HAMPTON MEWS

DRAINAGE STATEMENT

February 2016

HAMPTON MEWS
FORMER HAMPTON TRAFFIC UNIT
STATION ROAD
HAMPTON
THE LONDON BOROUGH OF RICHMOND UPON THAMES
TW12 2AX

FOUL & SURFACE WATER DRAINAGE PRE-PLANNING ASSESSMENT & FLOOD RISK STATEMENT

UK PACIFIC HAMPTON STATION LLP

FEBRUARY 2016

DOCUMENT CONTROL RECORD

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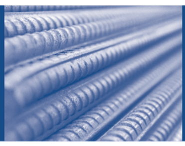
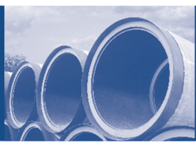

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REFERENCES

Environment Agency Flood Map Information © and database right www.environment_agency.gov.uk

Technical Guidance to the National Planning Policy Framework - NPPF (2012)
Department for Communities and Local Government ISBN: 978-1-4098-3410-6

The London Plan - Spatial Development Strategy for Greater London (2011, as consolidated 2015)

London Borough of Richmond upon Thames – Planning Guidance Document 'Delivering SuDS in Richmond' (February 2015)

London Borough of Richmond upon Thames – Strategic Flood Risk Assessment (SFRA) (August 2010)

British Water - Flows and Loads 4, ISBN 978-1-903481-10-3 (2013)

Homes & Communities Agency – Employment Densities Guide 2nd Edition (Drivers Jonas Deloitte) (2010)

The SuDS Manual CIRIA C753 (DEFRA 2015)

1 Executive Summary

SITE INFORMATION	CLIENT	UK Pacific Hampton Station LLP
	SITE NAME	Hampton Mews
	SITE LOCATION	Former Hampton Police Traffic Unit 60-68 Station Road Hampton London Borough of Richmond upon Thames TW12 2AX
	SITE AREA	0.285 ha (2850m^2)
	CURRENT LAND USE	Sui Generis (Brownfield)
	PROPOSED LAND USE	28No. residential dwellings
	SITE GEOLOGY - Superficial - Bedrock	Alluvium (Taplow Gravel Formation) London Clay Formation
	SOIL INFILTRATION RATE	N/A (Very low rate anticipated due to clay geology)
	GROUNDWATER LEVELS	3.65mBGL
	GROUNDWATER SPZ / AQUIFER	Not within GWSPZ Alluvium classified as a 'Principle Aquifer'
	GROUND CONTAMINATION	Localised hydrocarbon from fuel storage
FLOOD RISK	ENVIRONMENT AGENCY FLOOD ZONE	Flood Zone 1 - Lowest Risk < 0.1% (<1:1000)
	FLUVIAL (RIVERS & WATERCOURSES)	Not a risk
	PLUVIAL (SURFACE WATER)	Not a risk
	GROUNDWATER	Not a risk
	EXISTING/PROPOSED SEWERS & MAINS	Not a risk
	ARTIFICIAL	Not a risk
	TIDAL	Not a risk
FOUL & SURFACE	SURFACE WATER STRATEGY	Utilise existing site connection to surface or combined (TBC) public sewer
	PROPOSED SuDS TYPE	Green Roofs Rain Garden Planter Boxes Cellular podium deck and tank storage
	EXISTING SW PEAK FLOW RATE PROPOSED SW PEAK FLOW RATE	*1:1*-16.4 l/s *1:2*-20.5 l/s *1:30*-49.0 l/s *1:100*-72.6l/s *1:1*-3.8 l/s *1:2*-5.0 l/s *1:30*-14.0 l/s *1:100*-20.0l/s
	FOUL WATER STRATEGY	Pumped to Thames Water foul network
	EXISTING FW PEAK FLOW RATE PROPOSED FW PEAK FLOW RATE	0.31 l/s (TBC) pumped flow
MISC	FURTHER INVESTIGATIONS	Thames Water capacity check

2 Introduction

2.1 Scope

UK Pacific Hampton Station LLP is promoting a redevelopment site at the former Hampton Traffic Unit in the London Borough of Richmond upon Thames.
Development proposals for the site comprises of new construction including the refurbishment of an existing building and construction of new homes to achieve 28 residential dwellings.

2.2 MJA Consulting has been appointed to undertake an assessment of the site to identify any constraints in relation to the disposal of foul and surface water runoff from the proposed redevelopment and to appraise the proposed solutions incorporating the principles of sustainable drainage systems. This also includes an assessment of the level of flood risk to the site both pre and post development.

2.3 Policy Background

In accordance with the National Planning Policy Framework (NPPF) and the Flood Risk and Coastal Planning Practice Guidance (PPG), a full Flood Risk Assessment (FRA) is not required for planning as this development is situated wholly within Flood Zone 1, is less than 1ha in size and with reference to the Strategic Flood Risk Assessment (SFRA) carried out by the London Borough of Richmond upon Thames (2010), is not at risk from all potential sources of flooding.

2.4 Environment Agency guidance and government legislation such as the Flood and Water Management Act (Defra 2010) requires developers to demonstrate that the peak rate, volume and quality of all surface water runoff from a development is suitably managed and that the proposed surface water drainage strategy is accordance with the ideals of 'sustainable development' via the provision of Sustainable Drainage Systems (SuDS).
This is to ensure that the peak rate of surface water runoff from a development is no more than that currently coming off the existing site and to mitigate the effects of pollution on the receiving waterbodies for the lifetime of the development.

2.5 The London Plan (2015) - *Policy 5.13* '*Sustainable drainage*' and the
London Borough of Richmond Upon Thames - *Policy DM SD 7* '*Local Development Framework – Development Management Plan' (2011)* include specific guidance and regulation for incorporating SuDS into developments within the London Borough of Richmond.

2.6 Report Structure

This report will access the feasibility of utilising range of SuDS principles, outlining a suitable foul and surface water drainage strategy that will satisfy the local planning authority that robust and sustainable drainage solutions can be incorporated into the development along with details for the long term management and maintenance of all SuDS to be utilised, in accordance with the applicable SuDS polices.

2.7 This report will also demonstrate that this site is suitable for development with regards to 'Flood Risk' in accordance with the National Planning Policy Framework and Policy DM SD 6 of the London Borough of Richmond Upon Thames *Local Development Framework – Development Management Plan' (2011).*

3 The Site

3.1 Site Location and Description

The site is located at the former police traffic unit at No.60-68 Station Road in Hampton, within the London Borough of Richmond upon Thames.

3.2 The 2850m² (0.285ha) site comprises an L-shaped building around the western and northern boundaries, with a large car park forming the central part of the site.
The site is centred on National Grid Reference TQ 13766 69710.

