Old Kent Road IWMS: Offset Pricing Study

London Borough of Southwark

Project number: 60532317

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Quality information

Prepared by	Checked by	Verified by	Approved by
Amy Ruocco Senior Water and Flood Risk Consultant	Marcel Moolman Senior Engineer	Carl Pelling Associate Director	Michael Henderson Regional Director

Revision History

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1	19/07/18	First Draft	20/07/2018	Carl Pelling	Associate Director
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Prepared for:

London Borough of Southwark
Southwark Council
160 Tooley Street
London SE1 2QH

Prepared by:

AECOM Infrastructure & Environment UK Limited
Midpoint, Alencon Link
Basingstoke
Hampshire RG21 7PP
United Kingdom

T: +44(0)1256 310200
aecom.com

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Acronyms

AAP	**Area Action Plan**
E/O	**Extra-over**
HB2	**Half battered kerb**
IWMS	**Integrated Wtaer Management Strategy**
LBS	**London Borough of Southwark**
Nr	**Number**
OKR	**Old Kent Road**
RWP	**Rainwater pipe**
SuDS	**Sustainable Drainage Systems**
WwTW	**Wastewater Treatment Works**

1. Introduction

1.1 Background

LBS have developed draft policy as part of the Old Kent Road (OKR) Area Action Plan (AAP) related to the management of drainage and surface water flood risk (referred to herein as the "AAP sustainable drainage policy"). The AAP sustainable drainage policy requires developers to meet greenfield runoff rates for development proposal; that is, ensure that storm event runoff rates from developed areas do not exceed the rates at which runoff would be expected to occur if each site were completely undeveloped[1]. The AAP sustainable drainage policy goes beyond the related London Plan policy requirement to "aim to meet" greenfield runoff rates.

The Old Kent Road Integrated Water Management Strategy (OKR IWMS) identifies the lack of sewer capacity within the wider Crossness Wastewater Treatment Work (WwTW) which serves the AAP area, as a significant constraint to development. The risk of sewer and surface water flooding could increase if future development does not address discharge of surface water to the constricted combined sewer system

The IWMS therefore looked at water management measures that could be implemented to ensure the AAP sustainable drainage policy could be delivered. It also explored how such measures could support related policies to reduce demand for potable water supplies and manage water as sustainably as possible within the AAP area and minimise discharge of foul wastewater to the network.

Following the completion of IWMS, the London Borough of Southwark (LBS) is following the recommendations by developing an 'offset approach' to build into the draft AAP sustainable drainage policy. This offset approach acknowledges that the policy to meet greenfield runoff rates is more onerous than the London Plan and may not always be achievable in every case. The offset approach would allow developers to meet some of the greenfield runoff requirements through an offset payment to fund delivery of sustainable drainage measures (SuDS) off-site.

1.2 Drivers

The IWMS identified three key constraints to developers being able to meet the greenfield runoff requirements of the AAP sustainable drainage policy. These were:

- site constraints impacting on delivery feasibility of sufficient surface water attenuation storage volumes solely within the curtilage of each site's red line boundary;
- some sites likely to experience higher costs of delivering attenuation solely within the curtilage of each site's red line boundary compared to options for offsite solutions;
- Differences in development phasing which reduces opportunities for delivering strategic, multi-plot attenuation features; and,
- lack of a unified infrastructure provider to deliver joint SuDS schemes benefiting more than one developer/site which would more efficiently (and more sustainably) deliver greenfield runoff rates;

The IWMS concluded that an offset approach could provide developers an additional option to meet equivalent of greenfield runoff requirement given the constraints identified.

The current draft policy acknowledges that achievement of greenfield runoff rates for all sites will be challenging through delivery of SuDS within each site's red line boundary, therefore, the draft policy has an expectation[2] that developers provide a minimum of 70% of the surface water attenuation storage required to meet greenfield runoff rates on site and provide the residual attenuation via an offset payment to LBS. The offset approach can be used to deliver the remaining 30% attenuation storage, or where developers are unable to provide the 70% minimum attenuation storage onsite, it could be used to deliver more of a developer's commitment. The offset approach

[1] This is required for all storm events up to the 1 in 100 year return period event with a 40% increase in rainfall intensity as an appropriate allowance for climate change.
[2] The IWMS analysed case study development plots proposed within the OKR AAP area and determined that, based on generic parameters, most sites considered for regeneration would be likely to be able to provide 70% of the required attenuation to achieve greenfield rates on site. However, the draft policy does not have an absolute requirement for 70% onsite attenuation delivery as it would prevent some small, space constraint sites from achieving the minimal expectation. For these sites, developers would need to demonstrate that the provision of at least 70% of the required attenuation is not economically viable before a lower provision on site would be accepted.

would work by setting a charge per volume (m^3) of attenuation storage that could not be provided on site, and use this to create an offset fund which could be used to deliver SuDS measures throughout the AAP

As well as realising the IWMS aim of delivering greenfield runoff rates across the AAP area, the additional benefits of such an approach are that it can facilitate delivery of wider drainage catchment benefits in reduced runoff rates and volumes, as well as allow targeted delivery of multi-beneficial SuDS options throughout the AAP offering greater potential for environmental net gain, and delivery of ecosystem services.

Both the IWMS and this study have relied on the term ‘greenfield runoff rate’ as a basis for drainage design and policy requirement. Greenfield runoff rate can be defined as “the peak rate of runoff for a specific return period due to rainfall falling on a given area of vegetated land”[3]. It is important to note that the required greenfield runoff rate will vary on a site by site basis and hence neither this study nor the IWMS refer to a single greenfield runoff rate target for all proposed development sites when information policy compliance. For any given rainfall return period, a greenfield runoff rate can be standardised for varying site size by stating the rate of runoff per hectare; however using regulator approved methods for calculating the greenfield runoff rate, there will still be a site by site variation in the calculated runoff rate because of factors such as soil type which will be variable across different sites in the study area. The developer of each site will be required to follow appropriate guidance in calculating greenfield (and post development) runoff rates using a method approved by Southwark Lead Local Flood Authority (LLFA).

1.3 Study purpose

The IWMS considered different mechanisms for delivery of an offset approach, including the restrictions that such an approach would operate under. A key limitation identified was the difficulty in setting a consistent offset price to charge developers. Therefore, an offset pricing review study was commissioned to identify wider SuDS opportunities in the AAP from which a consistent price could be developed and justified.

This report outlines the findings of the offset pricing review.

[3] www.uksuds.com

2. Pricing exercise

2.1 Identifying typologies and appropriate SuDS

The first stage in the methodology for developing an offset price was to identify and define different types of land use that could be utilised for SuDS delivery. This included land that is currently within council control, as well as land that will be developed but be available for public use (e.g. proposed green space). The different land types are referred to as typologies.

It was agreed at project inception that the search area of SuDS interventions and typologies would be limited to the AAP boundary. Whilst there is some localised variation in sewer network capacity within the AAP, Thames Water's focus is on reduction of surface water runoff rates (and ideally, removal of surface water volume) from the wider Crossness WwTW drainage catchment which covers the entire AAP area. This assumption does not necessarily preclude the use of offset funds to deliver SuDS schemes more widely within the LBS administrative area because the Crossness WwTW drainage catchment of the AAP area is common to the wider borough as well as neighbouring boroughs[4]. However, the spatial scope of the study was necessarily limited to ensure efficient study delivery. In addition, LBS' preference was for solutions to bring localised benefits in sewer capacity within the AAP area.

