 the proposed development consists of a mixture of new buildings and the refurbishment of existing buildings. As can be seen on Drawing No 11316-CIV-101 in Appendix D the six accommodation buildings in the centre of the site are to be retained. This drawing also shows that much of the drainage for these buildings runs internally and becomes combined (foul and surface water) prior to emerging at the site frontage and connecting to the sewer network. Accordingly the flow control and attenuation of the flows entering these drainage networks will not be feasible in view of their foul content.

It would however seem feasible to intercept some of the surface water down-pipes and gullies around these buildings prior to their connection into the combined system where there are no overriding conservation issues such as protected trees and terrace areas adjacent to the building. The areas from which these potential connections could occur are shown on Drawing No 11316-CIV-101 in Appendix D. These assumptions will, however be subject to further drainage survey work involving CCTV surveys of the various connections in order to determine their existing condition.

In spite of the interception of some of the surface water connections on the retained buildings we have estimated that a total impermeable area of 1605m² will continue to discharge via the existing combined connections to the frontage of the retained buildings. This area will have peak discharges as tabulated in the central column of Table 5B below (see calculations on Hand/02 in Appendix F). In order to comply with the maximum discharge requirements as stated in the right-hand column of Table 5A above, (as repeated in the left hand column of Table 5B below), the maximum discharge from the remainder of the proposed development must therefore not exceed the rates as stated in the right-hand column of Table 5B below.

Table 5B

Storm Return Period	Absolute Max Permitted Outfall Rate From Development	Flow From Un-Attenuated Areas of Existing Building (1605m^2)	Absolute Max Permitted Discharge From Other Areas (Controlled Flows)
1 in 1 year	34.7l/s	22.3l/s	12.4l/s
1 in 30 year	78.5l/s	50.4l/s	28.1l/s
1 in 100 year	100.0l/s	64.2l/s	35.8l/s
1 in 100 year + 30%	100.0l/s	83.5l/s	16.5l/s

5.2.3 Requirements for the Control of Surface Water Volumes from the Development

Inevitably the volume of run-off from an impermeable area, irrespective of flow control and attenuation, will exceed that associated with the same area of permeable, greenfield land unless a means of disposal of the excess volume can be found within the site. The principle means of on-site disposal of excess surface water volumes is ground infiltration. However, as discussed in Sections 3 and 5.1 above this is not feasible at this site.

The London Borough of Camden's surface water pro-forma for new developments is supported by "Rainfall Runoff Management for Developments" (DEFRA & EA – 2012). This advises that rainwater run-off volumes from new developments should ideally not exceed those associated with the site in its original greenfield, un-developed state.

The London Borough of Camden's Pro-Forma also reflects this requirement and adds that if it is the case that volumes exceed those associated with the green field site they must not exceed existing volumes of run-off. The DEFRA & EA publication however acknowledges that, in some instances where ground infiltration is not feasible, it is not technically feasible to avoid an increase in the volume of run-off from the developed site. In such instances a more stringent form of flow control and attenuation than that discussed in Section 5.2.2 is imposed requiring all surface water discharges from the site not to exceed a rate of 2l/s/Ha or Qbar depending upon which is the higher rate. This applies to all storms with a return period of up to and including 1in100 years with an additional 30% intensity added for climate change. The attenuation required in this instance is referred to as "long-term" attenuation. Flow control is generally provided by a single vortex flow control device with no additional orifice plate to increase flows in severe storms. In the case of this development Qbar (4.7l/s) would be the appropriate rate.

The above flow control and long-term attenuation requirement is further modified within the DEFRA & EA publication by recognition of the fact that the incorporation of flow control outlets below 75mm in diameter introduces an increased risk of blockage to the system. This diameter equates to a flow-rate of approximately 5l/s for a vortex flow control device although the actual figure varies with the head of water above the device. This flow rate is generally accepted as the minimum achievable within flow control attenuation systems if the risk of blockage is to be reduced to an acceptable level. It is worth also noting here that the many water authorities will not accept the incorporation of vortex flow control devices or other orifices with outlets smaller than 100mm into their adopted networks.

Due to the increase in impermeable area that will be associated with this development and the lack of any ground infiltration options volumes of surface water discharging from the proposed development will exceed those associated with the existing development albeit that the increase will be reduced by the inclusion of various SuDS options as discussed in Section 5.2.5 below. The increased volumes are detailed in Section 5 of the London Borough of Camden Pro Forma in Appendix E.

Accordingly whilst certain "retained" impermeable areas will discharge unconstrained the majority of the proposed development will drain via "long-term" attenuation storage in accordance with the above-mentioned DEFRA & EA publication. This discharge will take place via two outfalls at either end of the site. Each outfall will discharge at a maximum controlled flow rate of 5l/s therefore restricting flows from the majority of the site to a maximum value of 10l/s for all storms with a return period of up to and including 1in100 years with an additional 30% intensity added for climate change.