Figure 1: Regional site location

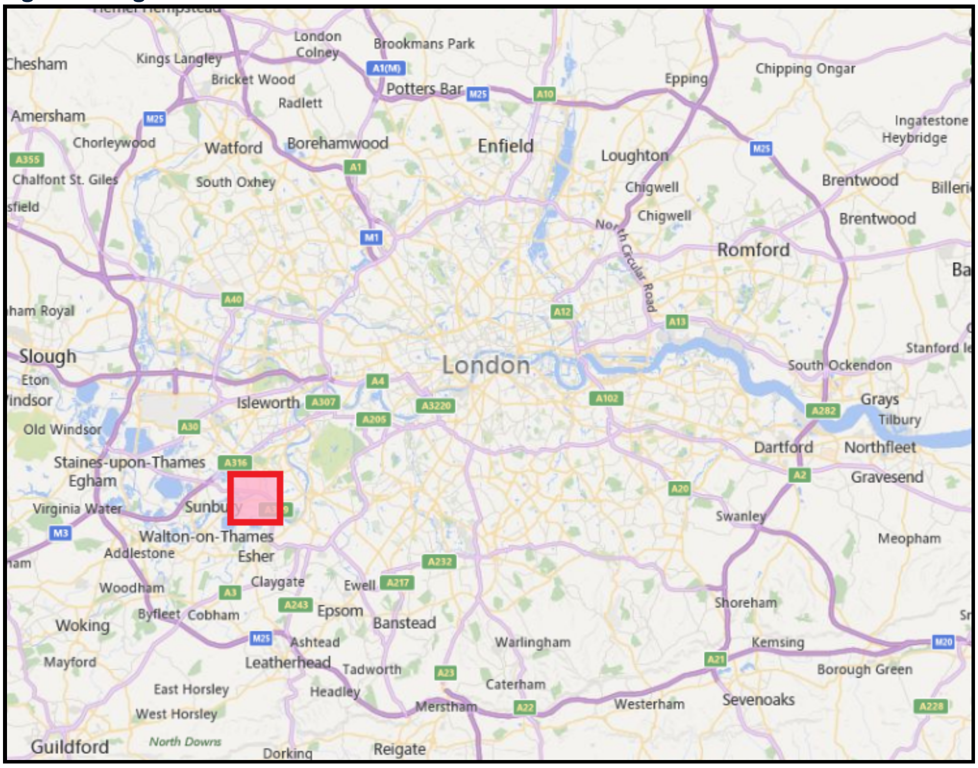


Image courtesy of @2016 HERE, @ 2016 Microsoft

Figure 2: Local site location

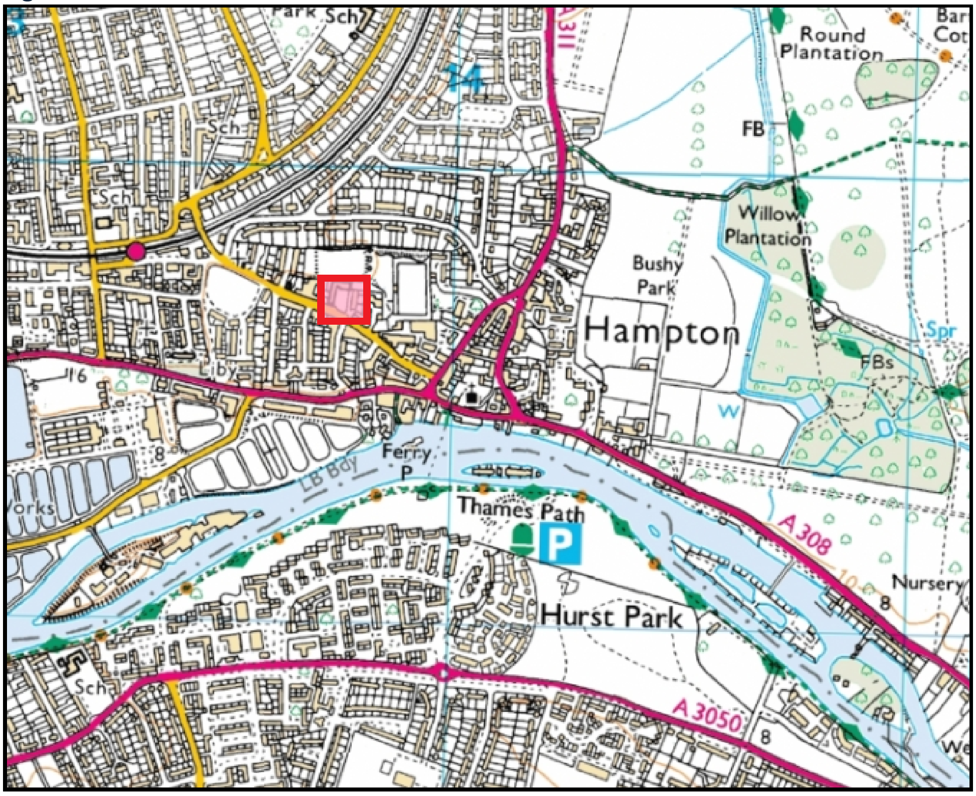


Image courtesy of Ordnance Survey, @2016 HERE, @ 2016 Microsoft

Figure 3: Development site boundary

Image courtesy of: Imagery @ 2016 Digital Globe, Getmapping plc, Infoterra Ltd & Bluesky, Map data @2016 Google

3.4 Topography

The site is generally flat, at a level of circa 13.0mAOD (metres above Ordnance Datum).

3.5 Geology

Information published by the British Geological Society (BGS) indicates the underlying site geology as:
Superficial: Taplow Gravel Formation (Alluvium Sand and Gravel)
Bedrock: London Clay Formation (Clay and Silt)

An intrusive site investigation was carried by LCM Environmental Ltd in October 2014 (LCM ref: 1374-14).
The results of the borehole investigations to a maximums depth of 5mBGL, generally concur with the anticipated published information and detail the general site geology as:

Made Ground (0.0-1.0mBGL)
Soft Clay / Sandy Gravel (1.0-2.0mBGL)
Sandy Clay (2.0-3.0mBGL)
Sand (3.0-4.0mBGL)
Wet Sandy Gravely Clay (4.0-5.0mBGL)

3.6 Ground Contamination

The site investigation report has identified one localised area of ground contamination associated with the existing underground fuel storage tanks located to the north of the site.

3.7 Hydrogeology

The Environment Agency has classified the site as not located within a 'Groundwater Source Protection Zone' for groundwater abstractions.

3.8 Under the Environment Agency's classification system, the bedrock (London Clay) is classified as 'Unproductive Strata'. These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

3.9 The superficial soils (Alluvium - Taplow Gravel Formation) are classified as a 'Principle Aquifer'.
These are layers of drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage.
They may support water supply and/or river base flow on a strategic scale.

3.10 Soil Permeability

Infiltration testing was not carried out during the site investigations.
With reference to the intrusive borehole investigations, the underlying geology at the site is Alluvium overlain London clay.
Although Alluvium can be permeable and suitable for infiltration, the level of clay content within these soils can significantly reduce permeability and may not be suitable for SuDS that rely on full infiltration.
London Clay is highly impermeable and not suitable for infiltration.

3.12 Groundwater

Borehole records held by the BGS indicate that groundwater levels near the site are expected to be encountered at approximately 3-4m below ground level.
During the intrusive site investigation groundwater was encountered at 3.65mBGL.

3.13 As the development is to include basement levels, further groundwater monitoring is required to inform the detailed design of the proposed SuDS system and to ascertain if remedial works are required to remove groundwater and whether special construction and waterproofing methods are required.

3.13 Existing site drainage characteristics

The existing brownfield site is fully developed and 100% impermeable.
It is believed that the site is served by either separate foul and surface water drainage networks or a combined system.
Surface water runoff from roofs and concrete hardstanding areas is collected and discharged un-attenuated together with the foul flows from the site into the Thames Water public sewerage network located within Station Road beyond the southern boundary of the site.
Runoff from the hardstanding parking areas passes through a petrol interceptor tank located to the south of the site.
A drainage survey is to be carried out to ascertain the exact foul and surface water systems serving the existing site and the connections to the public sewerage network.

3.14 Wider Catchment Information

There are no ‘ordinary’ watercourses located within the vicinity of the site.
The nearest ‘main river’ to the development is the River Thames located approximately 250m south the site.
The Longford River is located 850m east of the site. This is an artificial waterway that has an outlet to the Thames.

4 Flood Risk Statement

4.1 The main source of data for flood risk and recorded incidents of flooding for this site has been the London Borough of Richmond upon Thames - Strategic Flood Risk Assessment (SFRA) (August 2010).
Additional information has been obtained from The Environment Agency (historic flood extents maps), British Society Chronology of Extreme Hydrological Events and local news and media outlets.

4.2 Within the SFRA, consultation was carried out with all appropriate authorities and organisations including the Environment Agency, Thames Water, Richmond Borough Council and local community stakeholders to identify known and/or perceived problem areas with respect to flooding.

4.3 The information presented within the SFRA study report and from all other applicable resources has concluded that there is no historical, current or perceived future risk of flooding from potential all sources including:

- Tidal
- Groundwater
- Fluvial (rivers and watercourses)
- Pluvial (overland surface water)
- Existing foul and storm sewers or potable water main infrastructure
- Artificial infrastructure including reservoirs, water works and sewerage works

4.4 Nevertheless, the redevelopment of this site must not create or exacerbate existing flood risk elsewhere and in particular to properties and highways located downstream of the site. During the design of the proposed development careful consideration has been given to the most sustainable method of surface water disposal and strict controls have been imposed to limit the peak rate and volume of surface water runoff generated from the redeveloped site.

4.5 All surface water runoff from impermeable areas on the proposed development will be attenuated and safely disposed at a controlled rate to mimic the existing runoff regime for the existing brownfield site.
This will ensure that the risk of flooding to properties and land downstream of the site will not increase as a result of this redevelopment.

4.6 Thames Water will be consulted to ensure there is adequate capacity within the existing local foul and storm sewer system and to determine suitable points of connection to the network.
If required, sewer upgrading works will be carried out to the existing network to enable the proposed connection.
This will ensure that the proposed development has a ‘no detriment’ impact on the foul sewer system within Hampton and does not create a flood risk.

4.7 Tidal

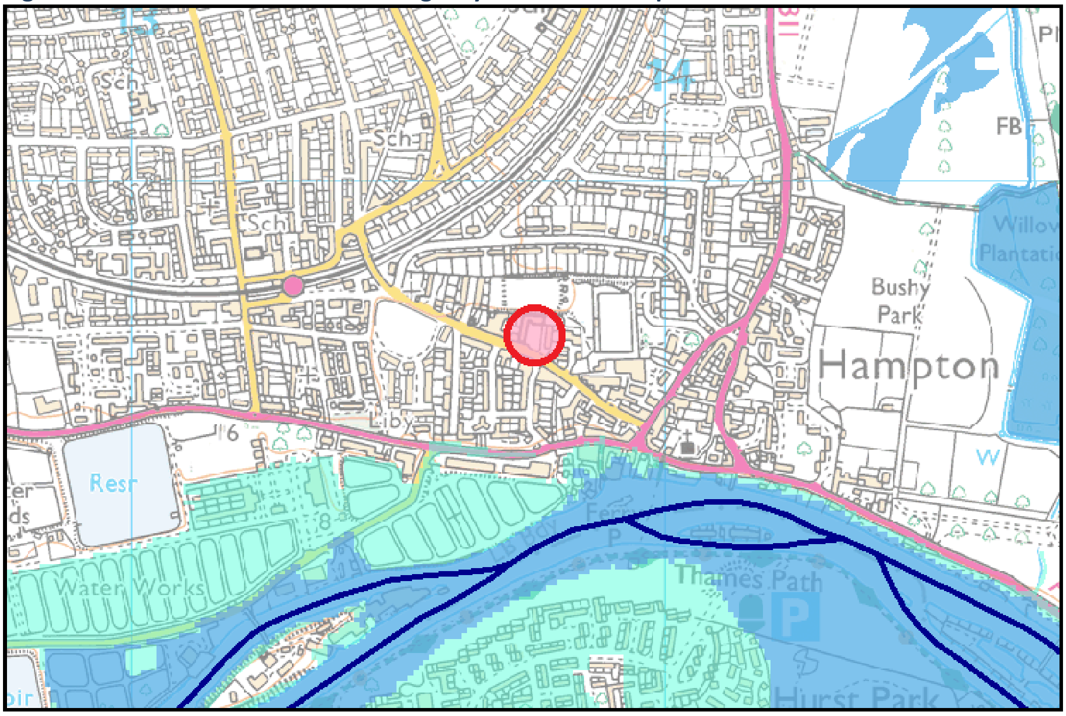
The site does not encounter a risk from tidal flooding as confirmed by the SFRA study.
The Environment Agency's indicative Flood Map shows the site to be located entirely within the lowest risk category - Flood Zone 1.
This is land assessed as having a less than 1 in 1000 (<0.1%) annual probability of flooding from a tidal surge along the River Thames in any year.