Mapping the location and geographic coverage of these typologies within the AAP was undertaken to enable identification of where different SuDS types could be theoretically delivered. These typologies were:

- Green areas – existing and proposed areas of publically accessible green space
- Housing estates – existing and proposed council owned housing estates where the council has greater scope to plan for or propose retrofit of SuDS measures;
- Other public areas – existing and proposed areas not defined as green space, but which are publically accessible and have sufficient space for planning or retrofit of some SuDS options (e.g. urban squares, pedestrian public realm); and
- Council owned development and adopted highways – existing and proposed high rise blocks, industrial estates, retail parks, warehouse development etc which will remain in council control and offers potential for planning or retrofit of some SuDS systems.

The extents of each existing typology were determined using available GIS data, aerial imagery and a selection of site walkovers in the AAP area. Some sample photographs from the site walkover, which took place on 16th May 2018, are included in Box 2.1. Future, post-development typologies have also been identified based on GIS layers of proposed development areas and layouts.

The results of the typology categorisation have been mapped in Drawing No: 60532317-ACM-XX-XX-DR-CE-01 located in Appendix A. The map provides a strategic view of typology coverage to identify potential opportunities to help inform the offset pricing, but does not replace the need for site specific investigations as SuDS opportunities will vary from site to site.

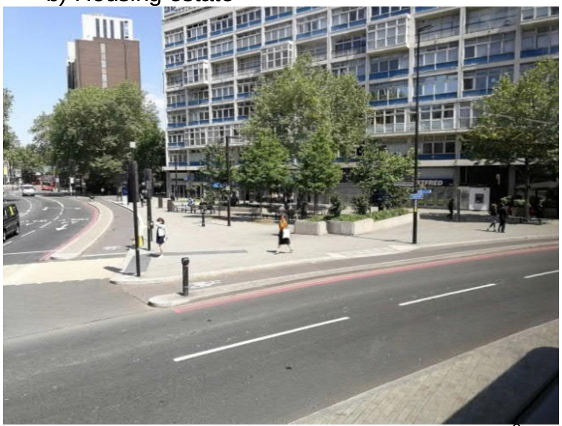
[4] Refer to the IMWS for more detail – the AAP and London Borough of Southwark boundary falls into Thames Water's Crossness Wastewater Treatment Works catchment which covers a large proportion of south London, such that reductions in runoff rate and volume anywhere within the Crossness catchment could be beneficial.

Box 2-1: observed examples of typologies offering opportunities for SuDS implementation in council controlled land uses

a) Other public areas - pedestrian walkway[5]

b) Housing estate[6]

c) Public green space[7]



d) “Other public areas - pedestrian ‘square’[8]

Once the geographic coverage of typologies was finalised, suitable SuDS types for each typology were identified based on knowledge of the likely available space, and practicality of implementation for an average site within the typology. The potential for these SuDS types was confirmed during site walkovers in the AAP in May 2018. The proposed SuDS for each typology have been summarised below[9].

- **Green Areas**
  - Bio-retention (also part of the intervention pallet); and
  - Rain gardens.

- **Housing Developments**
  - Disconnecting down pipes to swales;
  - Rain Water harvesting/ Water butts;
  - Tree pits;
  - Green or blue roof retrofitting;

[5] Footpath along Rotherhithe New Road (A2208) – opportunity of rain gardens and tree pit
[6] Green Hundred Road - opportunity for Swales (disconnecting roof water down pipes) and opportunity for bio-retention
[7] Paterson Park – opportunity
[8] Elephant and Castle Roundabout
[9] The identification of SuDS types for each typology does not preclude the future option for wider SuDS types to be included within these typologies – however, the process allowed a strategic overview of where different SuDS types were most likely to be feasible.

  - permeable paving; and
  - Retrofitting kerbs.

- **Other Public Areas**
  - Rain gardens/tree pits;
  - Bio-retention; and
  - New soft permeable surfaces.

- **Council owned development/Adopted highways**
  - Disconnecting down pipes to swales;
  - Rain Water harvesting/ Water butts;
  - Green roof/permeable paving; and
  - Permeable paving.

2.2 Building a unit cost

2.2.1 Unit cost definition

For each of the identified SuDS types within the typologies, typical specifications were identified using best practice guidance and likely restrictions within the typologies identified to provide a basis for developing unit costs.

These specifications were then provided to cost consultants to build up the rates. Costs have been broken down elementally to arrive at an all-in rate for the works. Elemental rates have come from price books (SPON's[10]) and other recently procured market rates as used by the cost consultants. The rates have been adjusted accordingly to allow for different locations, inflation, quantities and working conditions, etc. However, at a strategic scale the rates are a best estimate and specific costs are likely to vary from site to site.

2.2.2 SuDS to use for the unit cost

The offset element of the AAP sustainable drainage policy would require a unit cost to be charged per m^3 of attenuation storage that developers cannot provide on-site. In their drainage proposals, developers would set out the maximum attenuation storage volume they can provide on-site, compare it to the volume required to achieve greenfield runoff rates, and use these calculations to set out the residual volume that they are unable to provide on-site and hence would need to pay for, per m^3,via the offset mechanism. This therefore requires the offset price to be based on a cost per m^3 of storage, which would be delivered with the amalgamated offset funds.

Because of the largely retrofit nature of opportunities for SuDS delivery options, a significant proportion of SuDS types that could be delivered by the offset approach are likely to be focused on source control SuDS. These measures provide the benefit of slowing the response time to peak runoff rates, some degree of attenuation, and provision of wider sustainability benefits; examples include retrofit green roofs and rain gardens. However, to generate volume for volume SuDS delivery (a 1:1 offset ratio) would require very large areas of retrofit and high costs per m^3 that would create an expensive and unrealistic offset charge.

Therefore, it was agreed that only bio-retention features (which have the potential to provide significant attenuation storage) would be used to derive the unit costs for the offset pricing. A unit cost has been developed for all other identified source control SuDS, but the unit cost is based on area (m^2) or a single unit installation to inform planning decisions on how the offset fund could be spent.

The purpose of costing these other measures is to inform alternative means of delivering SuDS with wider benefits as opposed to limitations that might be imposed by focusing purely on volume for volume attenuation delivery. However, it is important to note that the use of the offset charge will be prioritised for delivering bio-

[10] AECOM (2018) SPON'S Civil Engineering and Highway Works Price Book 2018 (Spon's Price Books). CRC Press

retention SuDS schemes (as well as source control SuDS which provide significant attenuation) to ensure that as close to a 1:1 offset ratio as possible is delivered.

2.2.3 Developing the offsetting charge – costs per unit of bio-retention

Bio-retention SuDS were used as the basis for the offsetting charge. There are a range of different approaches to design of bio-retention; however, the main design considerations for developing the cost have referenced the CIRIA SuDS Manual C753[11].

These systems would be implemented in open green spaces; examples of which can already be observed within the AAP area (See Figure 2-1 and Figure 2-2).