5.2.4 Drainage Strategy – Flow Control, Attenuation and Outfalls

Clearly in view of the above requirements, the increase in impermeable area and the poor ground infiltration parameters present at the site there will be a need to both control flows and attenuate excess surface water volumes. The proposed regime for discharging surface water from the site will be as follows and as shown on our Drawing No 11316-CIV-102 in Appendix D. The stated strategy also reflects the topography of the site in terms of the falls away to the west and east from a central high point.

Western Section of Site

Flows from the impermeable areas here, totalling 4300m² and including some of the existing roof areas on the retained buildings, will be directed to a flow control facility to be located at the front of the Queen Mother Hall. A vortex flow control device within the flow control chamber will control flows to a maximum rate of 5l/s and will discharge via a new connection to be provided into the existing 300mm dia sewer that runs westwards along Kidderpore Avenue.

We have calculated that a long-term attenuation storage volume of 210m³ will be required here. Due to the presence of the underground parking structure and the various tree-root protection zones, there are very limited options for the location of the attenuation storage facility in this section of the site. However, as can be seen on Drawing 11316-CIV-102, the required volume will be provided within a 2.4x2.4m culvert to be located at depth adjacent to the southern and eastern faces of the Queen Mother Hall over a total length of approximately 37m.

The relevant calculations are provided on sheets MD/02 to MD14 in Appendix F.

It should be noted that some of the drainage connections will need to run within the basement parking as suspended drainage.

One area that will not be able to drain to the control chamber via gravity due to its depth is the submerged light well to the rear of the Pavillion units. Flows from this area (approximately 100m²) will need to be pumped. Noting that a foul pump facility will also be required for these units and the basement car park in general it may be best to channel flows from here to a single combined pump facility. Alternatively a separate surface water facility could be provided discharging into the on-site gravity network and subsequently the attenuation facility.

Central Section of Site

Section 5.2.2 above discusses how a proportion of the impermeable area associated with the existing buildings to be retained in the central section of the site will discharge un-attenuated via the three existing combined connections along the building frontages. This is as shown on Drawing 11316-CIV-102.

Eastern Section of Site

Flows from Rosalind Franklin and Lord Cameron Houses will discharge to a flow-control and attenuation facility to be located beneath the vehicular access road that will run into this section of the site. This facility will also cater for flows from certain roof areas on the retained buildings from which the existing surface water drainage can be intercepted. The total impermeable area draining via this route will be 2275m².

Rainwater downpipes from the eastern side of Cameron House and from the northern end of Rosalind Franklin House will need to be connected to the attenuation facility via suspended drainage passing through the bin and cycle store basement areas within these two buildings.

There are several light wells located around these two buildings from which surface water pumping will be required. In view of the proposed floor and patio levels along the eastern side of Rosalind Franklin House an area of approximately 425m² will require a surface water pump-facility in order to provide the necessary drainage connection to the attenuation unit.

The maximum long-term attenuation storage requirement is 97m³. Storage will be provided by a buried 2.0x1.5m deep culvert approximately 32.5m in length beneath the access road. Flows, controlled to a maximum rate of 5l/s by a vortex flow control device, will discharge into the existing 225mm diameter surface water drain that runs eastwards along the site frontage and which continues into the adjacent property at the south-eastern corner of the site.

The relevant calculations regarding the attenuation facility are provided on sheets MD/02 to MD/05 and MD/15 to MD/23 in Appendix F

Generally it should be noted that where it is proposed to re-utilise existing sewer connections or on-site drainage a CCTV survey should be carried out to verify the condition of the existing pipe-work.

Summary of Flows from Development

In view of the above proposals and as demonstrated by the calculations the combined peak flows for the two "attenuated" sections of the development will not exceed 9.9l/s for all rainfall events with a return period of up to and including 1in100 years with an additional intensity of 30% added for future climate change. This flow rate significantly less than the absolute maximum permitted controlled flow rates in the right-hand column of Table 5B. Flow rates from the developed site will therefore comply with the London Borough of Camden's minimum requirement that discharge rates from a new development should not exceed 50% of existing. This is further summarised in Section 4 of the London Borough of Camden's Drainage Pro-Forma in Appendix E and on Hand/05 in Appendix F.

It is worth noting that 80.4% of the total impermeable area within the redeveloped site will drain via the attenuation facilities described above.

5.2.5 Drainage Strategy - SuDS

In addition to, and if possible in place of, the standard piped methods of drainage within a development various Sustainable Drainage Systems (SuDS) can be incorporated into a drainage network to both reduce surface water flow-rates and volumes. Other potential benefits are as follows:

- Encourage natural groundwater re-charge
- Reduce pollutant concentrations in storm water
- Provide habitats for wildlife.