4.8 Fluvial

The Environment Agency is the principal flood risk management operating authority in England.
The EA have carried out a national flood risk assessment (NaFRA) which assesses the probability of flooding to land from all main rivers in England.
The results of this model are combined with data from actual historical flood events to produce the Environment Agency's 'Flood Zone Map' (Figure 4).

4.9 Flood Zone Map

Figure 4: Extract from Environment Agency Flood Zone Map



Main Rivers

Dark Blue : (Flood Zone 3)
Shows the area that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded: from the sea by a flood that has a 0.5 per cent (1 in 200) or greater chance of happening each year, or from a river by a flood that has a 1 per cent (1 in 100) or greater chance of happening each year.

Light Blue : (Flood Zone 2)
Shows the additional extent of an extreme flood from rivers or the sea.
These outlying areas are likely to be affected by a major flood, with up to a 0.1 per cent (1 in 1000) chance of occurring each year.
These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements.

Clear : (Flood Zone 1)
Shows the area where flooding from rivers and the sea is very unlikely.
There is less than a 0.1 per cent (1 in 1000) chance of flooding occurring each year.

4.10 As confirmed by the latest Environment Agency 'Flood Zone Map', the whole site is located within the lowest risk category - Flood Zone 1, and lies over 200m from the Flood Zone 2 & 3 floodplain of the River Thames.
'Flood Zone 1' is land assessed as having a less than 1 in 1000 (<0.1%AEP) annual probability of flooding from a main river in each year and is not within an area of recorded river flooding.

4.11 The London Borough of Richmond upon Thames - Strategic Flood Risk Assessment (August 2010) makes an assessment of the likely increase in river flows due to the effects of climate change, and the impact this has on the extent of the established flood zones.
This confirms that with a predicted increase of 20% in river flows up to 2115, the site would still be safely located within Flood Zone 1 for the lifetime of the development.

4.12 The London Borough of Richmond as the 'Lead Local Flood Authority (LLFA) are responsible for assessing the flood risk from all other 'ordinary watercourses' in Hampton.
The SFRA has confirmed that there are no historic incidents of flooding from all ordinary watercourses within the vicinity of the site.

4.13 Sequential Testing

The flood risk technical Guidance to the National Planning Policy Framework Table 2: Flood Risk Vulnerability classification, classifies residential developments as 'More Vulnerable'.
Table 2 & 3 would indicate that 'more vulnerable' developments located within Flood Zone 1 are considered appropriate under the National Planning Policy Framework.

NPPF Table 3: Flood Risk Vulnerability and Flood Zone 'compatibility'

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	×	×	×

Key: ✓ Development is appropriate.
× Development should not be permitted.

4.14 The National Planning Policy Framework Guidance states that Planning Authorities should complete a risk based 'Sequential Test' at all stages of the planning process, to steer new development to areas with the lowest probability of flooding.
Under the requirements of the 'sequential test' and as the proposed development is already located within flood zone 1 (lowest risk), there are no more suitable, developable and deliverable alternative sites, better located from a flood risk perspective, which would accommodate the proposed development.

4.15 Surface Water

With reference to the Richmond SFRA report, no instances of surface water (pluvial) flooding have been recorded at the proposed development site.

4.16 The Environment Agency's 'Risk of Flooding from Surface Water Map' is a theoretical assessment of potential overland flow paths, ground levels and drainage systems within the area using information from Lead Local Flood Authorities where available.

4.17 Surface Water Flood Zone Map

Figure 5: Extract from Environment Agency Surface Water Flood Map

Contains Environment Agency information © Environment Agency 2016

Key:

- High (Greater than 1:30(3.3%) chance of flooding)
- Medium (Between 1:100(1%) and 1:30(3.3%) chance of flooding)
- Low (Between 1:1000 (0.1%) and 1:100 (1%) chance of flooding)
- Very Low (Less than 1:1000 (0.1%) chance of flooding)

4.18 This map indicates that the whole of the existing site has a 'very low' (less than a 1:1000 or 0.1%) risk of flooding from surface water runoff.
There are areas outside of the site boundary along Station Road identified as having a 'Low' (0.1%-1%) to 'Medium' (1%-3.3%) risk of flooding from surface water runoff.

4.19 This risk of surface water flooding will be mitigated by the development of this site.
The implementation of a robust SuDS scheme and positive drainage systems will capture runoff from impermeable areas, with consideration of overland 'flood flow routes' to safely direct and contain runoff to low risk areas of the site during an extreme rainfall event.

4.20 This runoff will be then be discharged from the site at a restricted rate equivalent to the existing brownfield runoff rate.
This will protect new properties on the proposed development and provide a level of betterment over current conditions by preventing the current risk of uncontrolled surface water running off the site, protecting offsite third parties and land.

4.21 Any residual risk of surface water flooding can be mitigated by the provision of raised proposed property slab levels a minimum of 150mm above surrounding ground level.

4.22 Artificial Infrastructure

With reference to the Richmond SFRA there have been no recorded incidents of flooding from artificial sources within the vicinity of the site.

4.23 A number of key water supply reservoirs are situated within the Borough of Richmond. These reservoirs are stringently managed and monitored by Thames Water and the Environment Agency.
Although the potential risk of failure is considered extremely low, in the event of a failure the Environment Agency has assessed that the development site would be outside of the resultant flood path and therefore do not pose a flood risk to the site.

4.24 Groundwater

With reference to the Richmond SFRA there have been no recorded incidents of flooding from groundwater within the vicinity of the site.

4.25 Borehole records held by the BGS indicate that the groundwater levels near the site have historically been encountered at approximately 3-4m below ground level.
The intrusive site investigations encountered groundwater at 3.65mBGL

4.26 Although the groundwater table is not expected to be encountered at a shallow depth as to cause flooding at the site, areas adjoining the River Thames where deposits of sand and gravel designated as a ‘principle aquifer’ overly impermeable London Clay, localised perched pockets of groundwater may be encountered during excavation.

4.27 As the development is to include basement levels, further groundwater monitoring is required to ascertain if remedial works are required to remove groundwater and whether special construction and waterproofing methods are required to prevent or mitigate the risk of flooding to properties on the redevelopment.

5 Existing and Proposed Site Runoff

5.1 This section aims to calculate the estimated peak runoff rates and volumes of surface water leaving the site, for the pre and post development conditions.
These discharge rates can then be used for the preliminary design of the surface water drainage strategy for the proposed redevelopment.

5.2 Catchment Areas

The existing and proposed permeable and impermeable areas of the site are listed below:

	Permeable Areas	Impermeable Areas	Total Site Area
Existing Site Area	0 m²	2500 m²	2500 m²
Proposed Site Area	575 m²	1925 m²	2500 m²

5.3 This development represents an overall reduction of 575m² in impermeable area post development.

5.4 Existing Surface Water Runoff Peak Runoff Rate & Volume

The existing 2850m² site is 100% impermeable and served by a positive drainage system.
A suitable method for the estimation of peak flow and volume of runoff from impermeable areas is the 'Rational method' Q = 2.78 CIA.

Where:
Q = Peak flow (l/s)
I = Average rainfall intensity (mm/hr), during return period equal to time of concentration (30 mins)
A = Impermeable area drained (ha)
C = Runoff coefficient (1.0 for roofs and hardstanding)

Existing Catchment: 2500m²

1 in 1 year	16.4 l/s
1 in 2 year	20.5 l/s
1 in 30 year	49.0 l/s
1 in 100 year	72.6 l/s
Volume 100y 6hr	207 m³

5.5 Post Development Surface Water Runoff Peak Runoff Rate & Volume (Pre – Mitigation)

The estimated peak runoff rate from the proposed site (pre-mitigation) is based on 100% runoff from impermeable areas and 0% runoff from permeable areas, in accordance with CIRIA C697 The SuDS Manual & Preliminary rainfall runoff management for Developments (EA/DEFRA W5-074/A).

5.6 The National Planning Policy Framework requires that consideration is given to the effect of climate change on the flows generated by any new development.
For piped surface water drainage, an increase in 30% is considered as a likely increase in rainfall intensity due to long term climate change up to 2115.

NPPF Table 5: Recommended national precautionary sensitivity ranges for peak rainfall intensities:

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

Proposed Catchment: 1925m²

1 in 1 year +30%	17.0 l/s
1 in 2 year +30%	21.3 l/s
1 in 30 year +30%	50.9 l/s
1 in 100 year +30%	75.3 l/s
Volume 100y 6hr	216 m³

5.7 It can be seen that as a result of this redevelopment and the proposed reduction in total impermeable areas post development, the peak rate at which surface water could potentially runoff the site un-attenuated would be comparable to the current state during all rainfall events up to the 1:100y +30% storm.