Figure 2-1: Example of existing bio-retention in the vicinity of the AAP area

[11] See Chapter 18

Figure 2-2 Example of existing rain gardens in the vicinity of the AAP area

2.2.3.1 Cost breakdown

Unit costs per construction element were developed by the cost consultants based on a m^3 of excavation required to provide a bio-retention feature. These costs were used to determine the total cost of a bio-retention feature that could be typically delivered within the identified green area and other public area typologies within the AAP. A unit cost per m^3 of storage provided was then derived from the costed bio-retention concept design based on how much attenuation storage it was estimated it could provide.

The costing scope, as well as exclusions and assumptions area set out in Box 2-2 and details of the elements used in the cost build up for $1m^3$ of storage is presented in Table 2-1.

Box 2-2: Scope, exclusions and assumptions for bio-retention costing

Costing scope

- Earthworks (removal, re-shape existing material and surface)
- Surface (conversing/landscaping/ vegetation)
- 150-300mm infiltration media
- Geotextile
- Drainage layer
- Pipework (depending on application and ground conditions)

Exclusions

- Maintenance.
- Contamination and hazardous materials

Assumptions

- Implemented in open green spaces
- Allowances as per typical design (below)

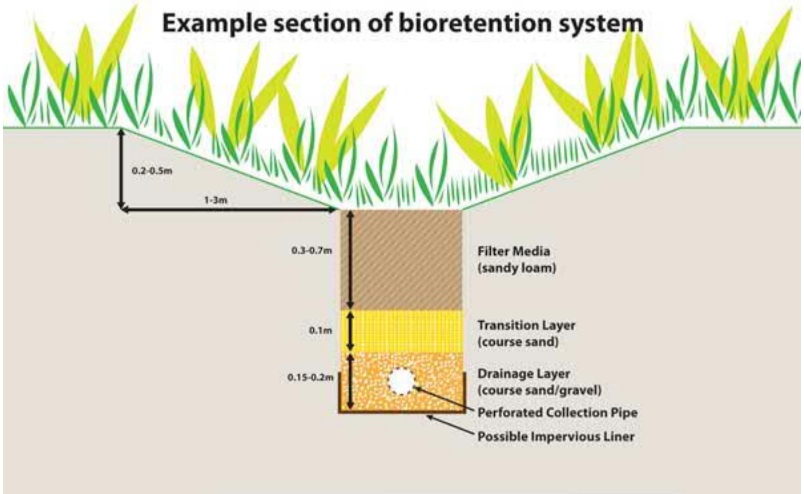


Table 2-1: Elemental breakdown for costing $1m^3$ of attenuation storage achieved by bio-retention

Item	Element/Description
1	**Construction elements**
1.1	Excavating top soil. Assumed machine excavation with average depth 150mm assumed)
1.2	Excavating trench down to depth, not exceeding 1m
1.3	Disposal of inert arising off-site including soft strip
1.4	Earthwork support. Providing support to opposing faces of excavation. Timber (distance between faces not exceeding 500mm)
1.5	Perforated pipe to trench excavation. 80mm diameter, assumed plastic
1.6	Drainage layer assumed to be gravel
1.7	Transition layer assumed coarse sand
1.8	Filter medium assumed sandy loam
1.9	Grass seeding including forming embankments

Item	Element/Description
2	**General Site Costs and Contingency**
2.1	Contingency Sum (10% of Construction Cost)
2.2	General Site Provisions (13% of Construction Cost) – updated to 13.5% (2018 SPONS)
2.3	Contractor Overheads/Profit (5% of Construction Cost)
2.4	Design Fee & Surveys (10% + 2% of Construction Cost)
2.5	Optimism Bias (21% of Construction Cost)
2	**Maintenance and operational cost**[12]
2.1	Contingency Sum (5% of Construction Cost per annum)

Total cost / m^3 of Storage capacity: £365.82

The costing exercise has identified a unit capital cost of £366 per m^3 of attenuation storage which can be used as the basis for a price for an offset charge.

2.2.4 Unit cost benchmarking

The IWMS undertook a high level costing exercise for a case study approach to offset, whereby high level assumptions where applied to two large areas of proposed regeneration within the AAP (Cantium and Ruby Triangle) to determine costs for delivering attenuation required to meet greenfield runoff rates.

A cost per m^3 of attenuation was derived using two scenarios: the developers provide all the required attenuation on plot; and, each developer provides 70% of the attenuation requirement on plot, and 30% via a communal SuDS systems within the proposed public open space. This coarse costing exercise determined a cost of between £190 and £460 m^3 where a communal approach was adopted, and between £370 and £550 m^3 where 100% of the attenuation is delivered on plot. Whilst the costing exercise was coarse and based on a wide-range of assumptions, it indicates that the unit cost for bio-retention derived within this study has the potential to be both cheaper than the estimated 100% on plot delivery method (ideally a need for offset approaches) and of a similar magnitude to costs when off-plot measures are considered.

2.3 Costs for other SuDS types

The remaining SuDS types identified are largely source control measures, which provide control on the response time to peak run off rates, biodiversity and amenity benefits, potential for reduction in volume of rainwater discharging to sewer, and provision of some degree of attenuation storage. However, because the volume of attenuation they provide can be limited, the costs have not been used to derive the offset price. Instead, costs have been built up either by square metre (m^2) of measure provided (e.g. green roof) or per unit of installation (e.g. a water butt).

These costs have been developed for planning purposes by LBS, to support decisions on how offset funds accumulated from the offset charge could be spent on a wider variety of SuDS measures to increase the number of opportunities for intervention and increase the range of wider benefits that different measures could provide. Because of the varying design life of different SuDS types, no maintenance and operational cost has been included for these SuDS types. A whole-life costing exercise for each SuDS type would be required to determine this.

2.3.1 Rain gardens

Rain gardens are a form of bio-retention; however, in this situation they are assumed to include a built-up enclosed surround as indicated in Figure 2-2 above. These systems would mostly be retrofitted to wide footpaths, next to public highways, pedestrian areas or around existing trees.

[12] Using Environment Agency R& D Project: Cost estimation for SUDS - summary of evidence: Report –SC080039/R9. A 50 year design life has been assumed, and the mid-range estimate of percentage of capital costs for all SuDS types.

In addition to improving the visual landscape and amenity, rain garden features can provide additional habitat and biodiversity benefits. Careful selection of soil mix vegetation can also treat pollution and remove nutrients during frequent rainfall events. Some runoff volume will also be removed through evaporation and plant transpiration. Cost scope and assumptions are detailed in Box 2-3, and cost elements detailed in Table 2-2.