Prior to the determination and final calculation of how much surface water flow attenuation and volume reduction is achievable within this development we have firstly considered the SuDS methods that are feasible in view of the various constraints that exist here. Those that are feasible have been incorporated into the drainage strategy for the development as is shown on our Drawing No 11316-CIV-102 in Appendix D.

Ground Infiltration

As discussed in Section 3 of this report there is insufficient permeability within the ground beneath the site for this method of drainage to be considered.

Rainwater Harvesting

Rainwater harvesting entails the provision of buried tanks that store filtered rainwater. The rainwater is then pumped into the domestic network for non-potable use such as irrigation for gardens, toilet flushing and clothes washing. Unfortunately the rainwater harvesting systems currently available do not cater for the catchment of surface water from non-roof external surfaces such as roads, car parks and pedestrian areas due to the increased levels of treatment required. The inclusion of rainwater harvesting can therefore increase the complexity of the required surface water drainage network and thus the environmental impact involved in its construction. The complexity of the internal water services within buildings is also increased considerably.

In terms of the appraisal of the reduction in volumes leaving the site rainwater harvesting will provide a reduction on a long-term annual basis. However the volumes associated with a 6Hour 1in100 year storm may potentially not be reduced in any way by rainwater harvesting if the tanks are already full at the time at which the storm event occurs.

There are further longer-term environmental implications involved in the potential electrical consumption associated with rainwater harvesting. Rainwater harvesting will therefore not be provided.

Green/ Brown Roof

Green or brown roofs involve various types of soil and vegetation cover of roof areas including an underlying drainage blanket linked to the rainwater down-pipes. In dry climatic conditions they can reduce the volume of run-off from roof areas due to the water demand of the vegetation. They also attenuate peak flows from roof areas. By their very nature they are much better suited and considerably more effective with regards to flat, non-pitched roof areas.

Within the Kidderpore development the existing and many of the proposed buildings will have pitched roof areas therefore precluding the use of green or brown roofs. However the below-ground car park and the pavilion units in the western section of the site will both have ground level green roofs. Flows from the underlying drainage blankets in the landscaped roof cover to the basement parking and the Pavillion units will be intercepted around the edges of the basement plan areas by a collector drainage system similar in many respects to a land drainage system. This will subsequently connect into the flow-control attenuation system for the western section of the site to be provided adjacent to the Queen Mother Hall.

Similarly the single storey unit to be constructed immediately to the north of Skeel House will be provided with a green roof. This will be connected into the flow-control attenuation system for the eastern section of the site.

Permeable Paving

Permeable paving allows rainwater to infiltrate through a hard-standing surface into an underlying storage/filtration sub-base layer. The water can then either soak into the ground beneath the paving via a permeable geotextile or migrate through the permeable sub-base into a separate infiltration device (soakaway).

Alternatively, as will be the case for this development, surface water will infiltrate through the permeable paving construction and be collected by a permeable piped drainage network with both the drainage and permeable construction underlain by an impermeable geotextile.

Permeable paving can both improve water quality particularly beneath vehicular areas and provide attenuation storage for surface water. It can also attenuate peak flow rates and reduce volumes such that less attenuation storage is required elsewhere within the drainage network.

It is proposed that permeable paving will be used beneath the proposed vehicular access road into the site between Dudin Brown and Lord Cameron Houses. Similarly a permeable surface will be provided for the proposed hardstanding area to be provided at the eastern end of the chapel.

Swales, Ponds and Wetlands

These facilities can range from depressions in grassed areas that can remain dry to permanent ponds with the water level increasing during periods of rainfall. Excess surface water is subsequently discharged via a combination of evaporation and/or soakage and/or controlled discharge. In the right circumstances these facilities can also provide aesthetic and amenity value.

As with many developments in a relatively urban area it is difficult to accommodate SuDS such as this in view of the limited space available noting also the need to protect many of the existing trees. It should also be appreciated that some of the residents will be young families with children. Ponds and semi-wet areas could potentially create a health and safety hazard in this environment.

Accordingly this form of SuDS will not be incorporated into the development.

Summary of SuDS

As advised above a large area of green roofing and some permeable paving will be incorporated into the western drainage network. Similarly areas of green roof and permeable paving will be incorporated into the eastern drainage network.

These facilities will attenuate the flow of surface water to the main long-term storage facilities thus helping reduce the size of the storage required. Perhaps more importantly they will also reduce the volume of water running off from the site due to absorption and long term evaporation. These benefits have been assessed within the Micro-Drainage modelling of the drainage networks as presented in Appendix F.

5.2.6 Volumes of Surface Water Run-Off

Utilising the Micro-Drainage Source Control Software we have appraised the volumes of surface water discharging from the site during a 6Hour 1in100 year storm event allowing not only for the proposed impermeable area but also the SuDS facilities discussed above. The results are presented in Sections 5 and 6 of the London Borough of Camden's Surface Water Drainage Pro-Forma as provided in Appendix E and as supported by the calculations on Hand/03,04 and MD/02 to MD/23 in Appendix F. The volume calculations are also summarised on Hand/05 in Appendix F.