5.8 Proposed Development Surface Water Runoff Peak Runoff Rate & Volume (Post – Mitigation)

The procedure for surface water management in accordance within the DEFRA/EA Report 'Rainfall runoff management for developments' (SC030219 E, 2013) states:
"For the range of annual flow rate probabilities up to and including the one per cent annual exceedance probability (1:100 year) event, including an appropriate allowance for climate change (+30% residential developments), the post-developed rate of run-off into a watercourse, sewer, or other receiving water body, should be no greater than the existing rate of run-off for the same event".

5.9 The London Borough of Richmond upon Thames - Strategic Flood Risk Assessment has also identified that reducing the rate of discharge from development sites to pre-developed runoff rates is one of the most effective ways of reducing and managing flood risk within the borough.

5.10 In addition, the aim of all development should be to contribute a tangible reduction in the peak rate of surface water run-off and to manage the additional volume of runoff generated by the development.

5.11 To achieve this reduction and to mitigate the additional volume of water generated from the site, the peak rate of surface water runoff from the redeveloped site will be restricted to a maximum of the existing 1 in 2 year peak runoff rate – 20 l/s, for all storms up to the 1:100year+30% event, providing a substantial level of betterment over existing runoff conditions.

Table of existing and proposed peak runoff from the site

RAINFALL EVENT	EXISTING PEAK RUNOFF	PROPOSED PEAK RUNOFF	REDUCTION IN PEAK RUNOFF POST DEVELOPMENT
1 in 1 year	16.4 l/s	3.8 l/s	- 77 %
1 in 2 year	20.5 l/s	5.0 l/s	- 76 %
1 in 30 year	49.0 l/s	14.0 l/s	- 71 %
1 in 100 year	72.6 l/s	20.0 l/s	- 72 %

6 Surface Water Drainage Strategy

6.1 The National Planning Policy Framework (NPPF) and the *Flood Risk and Coastal Planning Practise Guidance (PPG)* requires that new developments do not exacerbate flood risks both to the development site and to offsite parties and land, which means there is a need to control surface water drainage and overland runoff to ensure there are no increases in peak rates and volumes of runoff as a result of the development.

6.2 Environment Agency guidance and government legislation such as the Flood and Water Management Act (Defra 2010) requires surface water drainage strategies for new developments to be in accordance with the ideals of 'sustainable development' via the provision of Sustainable Drainage Systems (SuDS).

6.3 SuDS are more sustainable than conventional drainage methods because they can mitigate many of the adverse effects of urban stormwater runoff on the environment.
This can be achieved through reducing runoff rates and volumes to sewer networks and watercourses, reducing the risk of downstream flooding.
Where appropriate SuDS can reduce pollutant concentrations in stormwater, protecting the quality of the receiving water body in line with Environment Agency pollution prevention guidance GP3, NPPF, CIRIA C753 and DEFRA guidance.

6.4 Following a review of the underlying geology, potential soil permeability and groundwater levels, it has been considered that infiltration as a method to dispose of the surface water runoff generated from the proposed development will not be feasible.

6.5 Due to the anticipated construction depths of the basement level and subsequent depth of any infiltration device (approx. 4-5mBGL), the presence of the groundwater table (encountered at 3.65mBGL during the site investigations) will prevent the use of soakaways.
Also due to the concentrated nature of this urban redevelopment, it would be unlikely that any infiltration devices could be located more that 5m away from building foundations as dictated by the Building Regulations Part H.

6.6 There are no watercourses within the vicinity of the site to suitably dispose of the surface water runoff generated from this development.

6.7 Therefore it is proposed that all surface water runoff from impermeable areas at the redevelopment utilises the existing site surface water connection into the public Thames Water sewer located to the south of the site within Station Road.
Further investigations are required to ascertain the existing site surface water connection and whether this currently discharges into the surface water or the foul/combined sewer within Station Road. Thames Water is to be consulted with to confirm the existing connection and preference on the future connection point from the redevelopment.

6.8 The peak rate of surface water runoff from the redeveloped site will be strictly controlled via the use of Sustainable Drainage Systems (SuDS).
The SuDS selection process for this site has involved the evaluation of a range of information to enable feasibility of each technique to be assessed.
From this information a suitable drainage strategy incorporating the use of SuDS has been developed.

6.9 SuDS Components and Site Compatibility

Table1: SuDS Compatibility matrix

SuDS Type	Description	Suitable for this site	Comments
Green Roofs	Green roofs comprise a multi-layered system that covers the roof of a building with vegetation cover over a drainage layer. They are designed to intercept and retain rainfall, reducing the volume of runoff and attenuating peak flows.	✓	Living Roofs could be incorporated into this development where technically feasible subject to factors such as loadings, roof pitch, visual impact and maintenance burden.
Rainwater Harvesting	Re-using rainwater for non-potable purposes such as irrigation and toilet flushing.	✓	Rainwater harvesting techniques can be utilised for non-potable (greywater) re-use subject to factors such as spatial constraints, whole-life costs and maintenance burden. The watering of landscaped areas by connecting RWP's to planters can easily be achieved at this site to reduce potable water demand at the development.
Soakaways	Soakaways provide stormwater attenuation, stormwater treatment and groundwater recharge.	✗	Soil permeability testing to BRE365 and groundwater monitoring to confirm. Required depth of construction (3-5mBGL due to basement level) will likely preclude the effective use of infiltration techniques due to impermeable geology (London Clay) and groundwater table at this level. The 5m offset rule (Building Regs) would also be difficult to achieve at this development.
Filter Strip / Trenches / Swales	Filter strips are linear grassed or vegetated strips of land / channels designed to accept runoff as overland sheet flow from impermeable surfaces usually located adjacent road or parking areas and used to treat infiltrated or convey runoff.	✗	Impermeable soils present at the site will prevent infiltration. No green open space to incorporate on this development.
Permeable Paving	Pervious pavements provide a pavement suitable for pedestrian and vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored before infiltration to the ground, reuse, or discharge to a watercourse or other drainage system.	✓ non-infiltrating	Permeable surfaced pavements with a tanked (non-infiltration) sub-base connected to a positive drainage system would be suitable for this development.
Bio Retention	Bioretention areas are shallow landscaped depressions which are typically under-drained and rely on engineered soils and enhanced vegetation and filtration to remove pollution and reduce runoff downstream. They are aimed at managing and treating runoff from frequent rainfall events.	✗	Impermeable soils present at the site will prevent infiltration. No green open space to incorporate on this development.
Ponds / Basins	Ponds can be used to store and treat water. 'Wet' ponds have a constant body of water and run-off is additional, while 'dry' ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration into the ground or to store water for a period of time before discharge.	✗	Impermeable soils present at the site will prevent infiltration. No green open space to incorporate on this development.
Underground Storage	Underground Concrete or Geocellular Tanks to reduce and attenuate peak flows	✓	The use of underground storage to attenuate runoff would be suitable at this development.

6.10 For new developments within the London Borough of Richmond upon Thames, evidence is to be provided that demonstrates the drainage and flood risk policies as set out within the *London Plan - Policy 5.13, 5.14 & 5.15* (2015) and the councils *Local Development Framework – Development Management Plan - Policy DM SD 7* (2011) have been adhered to in the design of the proposed site drainage.

6.11 These policies identify the requirement of sustainable drainage solutions to manage the peak rate and volume of surface water from a development, in line with the following drainage hierarchy:

1. Store rainwater for later use
Where technically feasible green roofs could be utilised at this development.
Water butts could also be provided on RWP's where practicable (rear gardens) to collect rainwater for later use. Rain garden planter boxes can be connected to RWP's to attenuate and treat runoff, allowing transpiration and evaporation.
These methods not only reduce potable water use, but also prevent a portion of rainfall (the first 5mm or 50% of all rainfall events) leaving the site.

2. Use infiltration techniques, such as porous surfaces in non-clay areas.
Following an analysis of the geology, potential soil permeability and groundwater levels at the site, infiltration as a method of surface water disposal will not be feasible.

3. Attenuate rainwater in ponds or open water features for gradual release.
Site is too small /urban to consider open water features.
Although a water feature is proposed for the courtyard areas it could not be considered as offering any significant level of storage for outline design purposes.
During detailed design of this feature is may be possible to design in a small amount of attenuation (freeboard between permanent water level and pavement level).

4. Attenuate rainwater by storing in tanks or sealed features for gradual release.
Surface water runoff from the development can be temporally stored in sealed tanks, slowly releasing the runoff via a flow control device into a receiving sewer.

5. Discharge rainwater direct to a watercourse.
There are no suitable watercourses within proximity to the development to discharge into.

6. Discharge rainwater to a surface water sewer/drain.
Thames water are to confirm existing site connection and preferred future connection point.
It is proposed that all surface water runoff from the proposed development will utilise the existing connection with the Thames Water public surface water sewer located to the south of the site within Station Road.

7. Discharge rainwater to the combined sewer**.**
If required by Thames Water, a connection to the existing combined sewer will me made /maintained.

6.12 Surface Water strategy

All surface runoff from the redevelopment will be attenuated on site within a podium deck system consisting of a raft of modular cell storage located beneath the ground floor level of the central courtyard area.
This attenuation will be designed to manage the 1 in 100 year return storm (1% chance of occurrence each year) plus an extra allowance of 30% for the potential predicted increase in peak rainfall up to 2115.

6.13 Discharge from the attenuation tank will be controlled via a flow control device located at the downstream point of the system, prior to discharge into the receiving public sewer with Station Road.
Due to the limited head differential generated within the upstream storage an orifice plate would be the most suitable type of flow control.