Box 2-3 Scope, exclusions and assumptions for rain garden costing

Costing scope

- Removal of existing surface covering (pavement, blocks, etc.)
- Earthworks (removal, re-shape existing material) up to 450mm deep (depending on application and ground conditions)
- Build-up enclosed surround (kerbing, brick wall etc.)
- Surface conversing/landscaping/vegetation
- 150-300mm infiltration media
- Geotextile and drainage layer
- Pipework (depending on application and ground conditions)

Exclusions

- Planting of plants, shrubs and tree
- Maintenance
- Contamination and hazardous materials
- Any traffic management requirements

Assumptions

- Retrofitted to existing hardstanding areas
- Allowances as per typical diagram below (CIRIA C753)

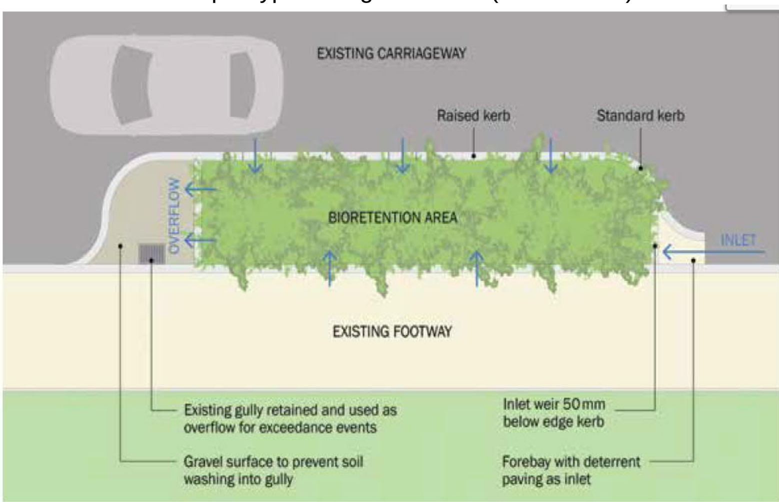


Table 2-2: Elemental cost breakdown for 1m^2 of rain garden

Item	Element / Description
1	Construction elements
1.1	Breaking out existing hardstanding
1.2	Excavating trench down to depth, not exceeding 1.00m
1.3	Disposal of inert arising off-site
1.4	E/O[13] disposal of hardstanding
1.5	Earthwork support. Providing support to opposing faces of excavation. Timber (distance between faces not exceeding 500mm)
1.6	Drainage layer assumed to be gravel
1.7	Geotextile layer
1.8	Filter medium assumed sandy loam
1.9	Grass seeding
1.10	Type HB2[14] 125 x 255 straight or curved

[13] 'Extra over' – term used to indicate an extra cost will be incurred for either labour, material or both for an item already measured

Item	Element / Description	
2.	**General site costs and contingency**	
2.1	Contingency Sum (10% of Construction Cost)	
2.2	General Site Provisions (13% of Construction Cost) – updated to 13.5% (2018 SPONS)	
2.3	Contractor Overheads/Profit (5% of Construction Cost)	
2.4	Design Fee & Surveys (10% + 2% of Construction Cost)	
2.5	Optimism Bias (21% of Construction Cost)	
	Total cost / m^2 of rain garden	**£242.16**

2.3.2 Green Roof

The unit cost for green roof has been built up for a square metre of extensive green roof. This type of green roof has low substrate depths, simple planting and low maintenance requirements.

These systems are most likely to be retrofitted and fitted to refurbishments to high rise residential developments or industrial buildings. They bring a range of extra benefits such as improving the thermal performance of buildings, helping to combat the urban heat island effect and improving air quality. Cost scope and assumptions are detailed in Box 2-4, and cost elements detailed in Table 2-3.

Box 2-4 Scope, exclusions and assumptions for green roof costing

Costing scope

a. Assume extensive green roofs only
b. Retrofitting green roof to exiting building

- Surface conversing/vegetation
- Growing material: 20-150mm
- Root barrier, water proof membrane
- Drainage layer

Exclusions

- Structural calcs
- roof deck / slab
- replacement of / connection to existing RWPs
- specific planting
- Maintenance

Assumptions

- Retrofitted to existing roofs
- Allowances as per typical diagram below (CIRIA C753)

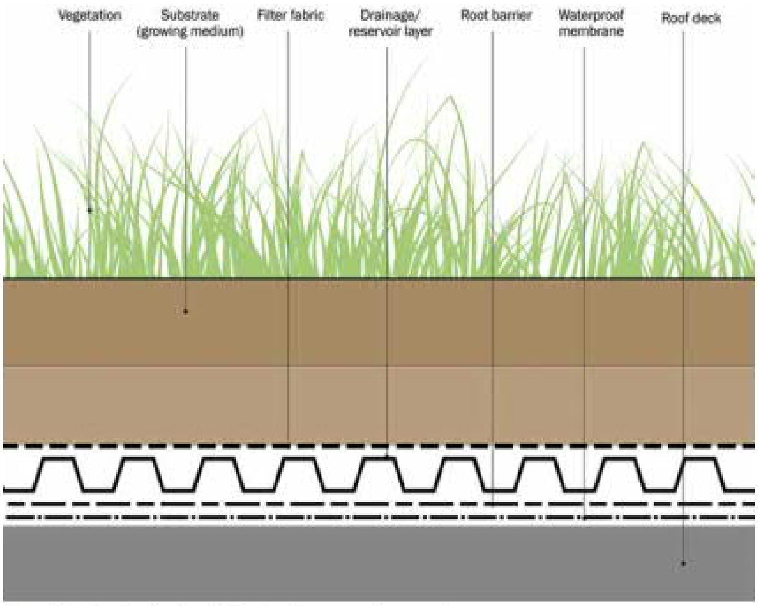


Figure 12.1 Section showing typical extensive green roof components

[14] Half-battered kerb

Table 2-3: Elemental cost breakdown for 1 m^2 of extensive green roof

Item	Element / Description	
1	**Construction elements**	
1.1	Waterproof membrane; moisture mat / protection fleece	
1.2	Drainage layer	
1.3	Filter fleece; filter sheet rolled onto drainage layer	
1.4	System substrate growing medium	
1.5	Sedum carpet mat; laid over system substrate	
2	**General site costs and contingency**	
2.1	Contingency Sum (10% of Construction Cost)	
2.2	General Site Provisions (13% of Construction Cost) – updated to 13.5% (2018 SPONS)	
2.3	Contractor Overheads/Profit (5% of Construction Cost)	
2.4	Design Fee & Surveys (10% + 2% of Construction Cost)	
2.5	Optimism Bias (21% of Construction Cost)	
	Total cost / m^2 of green roof	**£318.41**

2.3.3 Swales

Swale systems would mainly be retrofitted in green areas located next to residential developments to disconnect rainwater pipes (RWPs) from the network (i.e. divert surface water from roofs to swales). These systems bring the benefit of slowing the response time to peak run off, as well as removing some surface water from the drainage system where infiltration is possible. They can also provide biodiversity benefits through planting and linkage with green corridors or open space.

Cost scope and assumptions are detailed in Box 2-5, and cost elements detailed in Table 2-4.