As predicted in the absence of any available ground infiltration capabilities volumes of surface water run-off from the site will increase in comparison with the existing condition in spite of some reduction associated with the use of green roofs and permeable paving. This explains why the stringent long-term attenuation and flow control facilities have been provided as further discussed in 5.2.3 above.

5.3 Exceedance Storm Events

Proposed site levels including building finished floor levels will be set such that a storm event with a probability of return greater than a 1in100 year plus 30% (for climate change) will discharge from the site without flooding the buildings. The key locations at which surface water will surcharge above ground level and the routes that this water will subsequently take are indicated on Drawing No 11316-CIV-102 in Appendix D. These are similar to the exceedance routes associated with the existing site. Noting also that the existing drainage will not have been designed to accommodate storm events of the severity that will be considered within the detailed design for the proposed development the frequency of any such events should decrease in comparison with the current scenario.

5.4 Foul Drainage

Foul drainage from the proposed development will be connected, mostly by gravity, into the existing Thames Water sewer network the layout of which is shown in Appendix C and on Drawing No 11316-CIV-102.

A total of 156No residential dwellings will be provided by the new development. The existing development provides accommodation for 281No students. Peak foul flow rates generated by the proposed development will therefore increase from approximately 4.4l/s to 7.2l/s.

This relatively small increase in peak discharge of 2.8l/s should not present an issue with respect to capacity within Thames Water's local combined sewer network noting in particular that the local sewers lie at the head of the network and noting also that the comparatively much greater levels of surface water discharge from the site will be decreasing in accordance with the surface water proposals discussed above.

A pump facility will be required for the drainage of any foul connections located on the lower floor of the car park basement including those on the lowest floor within the Pavillion units. The ground floor on eastern side of Rosalind Franklin House will also require a foul pump facility as there is likely to be insufficient fall to the 900x600mm sewer from this location.

In accordance with Thames Water's requirements the final connection of any private pump facilities will need to run as a gravity drain from a rising main outfall chamber within the site.

6.0 Maintenance

6.1 Proposed Drainage

Maintenance of any drainage scheme is essential to ensure that it continues to perform as designed. Within the site's 'Health and Safety File' details of routine maintenance inspections should be included together with guidance as to how they should be undertaken, and at what intervals and/or events.

Generally the below-ground surface water drainage requires regular inspection and clearing to prevent blockages due to accumulation of silt. Trapped gullies, flow control devices and catch-pits should be inspected and cleared of silt and permeable paving surfaces should be jetted in order to remove silt from the open joints between the blocks.

It is recommended that all elements within the private sections of the proposed drainage network are initially inspected and cleared by a suitably trained person every six months for at least the first two years of operation in order to establish a long-term inspection/clearing interval appropriate for this site. Inspection/clearing should also be carried out after every major storm event.

We are advised that responsibility for this maintenance work will lie with our client's site management company.

6.2 Existing Sewers

It is important that the existing sewers and highway drains (road gullies) in the area are regularly maintained by Thames Water and Camden Highways respectively.

7.0 Conclusions

This Drainage Strategy Statement has demonstrated the following:

7.1 Surface Water Drainage

7.1.1 The redevelopment of the site will increase the impermeable area from 5000m² to 8180m². Therefore, if left uncontrolled, the likelihood of flooding from surface water discharging from the site towards lower lying areas will be increased due to the potential increase in flow rates and volumes. This report has detailed the means by which flow rates and volumes can be controlled so as not to increase flood risk.

7.1.2 In determination of this surface water drainage strategy the high-profile conservation aspects of the project have needed to be considered. Several listed buildings are to be retained along with protected trees. These issues have, to a large extent, dictated what is and isn't feasible in terms of providing controlled drainage flows from the site.

7.1.3 Ground infiltration is not feasible as a means of surface water discharge from this development. Therefore all surface water drainage will connect via gravity to the adjacent Thames Water sewer network as is currently the case. Accordingly, most of the surface water draining from the site will be attenuated (temporarily stored) on site within two storage tanks formed by pre-cast concrete culverts. In recognition of the increased volumes discharging from the site discharge will be limited via two flow control chambers to a maximum combined rate of 9.9l/s for all storm events up to and including the 1in100 year storm with an additional 30% intensity considered to allow for future climate change.

7.1.4 Due to the layout of the existing combined drainage serving the buildings that are scheduled to be retained an existing roof area 1605m² (19.6% of impermeable area) will continue to drain from the site un-attenuated. However, due to the flow controls applied to the rest of the site, the total surface water flow rates discharging from the site will be less than 50% of existing peak flow rates.

7.1.5 The proposed incorporation of green roof areas within the development along with permeable paving will help reduce volumes of surface water run-off from the development and will also help reduce the attenuation storage requirement.