6.14 Runoff from the site will be discharged at a maximum of the existing 1 in 2 year peak runoff rate – 20 l/s, for all storms up to the 1:100year+30% event.

Table of existing and proposed peak runoff from the site

RAINFALL EVENT	EXISTING PEAK RUNOFF	PROPOSED PEAK RUNOFF	REDUCTION IN PEAK RUNOFF POST DEVELOPMENT
1 in 1 year	16.4 l/s	**3.8 l/s**	- 77 %
1 in 2 year	20.5 l/s	**5.0 l/s**	- 76 %
1 in 30 year	49.0 l/s	**14.0 l/s**	- 71 %
1 in 100 year	72.6 l/s	**20.0 l/s**	- 72 %

6.15 This will ensure that the peak rate of surface water runoff from the site post development will be no greater than the existing runoff rate for all equivalent rainfall events, providing a significant level of betterment over existing conditions.

6.16 Thames water will be consulted with to ensure that there is adequate capacity within the receiving public sewerage network to serve the development.
This will ensure that the proposed development has a ‘no detriment’ impact on the exiting sewer system within Hampton and does not create a flood risk.

6.17 The proposed surface water drainage strategy offers a sustainable, safe and robust system which will afford complete flood risk protection to residents within the new site and to existing properties and land within the vicinity of the site.

6.18 Proposed SuDS Overview

6.18.1 Podium Deck Storage

Light-weight modular cells 150mm thick (Permavoid by Polypipe or similar approved) are interlocked to create a slender, load-supporting raft wrapped constructed upon an impermeable geomembrane, providing water-tight storage void for the attenuation of storm runoff.
These cells can be used with conventional drainage gullies and channels or beneath permeable paved paving, reducing the need for surface drains.
The slender modular raft is designed to have sufficient hydraulic capacity to facilitate lateral drainage over large areas without the need for constructed falls within the deck.

6.18.2 Orifice Flow Control

Simple SuDS control with an orifice sized to limit peak flow to the required rate.
The orifice can be protected to prevent blockages, are easy to maintain and have no moving parts.

6.18.3 Green Roofs

Green roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover or landscaping.
Green roofs are designed to intercept and retain precipitation, promoting transpiration reducing the volume of runoff and attenuating peak flows before connecting to the main drainage system.
A full assessment of loadings, roof pitch, cost and the increase maintenance burden will need to be carried out to ascertain the feasibility of incorporating green roofs at this development.

6.18.4 Rain Garden Planter Boxes

Planter boxed receive rainwater from buildings via the roof downpipe, where the water drains into the soil and is taken up by the plants and lost back to the air by evapotranspiration.
These rain gardens can be highly effective in absorbing 50% of all rainfall events, filtering the runoff and preventing the first 5mm of rainfall from entering downstream the drainage system.
During heavy rainfall and excess water is diverted into the drainage system.
This type of SuDS also reduces the demand for potable water.

6.19 Pollution mitigation

The use of SuDS within the development must provide effective treatment to the surface water runoff to ensure that water quality within the receiving waterbody is protected for the lifetime of the development, in line the Environment Agency pollution prevention guidance GP3, NPPF, CIRIA C753 and DEFRA guidance.

6.20 All runoff from the development entering the surface water system will be from roofs or pedestrian areas only, therefore the risk of significant pollution within the runoff is minimal. All surface water runoff from trafficked areas including the access ramp and basement level will discharge into the foul system.

6.21 For ‘low risk’ residential developments where the receiving waterbody is considered non sensitive, a minimum of two processes is suitable to treat the surface water runoff to required standards.

6.22 Where suitable, green roofs and rain garden boxes will offer a first stage treatment to runoff through filtration and biological uptake mechanisms.

6.23 The use of a filtration membrane within the upper layer of the permeable pavement will remove silts, pollutants and hydrocarbons from the runoff prior to entering the podium deck attenuation tank.

6.24 The final flow control chamber will contain a catchment sump and removable sediment trap to protect the orifice and prevent any residual silts from entering the receiving sewer network.

6.25 SuDS Management and Maintenance

SuDS incorporated within the site are to be accompanied by a 'Management Plan' to include maintenance schedules for both surface and sub-surface components for the lifetime of the development and ensure that all parties involved in the operation and maintenance of SuDS are fully aware of the system requirements.

6.26 A management company will be given the responsibility of managing all SuDS components including the foul water pumping station and will be entrusted with a robust inspection, de-silting and maintenance programme to ensure the optimum operation of the surface water and foul drainage network is continually maintained.
Refer to Appendix C for the SuDS Management & Maintenance Plan.

7 Foul water drainage strategy

7.1 A detailed drainage survey is to be carried out to confirm the exact foul and surface water systems serving the existing site and to ascertain whether the existing site surface water currently discharges un-attenuated into the public foul sewer within Station Road.

7.2 It is usually the preference of water authorities to separate the foul flows from that of the surface water runoff, if the opportunity is available.
As there is a public surface water sewer within Station Road, Thames Water will be consulted with to confirm the suitability of connecting the site surface water runoff into this sewer and a preference on splitting flows or to maintain as a combined system.

7.3 All foul flows associated with the proposed redevelopment will utilise the existing foul connection with the Thames Water sewer within Station Road.
The internal foul SVP's within each property are to be taken down through to basement level where a foul drainage system will convey flows to a new pumping station.
This pumping station is to be located outside the void of the basement level, as to minimise noise and odour and to provide access to the pump chamber from ground level for inspection, maintenance and emergency tanker access via Station Road.
The existing foul connections from the re-developed building will either be maintained where feasible or connected to the new pump station.

7.4 To ensure that sewage flooding does not occur at or upstream of the pumping station during plant or power failure, additional 24hr storage will be provided.
The pumping station will lift flows via a rising main into a discharge chamber located at the southern boundary of the site, where a new gravity sewer connection will be made to the existing public foul sewer within Station Road.

7.5 The management and maintenance responsibility of the foul water drainage system including the pumping station will be provided by a private management company.

7.6 For the pre / post development peak flow comparison, the design foul flows for the existing and proposed building use have been calculated using the British Water 'Flows and Loads - 4' Code of Practice (2013).

<u>Existing</u>
For *'Sui Generis'* use class a flow rate of 90l/person/day can be used.
Using the Homes & Communities Agency 'Employment Densities Guide' (2nd Edition, 2010), an approximate occupancy figure of 50 people can be established for the existing building (1 person per 12m2 of a total 600m2 gross internal area).

Using the approximate occupancy figure of 50 people and a peaking factor of 6, the peak flow rate from the existing site is calculated at:

(50 people x 90l/p/d x PF6) / 86400 = **0.31 l/s Existing Peak Foul Flow**

<u>Proposed</u>
The predicted peak foul sewer discharge from the re-developed site to the existing foul sewer based on the Sewers for Adoption figure (4000 l/dwelling/day) for 28No.units will be **1.30 l/s Proposed Peak Flow.**

7.7 This redevelopment represents a potential increase of approximately 1.0 l/s in peak foul flow over existing conditions.

7.8 It is possible that a portion of surface water runoff from the basement ramp, basement parking area and potentially from roof areas that cannot be drained to the courtyard podium deck will have to discharge in to the foul drainage system, with an approximate contributing area of 350m² determined as the potential worst case scenario.

Potential proposed additional catchment into foul: 350m²

1 in 1 year +30%	2.8 l/s
1 in 2 year +30%	3.6 l/s
1 in 30 year +30%	8.5 l/s
1 in 100 year +30%	12.6 l/s

7.9 However, as it is likely that the existing site currently drains via a combined system, the attenuation and removal of the majority of surface water runoff from the proposed development will significantly reduce the total combined peak flow entering the existing public foul sewer network.

7.10 Thames Water will be instructed to carry out a 'drainage impact study' to evaluate the available capacity within the local foul network and downstream treatment works to identify the extent of any off site works required to overcome any capacity issue as a result of this development.
This will ensure that the proposed development has a 'no detriment' impact on the foul sewer system within Hampton and does not create a flood risk.