Box 2-5 Scope, exclusions and assumptions for swale costing

Costing scope

- Earthworks (removal, re-shape existing material and surface)
- Surface conversing/landscaping/ vegetation)
- 150-300mm infiltration media
- Geotextile (may also require geo matting to protect side slope from erosion)
- Drainage layer
- Pipework

Exclusions

- Planting of plants, shrubs and trees (seeding is included)
- Maintenance
- Contamination and hazardous materials
- Inlet and disconnection of existing pipework

Assumptions

- Retrofitted in open green spaces
- Allowances as per typical diagram below (CIRIA C753)

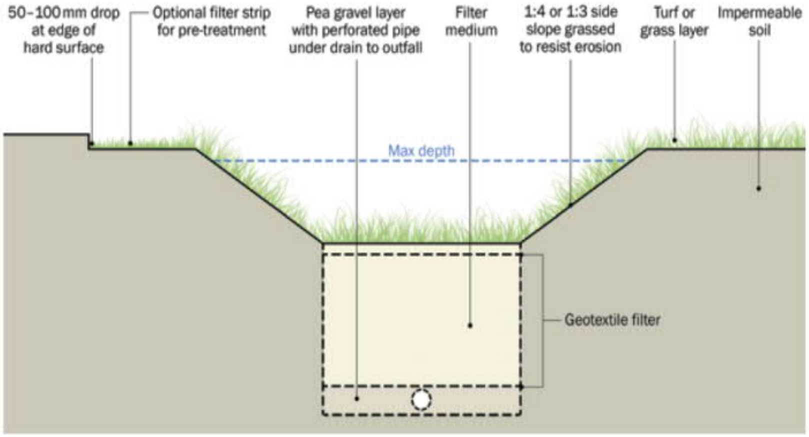


Table 2-4: Elemental cost breakdown for 1m^2 of swale

Item	Element / Description		
1	**Construction elements**		
1.1	Excavating top soil. Assumed machine excavation, average depth 150mm assumed		
1.2	Excavating trench down to depth not exceeding 1.00m		
1.3	Disposal of inert arising off-site including soft strip		
1.4	Earthwork support, providing support to opposing faces of excavation, and timber. Distance between faces not exceeding 500mm		
1.5	Perforated pipe to trench excavation. 80mm diameter, assumed plastic		
1.6	Drainage layer assumed to be gravel, 100mm depth		
1.7	Geotextile layer		
1.8	Filter medium assumed sandy loam, 300mm depth		
1.9	Grass seeding, including forming embankments		
1.10	Allowance for inlet structure	Item excluded*	
2	**General site costs and contingency**		
2.1	Contingency Sum (10% of Construction Cost)		
2.2	General Site Provisions (13% of Construction Cost) – updated to 13.5% (2018 SPONS)		
2.3	Contractor Overheads/Profit (5% of Construction Cost)		
2.4	Design Fee & Surveys (10% + 2% of Construction Cost)		
2.5	Optimism Bias (22% of Construction Cost)		
		Total cost / m^2 of swale	**£213.67**

*Inlet structure excluded; spec will vary depending on location and requirements

2.3.4 Water Butts

Water butts have been costed by unit. As a small scale storage device to collect rainwater form the roof, these are most likely to be retrofitted to residential developments and provide wider benefits in terms of reducing potable water demand.

Cost scope and assumptions are detailed in Box 2-6, and cost elements detailed in Table 2-5.

Box 2-6 Scope, exclusions and assumptions for water butt costing (250 litre capacity)

Costing scope

- Capital cost per unit
- Pipework and fittings (connected to downpipe)
- Tanks and fittings (250 l)
- General Construction (footing etc.)

Exclusions

- Replacement of existing Rainwater pipes

Assumptions

- Retrofitted to existing dwellings
- Allow for a base in lieu of a stand
- Allowances as per typical diagram below (CIRIA C753) for water butt only. Other Rainwater harvesting has not been considered in this example.

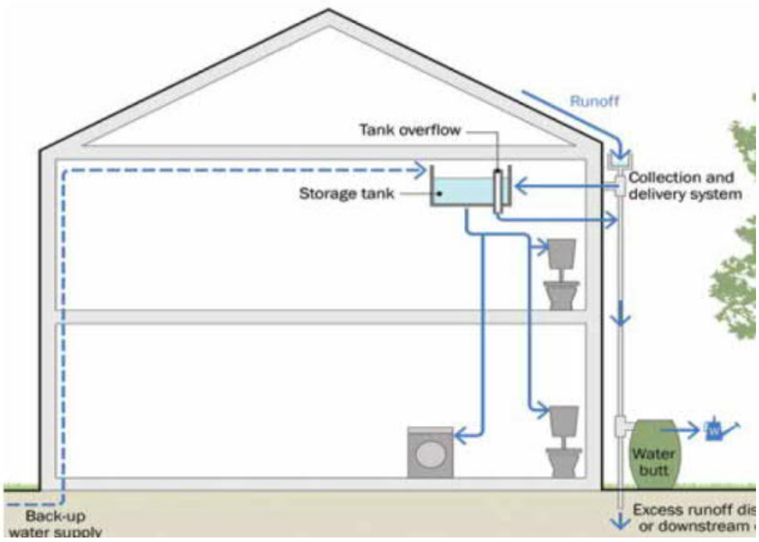


Table 2-5: Elemental cost breakdown for installation of a 250 litre water butt

Item	Element / Description	Unit	Rate £
1	**Construction elements**		
1	250 litre water butt	No.	50.00
2	Rain diverter kit	No.	5.00
3	Water butt base	No.	50.00
4	Installation; connecting components to drainage pipe and overflow system	item	30.00
2	**General site costs and contingency**		
2.1	Contingency Sum (10% of Construction Cost)		
2.2	General Site Provisions (13% of Construction Cost) – updated to 13.5% (2018 SPONS)		
2.3	Contractor Overheads/Profit (5% of Construction Cost)		
2.4	Design Fee & Surveys (10% + 2% of Construction Cost)		
2.5	Optimism Bias (4% of Construction Cost)		
	Total cost for installation of a water butt	No.	£194.45

2.3.5 Permeable paving

Permeable paving would mostly be retrofitted to adopted public highways with minimal traffic loading, car parks, footpaths and public areas. Where ground conditions are suitable, permeable paving offers benefits in terms of reduction of runoff volumes and reducing the time to peak runoff rates during heavier rain storms.

Cost scope and assumptions are detailed in Box 2-7, and cost elements detailed in Table 2-6.

Box 2-7 Scope, exclusions and assumptions for permeable paving

Costing scope

- Remove and dispose of existing surface and subbase up to 450mm
- 60mm blocks paving or similar (e.g. could be porous asphalt)
- 40mm sand layer
- Permeable Geo-textile (Terram 1000 or similar)
- Assume 200mm hydraulic sub-base (no fines stones)
- Impermeable membrane where paving should connect to sewer:

Exclusions

- Any traffic management requirements
- Connection to sewers

Assumptions

- Retrofitted to existing hardstanding areas
- Allowances as per typical diagram below (CIRIA C753)