7.1.6 Due to certain proposed site levels surface water pump facilities will be required to serve various light wells and the eastern side of Rosalind Franklin House.

7.2 Foul Drainage

7.2.1 Foul drainage will connect, mostly via gravity, to the existing sewers. However pumped connections will be required in order to serve the below ground foul facilities in the western section of the site and the ground floor units on the eastern side of Rosalind Franklin House.

7.2.2 Peak foul flows will increase by approximately 2.8l/s. This should not present a problem in view of the much greater decrease in surface water flows to the same sewer network.

7.3 Maintenance

7.3.1 The surface water drainage including the SuDS elements will need to be maintained regularly in order to retain its effectiveness. This maintenance will be carried out by our client’s management company.

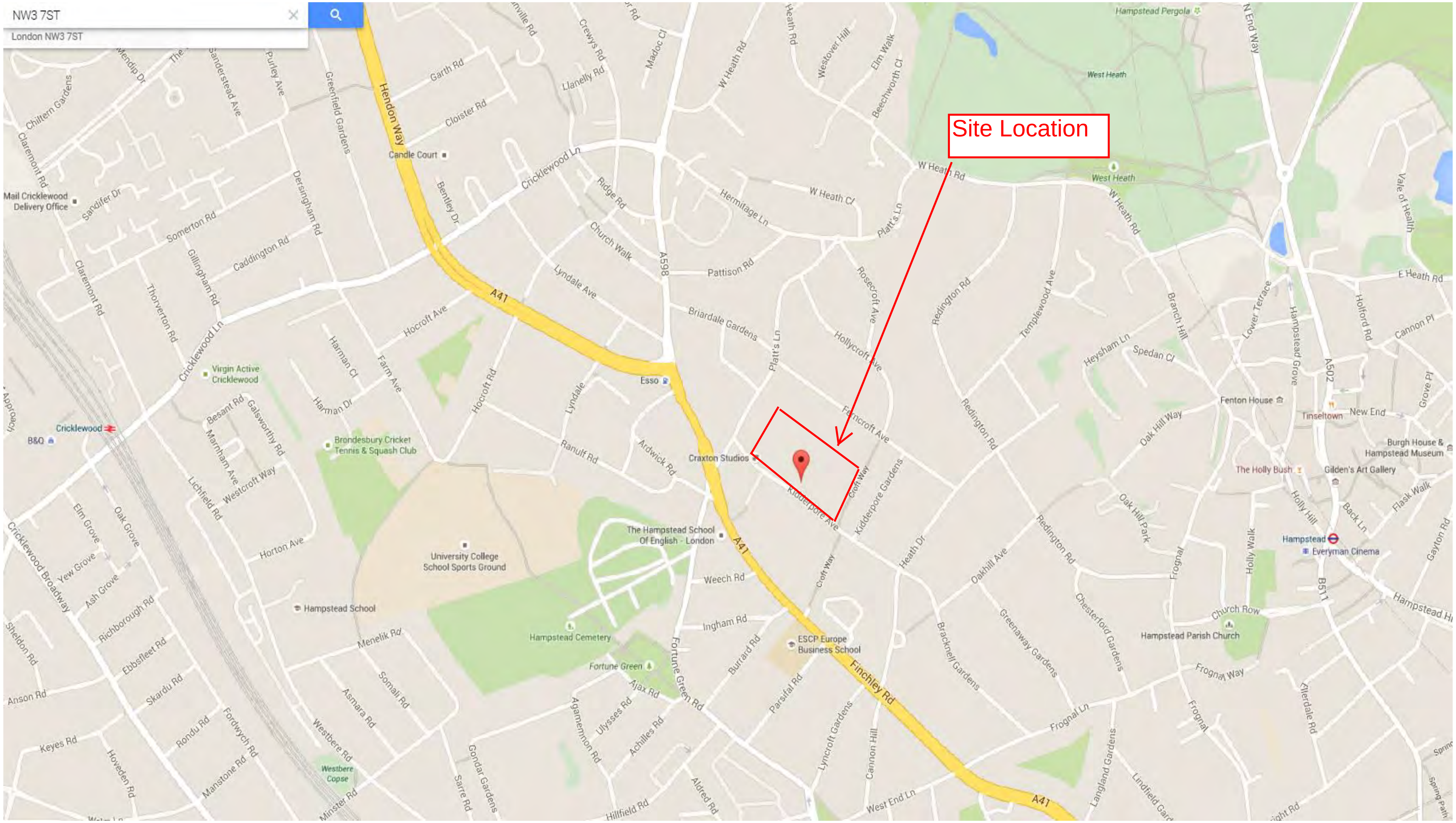
Signed by:

Simon Kaemena

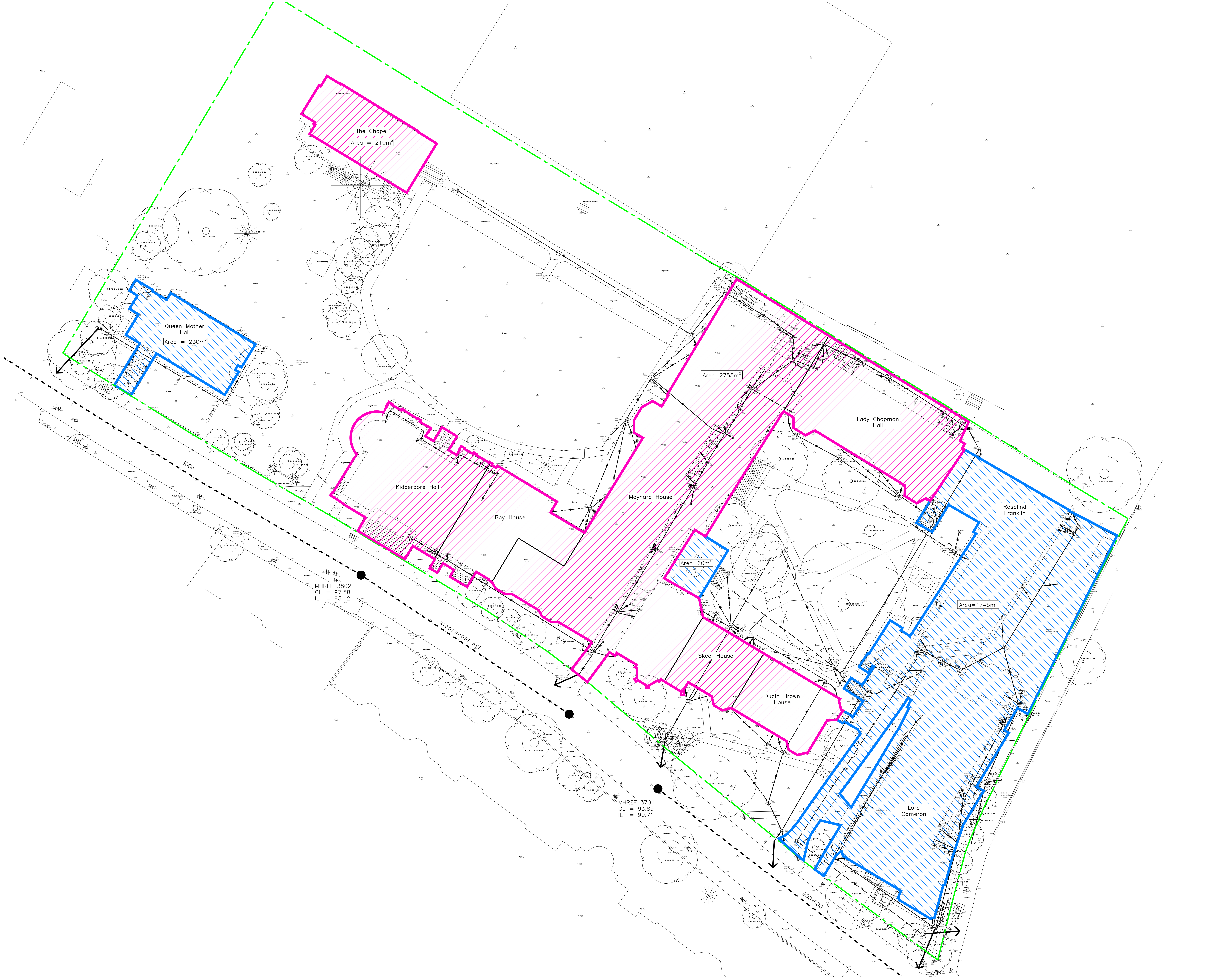
Date: **June 2015**

For and on Behalf of Tully De’Ath Consultants Ltd

Appendix A - Site Location Plan


NW3 7ST
London NW3 7ST
Site Location
Hendon Way
A41
Finchley Rd
A598
A502
B511
W Heath Rd
West Heath
Hampstead Pergola
E Heath Rd
Cricklewood Ln
Cricklewood
Cricklewood Broadway
Mail Cricklewood Delivery Office
B&Q
Virgin Active Cricklewood
Brondesbury Cricket Tennis & Squash Club
University College School Sports Ground
Hampstead School
Hampstead Cemetery
Fortune Green
The Hampstead School Of English - London
Craxton Studios
Esso
Candle Court
ESCP Europe Business School
Kidderpore Ave
Kidderpore Gardens
Ferncroft Ave
Hollycroft Ave
Rosecroft Ave
Platt's Ln
Briardale Gardens
Pattison Rd
Hermitage Ln
W Heath Cl
Redington Rd
Templewood Ave
Heysham Ln
Spedan Cl
Oak Hill Way
Oak Hill Park
Fenton House
Tinseltown
New End
Burgh House & Hampstead Museum
The Holly Bush
Gilden's Art Gallery
Hampstead
Everyman Cinema
Hampstead Parish Church
Church Row
Frognal
Frognal Way
Frognal Ln
Heath Dr
Oakhill Ave
Greenaway Gardens
Chesterford Gardens
Bracknell Gardens
Lyncroft Gardens
Cannon Hill
West End Ln
Ingham Rd
Weech Rd
Burrard Rd
Parsifal Rd
Fortune Green Rd
Ajax Rd
Achilles Rd
Ulysses Rd
Agamemnon Rd
Menelik Rd
Somali Rd
Asmara Rd
Westbere Rd
Westbere Copse
Horton Ave
Westcroft Way
Hocroft Ave
Hocroft Rd
Ranulf Rd
Ardwick Rd
Lyndale Ave
Church Walk
Ridge Rd
Garth Rd
Cloister Rd
Caddington Rd
Somerton Rd
Gillingham Rd
Dersingham Rd
Greenfield Gardens
Chiltern Gardens
Claremont Rd
Sandifer Dr
Elm Grove
Oak Grove
Yew Grove
Ash Grove
Richborough Rd
Ebbsfleet Rd
Skardu Rd
Rondu Rd
Fordwych Rd
Mansfield Rd
Keyes Rd
Anson Rd
Sheldon Rd
Hillfield Rd
Gondar Gardens
Sarre Rd
Minster Rd
Aldred Rd
Holly Walk
Holly Hill
Hampstead Grove
Lower Terrace
Branch Hill
Holford Rd
Cannon Pl
Flask Walk
Back Ln
Gayton Rd
Vale of Health
Ellerdale Rd
Langland Gardens
Lindfield Gardens

Appendix B – Existing Site Layout and Drainage



General Notes:

1. Any indication of site boundaries is to be considered diagrammatic. This Engineering Layout is based upon layouts prepared by others and our details are not in themselves intended to be any definition of land ownership.
2. The underlying survey information has been provided by Murphy Surveys (July. 2014), Tully De'Ath cannot be held responsible for any inaccuracies therein.