APPENDIX A
CONCEPTUAL FOUL & SURFACE DRAINAGE STRATEGY LAYOUT

REV. No.	DATE	DESCRIPTION	INITIALS

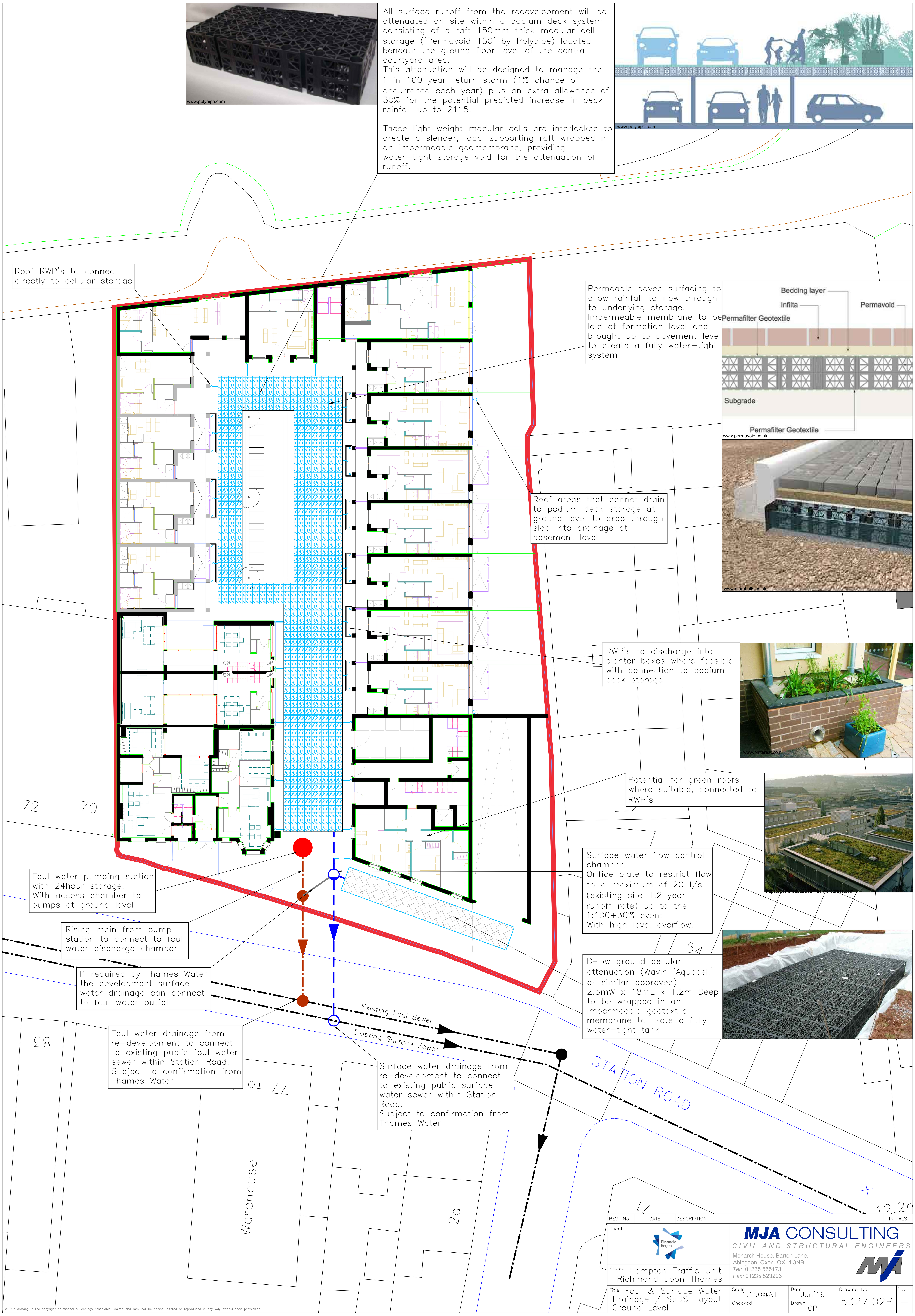
Client: Pinnacle Regen

MJA CONSULTING
CIVIL AND STRUCTURAL ENGINEERS
Monarch House, Barton Lane,
Abingdon, Oxon, OX14 3NB
Tel: 01235 555173
Fax: 01235 523226

Project: Hampton Traffic Unit Richmond upon Thames

Title: Foul & Surface Water Drainage / SuDS Layout Basement Level

Scale	Date	Drawing No.	Rev
1:150@A1	Jan'16	5327:01P	—
Checked	Drawn CP		


www.polypipe.com
All surface runoff from the redevelopment will be attenuated on site within a podium deck system consisting of a raft 150mm thick modular cell storage ('Permavoid 150' by Polypipe) located beneath the ground floor level of the central courtyard area.
This attenuation will be designed to manage the 1 in 100 year return storm (1% chance of occurrence each year) plus an extra allowance of 30% for the potential predicted increase in peak rainfall up to 2115.
These light weight modular cells are interlocked to create a slender, load-supporting raft wrapped in an impermeable geomembrane, providing water-tight storage void for the attenuation of runoff.
www.polypipe.com
Roof RWP's to connect directly to cellular storage
Permeable paved surfacing to allow rainfall to flow through to underlying storage. Impermeable membrane to be laid at formation level and brought up to pavement level to create a fully water-tight system.
Bedding layer
Infilta
Permavoid
Permafilter Geotextile
Subgrade
Permafilter Geotextile
www.permavoid.co.uk
Roof areas that cannot drain to podium deck storage at ground level to drop through slab into drainage at basement level
www.marshalls.co.uk
RWP's to discharge into planter boxes where feasible with connection to podium deck storage
DN
UP
Potential for green roofs where suitable, connected to RWP's
72
70
Surface water flow control chamber.
Orifice plate to restrict flow to a maximum of 20 l/s (existing site 1:2 year runoff rate) up to the 1:100+30% event.
With high level overflow.
Foul water pumping station with 24hour storage.
With access chamber to pumps at ground level
Rising main from pump station to connect to foul water discharge chamber
54
Below ground cellular attenuation (Wavin 'Aquacell' or similar approved) 2.5mW x 18mL x 1.2m Deep to be wrapped in an impermeable geotextile membrane to crate a fully water-tight tank
If required by Thames Water the development surface water drainage can connect to foul water outfall
Existing Foul Sewer
Existing Surface Sewer
83
77 to
Foul water drainage from re-development to connect to existing public foul water sewer within Station Road.
Subject to confirmation from Thames Water
Surface water drainage from re-development to connect to existing public surface water sewer within Station Road.
Subject to confirmation from Thames Water
STATION ROAD
Warehouse
2a
12.2
REV. No. DATE DESCRIPTION INITIALS
Client
Pinnacle Regen
MJA CONSULTING
CIVIL AND STRUCTURAL ENGINEERS
Monarch House, Barton Lane, Abingdon, Oxon, OX14 3NB
Tel: 01235 555173
Fax: 01235 523226
Project Hampton Traffic Unit Richmond upon Thames
Title Foul & Surface Water Drainage / SuDS Layout Ground Level
Scale 1:150@A1
Date Jan'16
Checked
Drawn CP
Drawing No. 5327:02P
Rev –
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APPENDIX B
PRE / POST DEVELOPMENT RUNOFF & ATTENUATION CALCULATIONS

Project HAMPTON TRAFFIC UNIT	Job No.	Date JAN'16	Page No.	Rev.
	Member/Location		Engineer CP	Checked

RATIONAL METHOD : $Q = 2.78 \times C \times I \times A$

Q = PEAK RUNOFF (l/s)
C = COEFFICIENT (1.0)
I = RAINFALL INTENSITY ≈ T.O.C (30 MINS)
A = IMPERMEABLE AREA - PRE = 2850 m²
- POST = 2275 m²

RP	D(MINS)	AVE. I (mm/hr)	+30% CC
1	30	20.7	26.9
2	30	25.9	33.7
30	30	61.9	80.5
100	30	91.7	119.2
100	360	12.1	15.8

PRE-DEVELOPMENT RUNOFF RATE & VOLUME

1 YEAR $Q = 2.78 \times 1 \times 20.7 \times 0.285 = 16.4$ l/s
2 YEAR $Q = 2.78 \times 1 \times 25.9 \times 0.285 = 20.5$ l/s
30 YEAR $Q = 2.78 \times 1 \times 61.9 \times 0.285 = 49.0$ l/s
100 YEAR $Q = 2.78 \times 1 \times 91.7 \times 0.285 = 72.6$ l/s
100y 6HR $V = 72.6 \times 2850 \times 0.001 =$ **206.9 m³**

POST-DEVELOPMENT RUNOFF RATE & VOLUME

1 YEAR $Q = 2.78 \times 1 \times 26.9 \times 0.2275 = 17.0$ l/s
2 YEAR $Q = 2.78 \times 1 \times 33.7 \times 0.2275 = 21.3$ l/s
30 YEAR $Q = 2.78 \times 1 \times 80.5 \times 0.2275 = 50.9$ l/s
100 YEAR $Q = 2.78 \times 1 \times 119.2 \times 0.2275 = 75.3$ l/s
100y 6HR $V = 94.8 \times 2275 \times 0.001 =$ **215.6 m³**

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 46 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	99.578	1.528	0.0	19.1	19.1	76.7	O K
30 min Summer	99.582	1.532	0.0	19.2	19.2	78.1	O K
60 min Summer	99.571	1.521	0.0	19.1	19.1	74.5	O K
120 min Summer	99.545	1.495	0.0	18.9	18.9	66.0	O K
180 min Summer	99.521	1.471	0.0	18.8	18.8	58.1	O K
240 min Summer	99.502	1.452	0.0	18.6	18.6	52.1	O K
360 min Summer	99.052	1.002	0.0	15.5	15.5	42.8	O K
480 min Summer	98.884	0.834	0.0	14.2	14.2	35.7	O K
600 min Summer	98.756	0.706	0.0	13.0	13.0	30.2	O K
720 min Summer	98.655	0.605	0.0	12.1	12.1	25.9	O K
960 min Summer	98.518	0.468	0.0	10.6	10.6	20.0	O K
1440 min Summer	98.355	0.305	0.0	8.6	8.6	13.0	O K
2160 min Summer	98.235	0.185	0.0	6.8	6.8	7.9	O K
2880 min Summer	98.174	0.124	0.0	5.6	5.6	5.3	O K
4320 min Summer	98.115	0.065	0.0	4.0	4.0	2.8	O K
5760 min Summer	98.097	0.047	0.0	3.1	3.1	2.0	O K
7200 min Summer	98.086	0.036	0.0	2.6	2.6	1.5	O K
8640 min Summer	98.078	0.028	0.0	2.2	2.2	1.2	O K
10080 min Summer	98.072	0.022	0.0	1.9	1.9	0.9	O K
15 min Winter	99.609	1.559	0.0	19.3	19.3	87.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	209.654	0.0	89.6	17
30 min Summer	119.251	0.0	101.9	30
60 min Summer	67.830	0.0	115.9	46
120 min Summer	38.582	0.0	131.9	80
180 min Summer	27.736	0.0	142.3	112
240 min Summer	21.945	0.0	150.1	144
360 min Summer	15.776	0.0	161.9	210
480 min Summer	12.483	0.0	170.7	270
600 min Summer	10.409	0.0	177.9	332
720 min Summer	8.974	0.0	184.1	392
960 min Summer	7.184	0.0	196.5	512
1440 min Summer	5.251	0.0	215.5	750
2160 min Summer	3.838	0.0	236.3	1104
2880 min Summer	3.073	0.0	252.2	1468
4320 min Summer	2.147	0.0	264.4	2200
5760 min Summer	1.665	0.0	273.3	2912
7200 min Summer	1.367	0.0	280.5	3640
8640 min Summer	1.164	0.0	286.5	4336
10080 min Summer	1.015	0.0	291.7	5008
15 min Winter	209.654	0.0	100.4	17