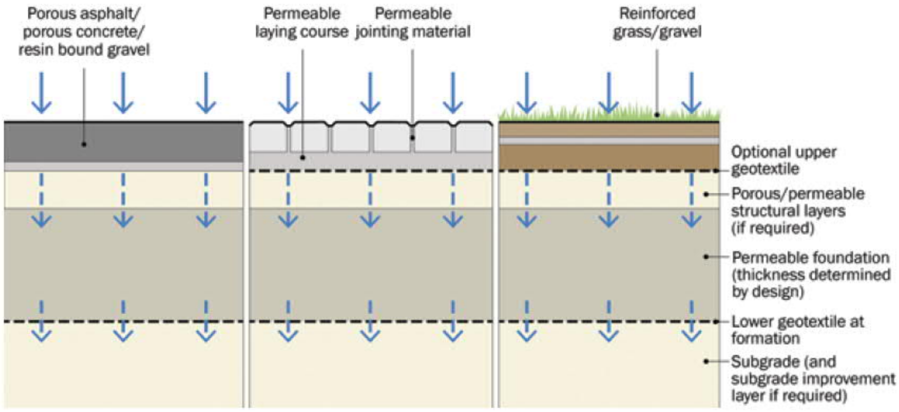


Table 2-6: Elemental cost breakdown for 1m² of permeable paving

Item	Element / Description
1	**Construction elements**
1.1	Breaking out existing hardstanding
1.2	Excavation, assumed depth 300mm
1.3	Disposal of inert arising off-site including soft strip
1.4	E/O[15] disposal of hardstanding
1.5	Hydraulic sub-base, open graded material assumed 200mm thick
1.6	Geotextile, top and bottom layers
1.7	Permeable sand layer, 40mm depth
1.8	Rectangular permeable block paving / asphalt; 60mm thick
2	**General site costs and contingency**
2.1	Contingency Sum (10% of Construction Cost)
2.2	General Site Provisions (13% of Construction Cost) – updated to

[15] 'Extra over' – term used to indicate an extra cost will be incurred for either labour, material or both for an item already measured

Item	Element / Description		
	13.5% (2018 SPONS)		
2.3	Contractor Overheads/Profit (5% of Construction Cost)		
2.4	Design Fee & Surveys (10% + 2% of Construction Cost)		
2.5	Optimism Bias (4% of Construction Cost)		
	Total cost / m2 of permeable paving		**£178.32**

2.3.6 Tree pits

Tree pits are relatively small features that are not intended to manage large volumes of water but could potentially replace a single road gully. They are most likely to be retrofitted to wide footpaths, next to public highways, pedestrian areas or around existing trees. The cost has been developed per tree pit.

Cost scope and assumptions are detailed in Box 2-8, and cost elements detailed in Table 2-7.

Box 2-8 Scope, exclusions and assumptions for tree pi costing

Costing scope

- Opening up existing surface
- Open up existing tree or acquiring an appropriate new tree
- Structural growing media (various stone or modular structures/crates etc.)
- Root barrier and stone mulch barriers
- Permeable surface/tree-pit cover and surface around cover
- Underdrain depending on drainage configuration and soil conditions

Exclusions

- Traffic management requirements (if required)
- Connection to sewers

Assumptions

- Retrofitted to existing hardstanding areas
- Allowances as per typical diagram below (CIRIA C753)

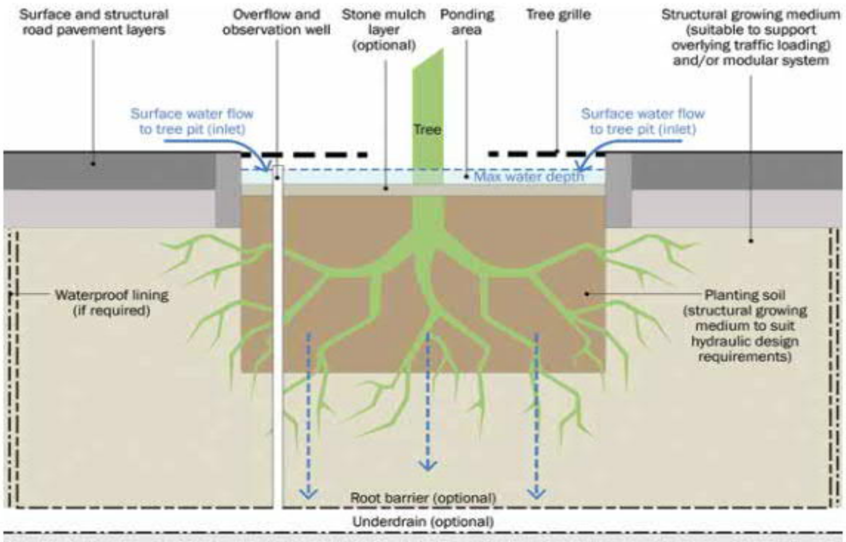


Table 2-7: Elemental cost breakdown for a tree pit

Item	Element / Description	Unit	Rate £
1	**Construction elements**		
1.1	Excavate tree pit; 1.00 × 1.00 × 600mm deep	m³	15.00
1.2	E/O[16] for breaking out paving	m²	10.00
1.3	Tree planting; medium sized tree including backfill	No.	500.00

[16] 'Extra over' – term used to indicate an extra cost will be incurred for either labour, material or both for an item already measured

Item	Element / Description	Unit	Rate £
1.4	Root barrier to sides and bottom of excavation	m²	15.00
1.5	Tree pit frame - galvanised	No.	500.00
1.6	Stone mulch layer, assumed gravel	m²	20.00
1.7	Allowance for edging to footpath / roadways	item	250.00
2	**General site costs and contingency**		
2.1	Contingency Sum (10% of Construction Cost)		
2.2	General Site Provisions (13% of Construction Cost) – updated to 13.5% (2018 SPONS)		
2.3	Contractor Overheads/Profit (5% of Construction Cost)		
2.4	Design Fee & Surveys (10% + 2% of Construction Cost)		
2.5	Optimism Bias (21% of Construction Cost)		
	Total	No.	**2245.64**

3. Using the typology mapping

The typology mapping exercise has identified geographical areas where different SuDS may be feasible. Initial assumptions have been made regarding the proportion of those areas which could potentially have a SuDS feature implemented within it. These assumptions were based a review of typical land parcels within each typology and averaging the space of each parcel which could be made available for each type of SuDS feature.

These findings are summarised in Table 3-1 and give an indication of the potential attenuation storage volume and source control square meterage which could be achieved within the AAP.

Table 3-1: Spatial analysis of SuDS based on identified typologies within the AAP area

SuDS	Total area identified in AAP (m^2)	Effective SuDS area (m^2)	Effective SuDS Area (m^2)	Average depth (m)	Potential Volume[17] (m3)
Bio-Retention	34,411	50%	17,206	0.35	6,022
Swales	126,704	15%	19,006	0.5	9,503
Permeable Paving	35,401	95%	33,631	0.2	
Rain Gardens & Tree Pits	48,318	25%	12,080	0.2	
Green roof	19,841	50%	9,921	0.15	

[17] Volume has only been provided for those schemes where a unit cost per volume has been derived – whilst other SuDS can provide a degree of storage, the costing element of the study has focused on the SuDS types that support the aim for 1:1 offset attenuation delivery

3.1 Infiltration potential

The IWMS identified that, despite potential pollution risk from contaminated land, there is a significant land area within the study area where the geology and soil is likely to support a degree of infiltration. This presents greater opportunity for source control measures to provide a degree of attenuation (such as permeable paving, and roofs connecting downpipes to swales) to aid in the attainment of as close to a 1:1 offset delivery as possible. The coverage of permeable geology also allows an indication of where delivery of swales and bio-retention SuDS is likely to be more effective.