3. Only impermeable areas draining to the sewer network are shown. Impermeable areas draining to landscaping are not shown.

LEGEND

Impermeable Area to be retained within proposed development. = 2965m²	pink hatched box
Impermeable Area to be removed/reconstructed within proposed development. = 2035m²	blue hatched box
Total Impermeable Area = 5000m²	
Existing Combined Sewer	solid line
Existing Storm Sewer	dashed line
Existing Foul Sewer	dash-dot line
Existing Outfall (exact routes to be confirmed)	arrow
Existing Adopted Combined Sewer	dash-dot line with black dot
Site Boundary	green dash-dot line

REV	DATE	DESCRIPTION	BY	CHK'D
A	26.06.15	Key amended. Hatching of chapel amended. Figures for areas amended.	SFK	

MOUNTANVIL

TITLE:
Existing Site Layout Drainage & Impermeable Areas

PROJECT:
Kidderpore Avenue, NW3

SCALE: 1:200@A0 DATE: June 2015 DRAWN: JSR CHK'D: SFK

JOB NO.	DRG NO.	REV.
11316–CIV–100		A

Tully De'Ath consultants
Engineering at its Best
T: 01342 828 000
E: info@tullydeath.com
W: www.tullydeath.com

Appendix C – Thames Water Sewer Records

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
2901	89.17	n/a ← SURVEY SAYS 86.98m
3802	97.58	93.12
4902	100.08	95.55
491A	n/a	n/a
49AE	0	0
0801	88.37	81.2
0901	n/a	n/a
1803	88.57	n/a
191A	n/a	n/a
1901	87.13	78.33
1802	85.86	77.59
1801	n/a	n/a
25DA	n/a	n/a
2701	83.08	76.14
26CG	n/a	n/a
26CH	n/a	n/a
26CI	n/a	n/a
26CJ	n/a	n/a
2602	80.34	n/a
2606	80.34	n/a
25FA	n/a	n/a
35BE	n/a	n/a
35CF	n/a	n/a
3603	n/a	n/a
35BH	n/a	n/a
35AJ	n/a	n/a
35BI	n/a	n/a
35BA	n/a	n/a
35CG	n/a	n/a
3601	80.54	75.79
35DE	n/a	n/a
35AI	n/a	n/a
35DA	n/a	n/a
35CH	n/a	n/a
35CB	n/a	n/a
35BF	n/a	n/a
35BG	n/a	n/a
3501	76.74	73.19
35CC	n/a	n/a
45AG	n/a	n/a
44BD	n/a	n/a
451A	n/a	n/a
45AH	n/a	n/a
45BD	n/a	n/a
35CE	n/a	n/a
35CD	n/a	n/a
3502	77.59	75.9
35BD	n/a	n/a
35BC	n/a	n/a
35BB	n/a	n/a
3604	n/a	n/a
3602	83.88	82.09
4701	84.53	81.17
4703	87.94	85.04
3701	93.89	90.71
481B	n/a	n/a
481A	n/a	n/a
0501	75.42	74.43
0502	77.06	75.53
1503	78.29	71.46
16BG	n/a	n/a
16BF	n/a	n/a
16BE	n/a	n/a
16BH	n/a	n/a
171A	n/a	n/a
1601	n/a	n/a
1602	80.52	77.66
18CI	n/a	n/a
17AF	n/a	n/a
17AG	n/a	n/a
17AH	n/a	n/a
17AI	n/a	n/a
2503	79.14	75.01
2603	81.67	76.7
2501	78.53	74.75
0902	86.08	n/a
0802	89.08	82.08