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	99.618	1.568	0.0	19.4	19.4	89.8	O K
60 min Winter	99.603	1.553	0.0	19.3	19.3	85.1	O K
120 min Winter	99.567	1.517	0.0	19.1	19.1	73.2	O K
180 min Winter	99.531	1.481	0.0	18.8	18.8	61.4	O K
240 min Winter	99.504	1.454	0.0	18.7	18.7	52.7	O K
360 min Winter	98.997	0.947	0.0	15.1	15.1	40.5	O K
480 min Winter	98.785	0.735	0.0	13.3	13.3	31.4	O K
600 min Winter	98.634	0.584	0.0	11.9	11.9	25.0	O K
720 min Winter	98.524	0.474	0.0	10.7	10.7	20.2	O K
960 min Winter	98.384	0.334	0.0	9.0	9.0	14.3	O K
1440 min Winter	98.241	0.191	0.0	6.9	6.9	8.2	O K
2160 min Winter	98.153	0.103	0.0	5.1	5.1	4.4	O K
2880 min Winter	98.118	0.068	0.0	4.1	4.1	2.9	O K
4320 min Winter	98.093	0.043	0.0	2.9	2.9	1.8	O K
5760 min Winter	98.079	0.029	0.0	2.3	2.3	1.2	O K
7200 min Winter	98.071	0.021	0.0	1.9	1.9	0.9	O K
8640 min Winter	98.063	0.013	0.0	1.6	1.6	0.6	O K
10080 min Winter	98.057	0.007	0.0	1.4	1.4	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	119.251	0.0	114.1	30
60 min Winter	67.830	0.0	130.0	48
120 min Winter	38.582	0.0	147.7	86
180 min Winter	27.736	0.0	159.4	120
240 min Winter	21.945	0.0	168.1	152
360 min Winter	15.776	0.0	181.3	220
480 min Winter	12.483	0.0	191.2	282
600 min Winter	10.409	0.0	199.4	342
720 min Winter	8.974	0.0	206.3	400
960 min Winter	7.184	0.0	220.1	520
1440 min Winter	5.251	0.0	241.4	752
2160 min Winter	3.838	0.0	264.6	1104
2880 min Winter	3.073	0.0	282.5	1464
4320 min Winter	2.147	0.0	296.1	2172
5760 min Winter	1.665	0.0	306.1	2904
7200 min Winter	1.367	0.0	314.2	3600
8640 min Winter	1.164	0.0	320.9	4352
10080 min Winter	1.015	0.0	326.6	4968

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	GB 513950 170000 TQ 13950 70000
C (1km)	-0.025
D1 (1km)	0.301
D2 (1km)	0.342
D3 (1km)	0.231
E (1km)	0.306
F (1km)	2.547
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.228

Time From:	(mins) To:	Area (ha)
0	4	0.228

Model Details

Storage is Online Cover Level (m) 100.000

Complex Structure

Cellular Storage

Invert Level (m) 98.050 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	45.0	45.0	1.201	0.0	94.2
1.200	45.0	94.2			

Cellular Storage

Invert Level (m) 99.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	344.1	344.1	0.151	0.0	358.9
0.150	344.1	358.9			

Orifice Outflow Control

Diameter (m) 0.086 Discharge Coefficient 0.600 Invert Level (m) 98.000

APPENDIX C

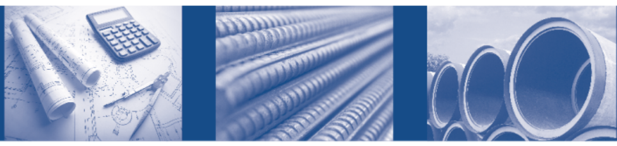
SUDS MANAGEMENT & MAINTENANCE PLAN

HAMPTON MEWS
FORMER HAMPTON TRAFFIC UNIT
STATION ROAD
HAMPTON
THE LONDON BOROUGH OF RICHMOND UPON THAMES

SUDS MANAGEMENT & MAINTENANCE PLAN

UK PACIFIC HAMPTON STATION LLP

FEBRUARY 2016



DOCUMENT CONTROL RECORD

Document Issue:

Rev	Date	Issue Status	Prepared by	Checked by
-	05.02.16	First Issue	C.Pendle	A.Mcshane

References:

The SUDS manual – CIRIA C753 (2015) ISBN 9780-86017-760-9

National Planning Policy Framework (NPPF) – Communities and Local Government
Technical Guidance - Flood Risk & Coastal Change (March 2012)

1 Introduction

1.1 This document sets out the principles for the long term management and maintenance of the proposed surface water Sustainable Drainage Systems (SuDS) installed at the residential development at the Former Hampton Traffic Unit off Station Road, Hampton.

1.2 The purpose of this document is to ensure that the adopting management company and /or homeowner that will be adopting SuDS is entrusted with an inspection and maintenance programme to ensure the optimum operation of the surface water drainage network is continually maintained for the lifetime of the development and to prevent the increased risk of flooding both on and off site in accordance with the NPPF.

1.3 This plan has been comprised of and is directly referenced from the latest technical SuDS guidance within the *CIRIA Report C753 The SuDS Manual* (2015) and other applicable guidance.

1.4 This document is laid out in specific sections applicable to the relevant SuDS type detailing:

- A description of the SUDS component and its use.
- Maintenance requirements and frequencies.
- Inspection requirements and frequencies.

1.5 The activities listed are generic to the relative SuDS types and represent the minimum maintenance and inspection requirements, however additional tasks or varied maintenance frequency may be instructed by the maintenance company as required.
Specific maintenance needs of the SuDS elements should be monitored and maintenance schedules adjusted to suit requirements.

1.6 All those responsible for maintenance should follow relevant Health and Safety legislation (Health and Safety at Work Regulations, 1999) for all activities listed within this report including lone working, if relevant) and risk assessments should always be undertaken.

1.7 This report is to read in conjunction with MJA drawing '*5327:01 & 02 'Drainage Layouts'* for the location of all SuDS elements present within the development.
There are three categories of maintenance activities referred to in this report:

- **Regular maintenance** (including inspections and monitoring).
  Consists of basic tasks done on a frequent and predictable schedule, including vegetation management, litter and debris removal, and inspections.

- **Occasional maintenance**
  Comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example).

- **Remedial maintenance**
  Comprises intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design.
  Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.

2 SuDS Layout & Design

2.1 There are three main SuDS components with the surface water drainage strategy:

- Permeable Block Paved Courtyard
- Cellular Attenuation Cells
- Flow Control Chamber

2.2 The installed SuDS system at this development are the responsibility of UK Pacific Hampton Station LLP and their appointed Management Company.
An agreement shall be set up by UK Pacific Hampton Station LLP, who shall confirm in writing to the Principle Planning Officer of the Richmond Borough Council when the maintenance agreement is completed and is operative.

2.3 Following installation and after transfer, all SuDS are to be maintained in perpetuity by the Management Company and shall ensure that it or any contractor employed by it carries out periodic maintenance of all such SuDS in accordance with the general schedules listed in this report.
Inspection checks shall be carried out by a qualified and competent person, at the minimum intervals listed within the schedules and the appropriate work carried out.

3 SUDS Management & Maintenance

Permeable Block Paving

Key Maintenance Requirements:

- Sweeping
- Regular brushing and vacuuming

3.1 Regular inspection and maintenance is important for the effective operation of permeable pavements and should be inspected regularly, preferably during and after heavy rainfall to check effective operation and to identify any areas of ponding.

3.2 Permeable block paving needs to be regularly cleaned of silt and other sediments to preserve infiltration capability and should have a minimum of three surface sweepings per year.
A brush and suction cleaner, which can be a lorry-mounted device or a smaller precinct sweeper, should be used and the sweeping regime should be as follows:

1. End of winter (April) – to collect winter debris.
2. Mid-summer (July/August) – to collect dust, flower and grass-type deposits.
3. After autumn leaf fall (November).

3.3 Care should be taken in adjusting vacuuming equipment to avoid removal of jointing Material and any lost material should be replaced.

3.4 To ensure the continual optimal performance of the permeable paving, it is recommended that the following maintenance should be carried out:
The following guidelines are offered as an initial regime, but maybe either increased or decreased depending on the local environment and any external contributing factors:

- A visual inspection of the paving may be carried out on a regular basis.
  This will confirm the effectiveness of the agitation maintenance due to variations between sites and allow any refinement of the regular agitation activity if necessary.

- The paving should be agitated (e.g. brushed, vacuumed, etc.) at least twice a year.
  This is to ensure no vegetation of any sort is allowed to grow and develop in the joints. Ideally, this activity should be carried out in the spring and autumn seasons.