Appendix B includes the geology mapping of the AAP area and this indicates infiltration SuDS are more likely to be viable where:

- the Chalk bedrock outcrops to the north east of the AAP area and is overlain by a secondary aquifer associated with the shallower superficial deposits (the areas shown as green in Appendix B); and
- the Thanet Sands bedrock outcrops and is overlain by the secondary A aquifer within the associated with the shallower superficial deposits in the central and southern regions of the AAP area (the areas marked as blue with diamond hatchings in Appendix B).

4. Summary

The offset pricing study has identified a range of typologies within the AAP area where different SuDS systems could be retrofitted or provided within new development proposals. These typologies have been mapped and an estimate of the volume of attenuation storage that could be provided by bio-retention and swales features, as well as an estimate of the AAP area that could provide wider source control SuDS, has been provided.

The potential for bio-retention to provide offset attenuation storage has been used to derive a price per m^3 to use as an offset charge to developers who are unable to provide sufficient on site attenuation in order to meet the draft AAP policy related to sustainable drainage; that is, to deliver site specific greenfield runoff rates.

This price was developed by building up a capital cost for a typical bio-retention intervention that could be delivered within the identified green space and other public space typologies within the AAP, and determining the cost per m^3 of attenuation storage that intervention could provide. The costing exercise identified a unit capital cost of £366 per m^3 of attenuation storage which can be used as the basis for a price for an offset charge.

The study has also identified where offset funds accumulated could be used to deliver a wider range of source control SuDS, that would bring wider sustainability benefits to the AAP area. A cost per m2 of intervention (or unit of intervention) has been provided for these schemes to aid planning decisions on how the offset fund could be applied in particular, where bio-retention schemes may not be feasible in some locationsw. However, it is important to note that the use of the offset charge will be prioritised for delivering bio-retention SuDS schemes (as well as source control SuDS which provide significant attenuation) to ensure that as close to a 1:1 offset ratio as possible is delivered.

4.1 Limitations

There are several key limitations to consider in how the unit cost has been developed:

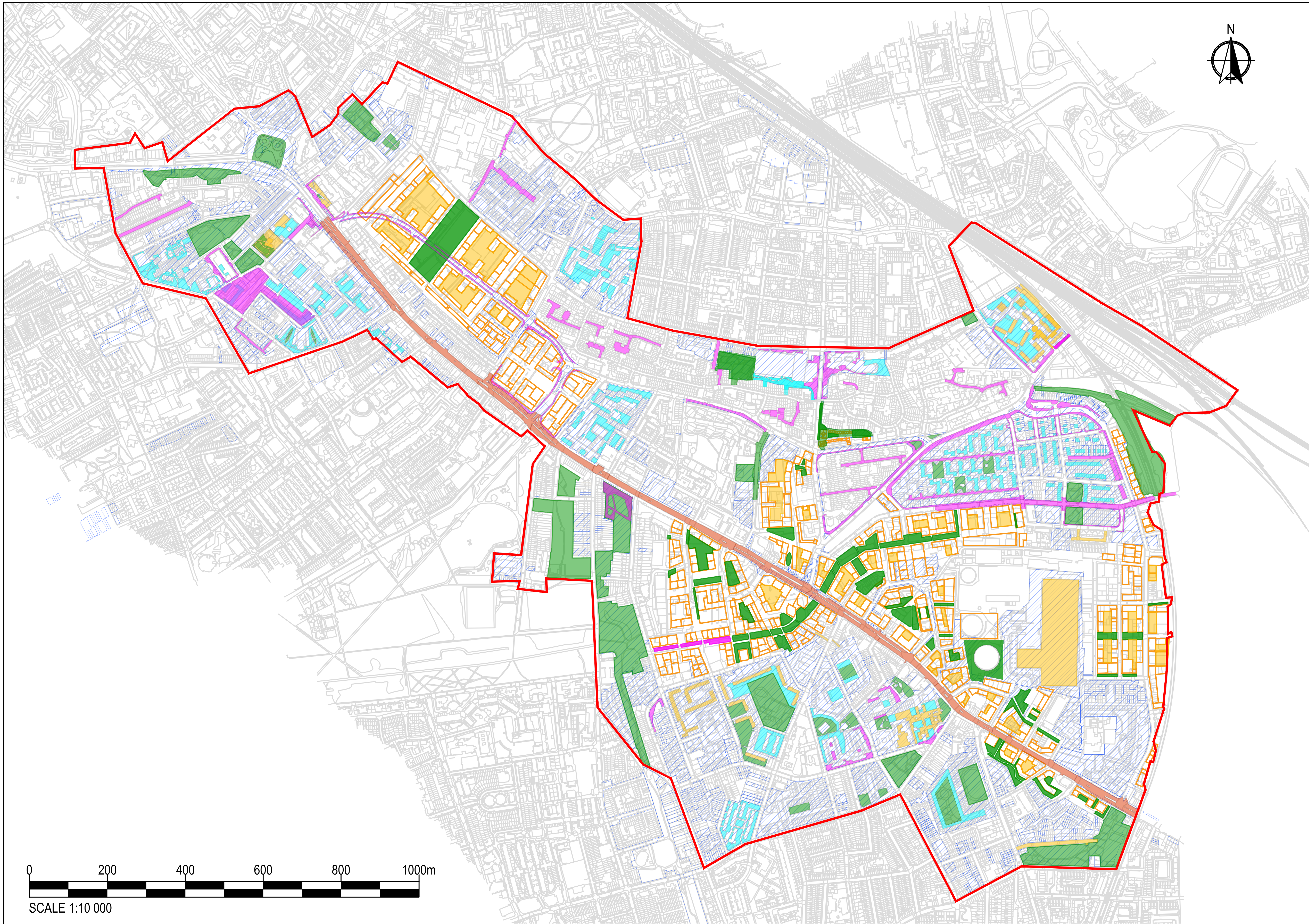
- The actual capital cost of interventions will depend on local site conditions and constraints as well as other unknown factors such as contractor type;
- In determining the spatial scale of potential SuDS interventions, assumptions have been made at a high level on how much of the typology area could be used for SuDS implementation; the actual extent of usable area will vary on a site by site basis across the AAP area.

4.2 Recommendations

It is recommended that the following measures are taken forward as part of the offset approach:

- As SuDS schemes are funded and delivered by the offset mechanism, the actual cost of scheme delivery is monitored and recorded for regular annual analysis;
- The off-set price per m^3 of attenuation is reviewed and adjusted (as required) to reflect:
  - Annual inflation;
  - Outputs from the annual analysis of actual costs (capital and operational) of scheme delivery.
- Opportunities are considered to use the offset approach to jointly fund schemes being considered by the LLFA to reduce surface water discharge to the sewer system. As part of a partnership funding approach for surface water flood risk management schemes, offset funds could be used to provide significant surface water reduction compared to funding new SuDS schemes.

Appendix A – Mapping of typologies within the AAP



THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

NOTES

1. The mapping was compiled in conjunction with the following data provided to AECOM by the London Borough of Southwark:
   a. Metropolitan Open Land Proposed Green Spaces
   b. Proposed Open Space Ruby Triangle
   c. Other Green Spaces
   d. Borough Open Land
   e. Podium Green Spaces
   f. Housing Developments
   g. Adopted Highways
   h. Freehold Title_Extent_April_2018
2. Typology mapping was compiled at desk top level for planning purposes only. Typologies may overlap in specific areas and more than one SuDS strategy may be feasible for the same typology.
3. The SuDS strategies shown in this drawing should not be considered an exhaustive list; alternative SuDS strategies may be more suitable and should be evaluated on a case by case basis.
4. All SuDS strategies should be reviewed on a site specific basis. Consideration should be given, but not limited to flood risk, geology, typography, existing and proposed developments before implementation of any of the indicated SUDS strategies.