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.

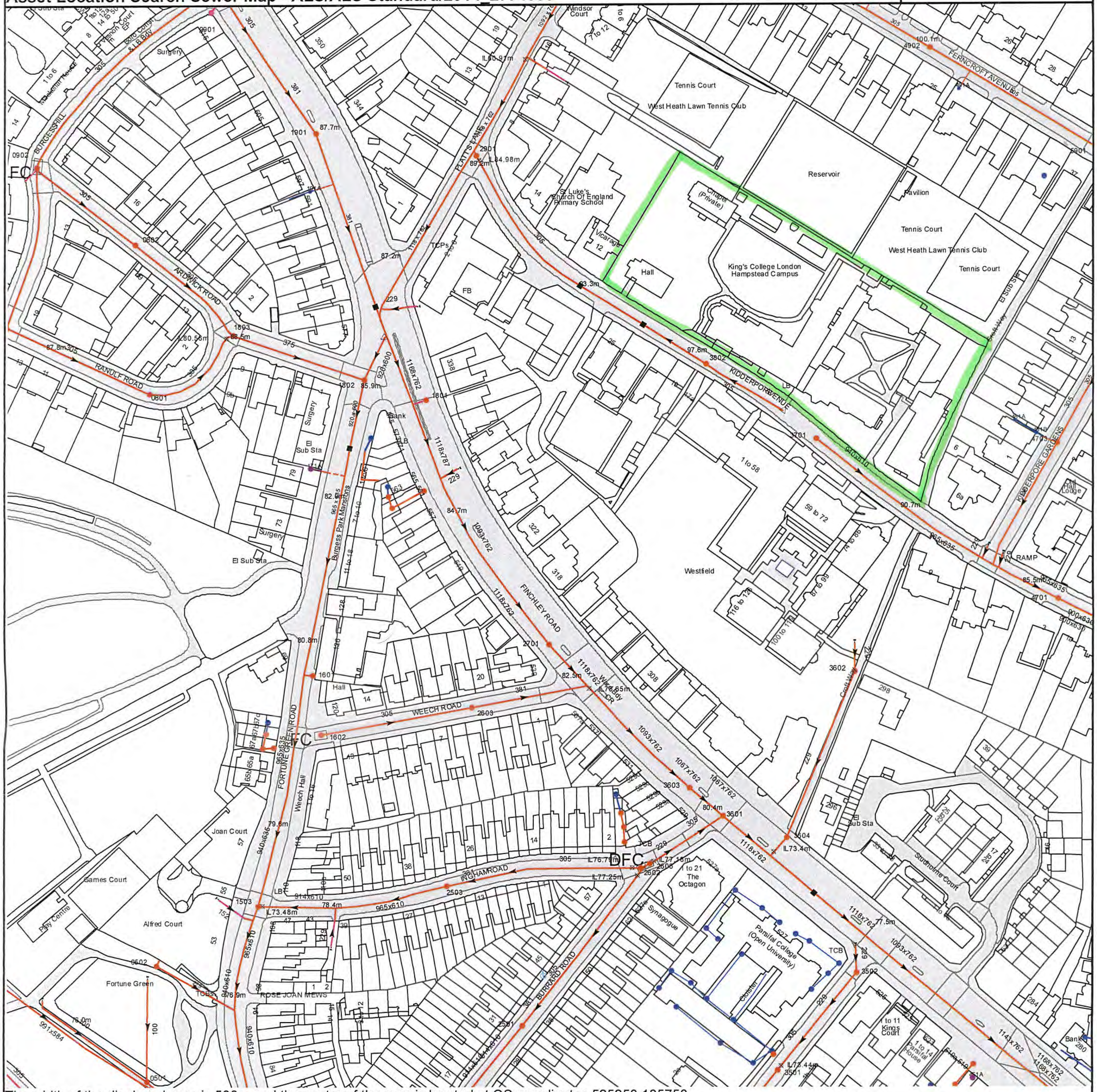
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

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 Sewer Map - ALS/ALS Standard/2014_2774333	TQ2585NW



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 525250,185750

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Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

Appendix D – Proposed Site Layout and Drainage Strategy