- The paving should be inspected after any heavy precipitation to ensure no displacement of any organic matter onto the surface of the pavement.

- For winter maintenance, the controlled use of de-icing may be used without causing significant detrimental effects towards the permeable pavements performance.
  When used carefully, the use of these chlorides will not result in an increase in the chloride levels in the local ground.

- Weed growth – when sedimentation occurs in areas of permeable paving then there is the potential for weed growth, this will typically occur where there are overhanging trees or soft landscaping slopes down on to the paving or in areas which do not receive over run from vehicles particularly frequently. Weeds can be removed from the surface through the controlled application of proprietary non-persistent contact herbicides. Those containing Glyphosate are the most suitable.

3.5 Glyphosate based herbicides are the most common for general-purpose use, they are most effective on grasses and perennial weeds with non-woody stems. Weeds should be sprayed when they are actively growing, in dry but not sunny conditions, so that the Glyphosate will go down to the root and kill the weed completely. Glyphosate will be neutralized upon contact with the ground, which makes it safe to plant in the area soon after treatment. It is available ready mixed or as a concentrate.

3.6 Depending on the amount of usage and the environment the permeable pavement has received and been exposed to, the laying course material may require either replacement or cleaning after a 25 to 30 year period. This would be evident if the infiltration rate of the paving became prolonged, allowing ponding to develop.
Should this occur, the uplifting and cleaning (or replacing, depending on the costings of the activity) of the laying course maybe considered.
The laying course material, jointing and blocks may be reused (once cleaned), minimising costs.

3.7 If reconstruction is necessary, the following procedure should be followed:

1. Lift surface layer and laying course.
2. Remove any geotextile filter layer.
3. Inspect sub-base and remove, wash and replace if required.
4. Renew any geotextile layer.
5. Renew laying course, jointing material and concrete block paving.

3.8 Materials removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and may need to be disposed of as controlled waste. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods.

Permeable Paving Operation and Maintenance Requirements

Maintenance schedule	Required action	Frequency
Regular maintenance	Brushing and vacuuming.	Three times/year at end of winter, mid-summer, after autumn leaf fall, or as required based on site-specific observations of clogging or manufacturers' recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weed.	As required.
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required.
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users.	As required.
	Rehabilitation of surface and upper sub-structure.	As required (if infiltration performance is reduced as a result of significant clogging).
Monitoring	Initial inspection.	Monthly for 3 months after installation
	Inspect for evidence of poor operation and/or weed growth. If required take remedial action.	3-monthly, 48 h after large storms.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.
	Monitor inspection chambers.	Annually.

4 Cellular Attenuation Podium Deck & Tank

4.1 Key Maintenance Requirements:

- Regular inspection of silt traps, manholes, pipework and pre-treatment devices, with removal of sediment and debris as required.

4.2 Regular inspection and maintenance is required to ensure the effective long-term operation of below ground modular storage systems.

Cellular Soakaway Operation and Maintenance Requirements

Maintenance schedule	Required action	Recommended Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly
	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.	Monthly (and after large storms)
	Remove sediment from pre-treatment structures	Annually, or as required
Remedial actions	Repair/rehabilitation of inlets, outlet , overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after large storms

5 Flow Control Chamber

5.1 The orifice flow control unit has no moving parts and are self-activating, requiring minimal maintenance.
After initial installation, it is recommended that the unit be inspected monthly for three months.
Thereafter the manhole chamber and control device should be inspected at least every six months to verify the condition and operation of the unit and check for blockages within the inlet of the chamber and of the flow control device.
During these inspections, accumulated silts should be removed and the sump cleaned out using a conventional sump vacuum cleaner.

6 Contact Information

In the event of concern over any matter to do with the SuDS on this development please contact:

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APPENDIX D

RICHMOND BOROUGH SUDS DESIGN ASSESSMENT CHECKLIST

Treatment – Improving the quality of water by physical, chemical and/or biological means.
Watercourse – A term including all rivers, streams, ditches, drains, cuts, culverts, dykes, sluices, and passages through which water flows.

Water table (or groundwater table) – The point where the surface of groundwater can be detected. The water table may change with the seasons and the annual rainfall.

APPENDIX I:

DESIGN ASSESSMENT CHECKLIST: SCHEME

Table 1: Scheme Design Assessment Checklist

Requirements			
Site ID	HAMPTON TRAFFIC UNIT, RICHMOND UPON THAMES		
Site Location and co-ordinates	TW12 2AX NO. 60-68 STATION ROAD, HAMPTON		
Site description		Drawing Reference(s)	
Date of assessment	19.01.16	Specification Reference	
Type of development	RESIDENTIAL	Site Area	2850 m²

	SuDS Manual Page Ref*	Y	N	Summary of details	Comments / Remedial actions
PRINCIPLES					
Is the runoff managed at or close to its source, wherever possible? If not, give reasons.		✓			
Is the runoff managed at or close to the surface, wherever possible? If not, give reasons e.g. infiltration systems are being used to manage the runoff.		✓			
Where the drainage system serves more than one property, is public space used and integrated with the drainage system in an appropriate and beneficial way ? If not, give reasons.		✓			
Have the opportunities afforded by the drainage system in terms of green infrastructure, biodiversity, urban design, climate adaptation and amenity provision been maximised?		✓			
Has an appropriate SuDS Management train been provided?		✓			
Are the operating and maintenance requirements of the drainage system adequately defined?		✓			
Is operation and maintenance achievable at an acceptable cost?		✓			
POINT OF DISCHARGE					
Does the design meet the following discharge hierarchy 1. Infiltration is preferred where it is safe and acceptable to do so; 2. If infiltration is not possible discharge to water course; 3. Discharge to sewer as last resort.		✓			
If infiltration is used: Confirm that an acceptable infiltration assessment has been undertaken and submitted?					

	SuDS Manual Page Ref*	Y	N	Summary of details	Comments / Remedial actions
If discharge is to sewer, rather than a surface water body, provide justification.		✓			
If discharge to a sewerage asset is proposed, has evidence been provided that the design criteria have been agreed with the sewerage undertaker and that an appropriate connection detail has been agreed?			✓	STILL IN CONSULTATION WITH THAMES WATER	
Have adequate and appropriate exceedance routes been provided and are they protected from future development?		✓			
INTERCEPTION					
Does the scheme design demonstrate on-site retention of approximately the first 5mm of runoff from impermeable surfaces for most events? How is Interception to be delivered (e.g. infiltration, green roofs, permeable pavements, vegetated surfaces, bespoke design - provide details)?		✓			
PEAK FLOW RATE CONTROL					
Does the design demonstrate control of the 1 year, critical duration site event to the equivalent 1 year greenfield peak flow rate or below?		✓			
Does the design demonstrate control of the 100 year, critical duration site event to the equivalent 100 year greenfield peak flow rate or below?		✓			
Do the design calculations take account of future development (urban creep) and climate change?		✓			
VOLUMETRIC CONTROL (FOR THE 100 YEAR, 6 HOUR EVENT)					
Does the design demonstrate that, for the 100 year 6 hour event: *Either:* The discharged site runoff volume is not greater than the equivalent greenfield runoff volume? *Or:* The discharged site runoff volume over and above the equivalent greenfield runoff volume (i.e. the Long Term Storage Volume) is discharged at a rate < 2 l/s/ha (or another rate that is considered acceptable in not negatively impacting flood risk of the receiving water body) *Or:* Peak flow rates from the site are restricted to 2 l/s/ha or Qbar, whichever is the greater ha (or another rate that is considered acceptable in not negatively impacting flood risk of the receiving water body).		✓			
WATER QUALITY TREATMENT					
Is the receiving water body (surface or groundwater) environmentally sensitive (E.g. Groundwater Source Protection Zone? What is its designation? Are any implications for drainage design clearly defined?		✓			

	SuDS Manual Page Ref*	Y	N	Summary of details	Comments / Remedial actions
Does the design include an appropriate treatment strategy that ensures: 1. Sediment is trapped and retained on site in accessible and maintainable areas? 2. Has a sufficient number of drainage components been provided in series prior to discharge? 3. Suitable pollution removal capability e.g. % TSS removal (where this is a requirement of the SAB)		✓			
FUNCTIONALITY					
Are the design features sufficiently durable to ensure structural integrity over the system design life (residential 100 years and commercial 60 years), with reasonable maintenance requirements?		✓			
Are all parts of the SuDS system outside any areas of flood risk? If not, provide justification and evidence that performance will not be adversely affected.		✓			
Is pumping a requirement for operation of the system? If yes, provide justification and set out operation and maintenance/adoption arrangements.		✓		FOULWATER ONLY	
Has runoff and flooding from all sources (both on and off site) been considered and taken into account in the design?		✓			
Are 1 in 30 year flows fully conveyed within the SuD system ?		✓			
Are 1 in 100 year flows contained or stored on-site within safe exceedance storage areas and flow paths? Note some approving authorities may require greater return periods.		✓			
CONSTRUCTABILITY					
Has an acceptable construction method statement been submitted and approved?			✓	PRE-PLANNING ONLY	
MAINTAINABILITY					
Has an acceptable Maintenance Plan been submitted and approved?		✓		NOT APPROVED	
INFORMATION PROVISION					
Do the design proposals include sufficient provision for community engagement and awareness raising?		✓			

(*) to be added on completion of SuDS Manual update

SYSTEM DESIGN ACCEPTABILITY	Summary details including any changes required	Acceptable (Y/N)	Date changes made
Acceptable: Minor changes required: Major changes required / re-design:			

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