LEGEND

- Old Kent Road Opportunity Area
- OKR Freehold Title Extent
- OKR Development Plots (2017)
- Typology 1: Green Space
  ► Bio-Retention/Rain Gardens
- Typlology2: Housing Amenity Areas with potential for Greening
  ►Swales/Water Butts
- Typology 3: Public Area
  ►Rain Gardens/Tree pits
- Typology 4: Courtyards and Council Owened Properties
  ►Green roofs/Permeable Paving
- TFL OKR Corridor

Plot Date : 27 March 2019 16:26:11
File Name : \\BA-WIP-003\4700 - WATER\WATER NEW\4 - PROJECTS\60532317 - OLD KENT RD IWMS\20 WIP\07 OFFSET DEVELOPMENT\TYPOLOGIES MAPS\60532317-ACM-XX-XX-DR-CE-01001

Project Title	LONDON BOROUGH OF SOUTHWARK OFFSET DEVELOPMENT
Client	LONDON BOROUGH OF SOUTHWARK
Drawing Title	OLD KENT ROAD OPPORTUNITY AREA TYPOLOGIES MAP
Purpose of issue	PLANNING

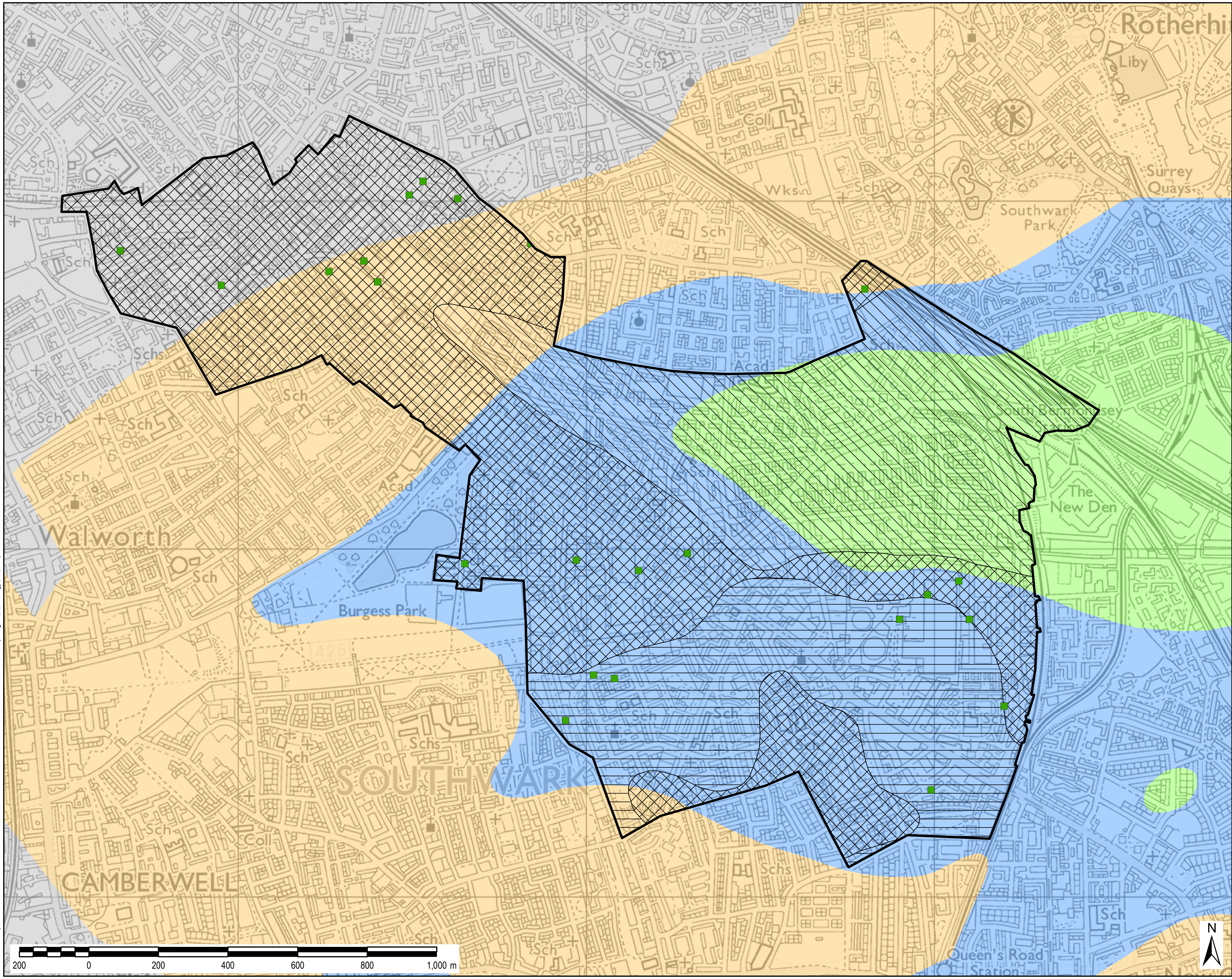
Designed	Drawn	Checked	Approved	Date
MM	MM	AR	CP	JUL '18

AECOM Internal Project No.	60532317
Suitability	
Scale @ A3	1:10 000
Zone / Mileage	OKR

Drawing Number	Rev
60532317-ACM-XX-XX-DR-CE-01001	P1

AECOM Infrastructure & Environment UK Limited
MIDPOINT
Alencon Link
Basingstoke, RG21 7PP, UK
Tel:T +44-01256310200
Fax:
www.aecom.com

Appendix B – IWMS Geology figure extract



LEGEND

- Old Kent Road Opportunity Area
- Boreholes Wells and Springs

Aquifer Designation Superficial Deposits

- Secondary (undifferentiated)
- Secondary A
- Unproductive

Bedrock Geology

- London Clay Formation
- Claygate Member
- Harwich Formation
- Lambeth Group
- Lewes Nodular, Seaford and Newhaven Chalk Formations (Undifferentiated)
- Thanet Sand Formation

Purpose of Issue
FINAL

Client
SOUTHWARK COUNCIL

Project Title
OLD KENT ROAD IWMS

Drawing Title
GEOLOGY

Drawn	Checked	Approved	Date
JW	AK	CP	23/08/2017

AECOM Internal Project No.	Scale @ A3
60532317	1:10,000

AECOM
Scott House
Alençon Link, Basingstoke
Hampshire, RG21 7PP
Telephone (01256) 310200
Fax (01256) 310201
www.aecom.com

Drawing Number
FIGURE 4

Rev

File Name:\\ba-wip-0034700 - Water\Water New\4 - PROJECTS\60536\60532317 - Old Kent Rd IWMS\40 GIS\Constraints maps\Figure_4_Geology_A3_Template.mxd