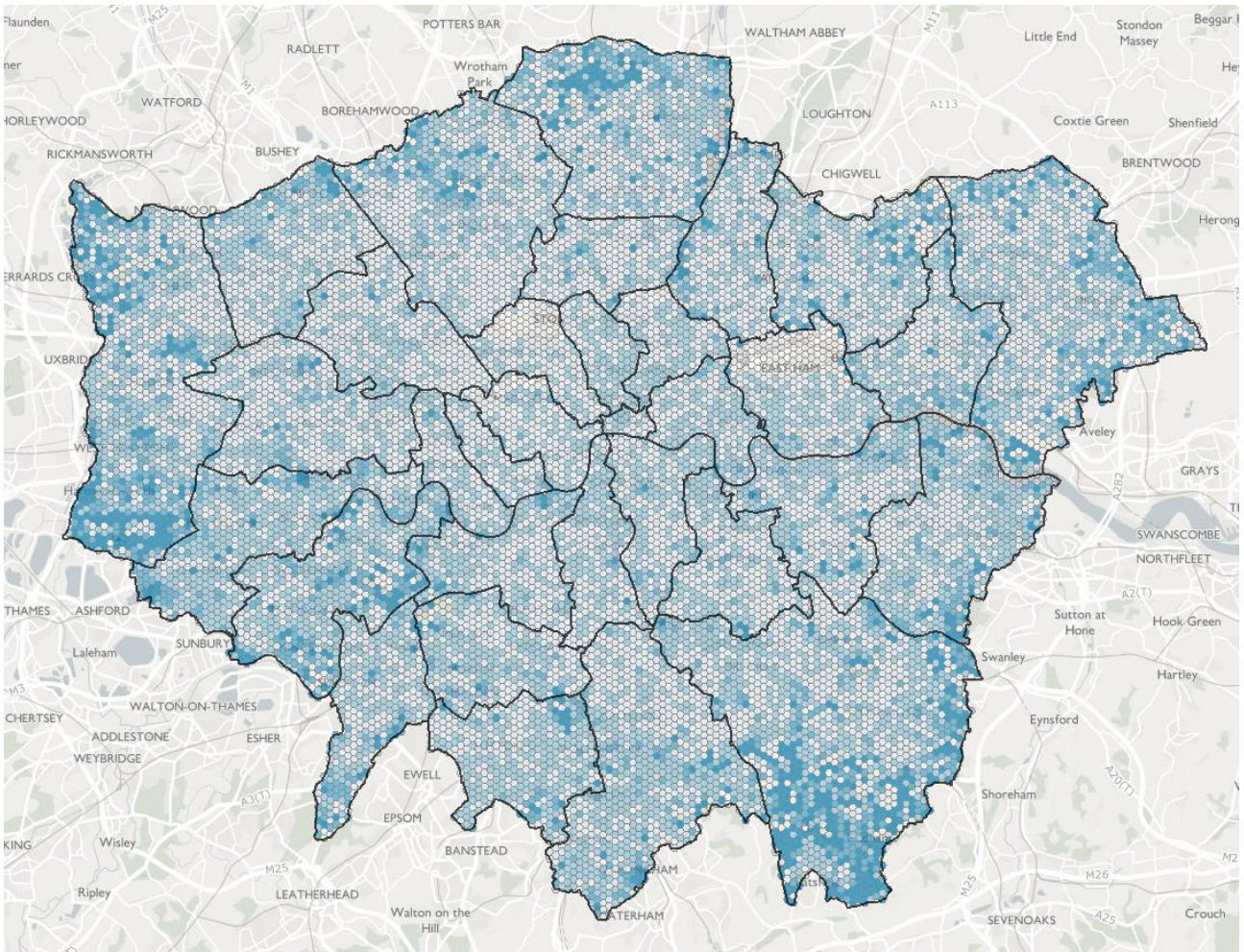


SuDS Opportunity Mapping Tool

User Guide



December 2018

COPYRIGHT

**Greater London Authority
December 2018**

Published by
Greater London Authority
City Hall
The Queen's Walk
More London
London SE1 2AA
www.london.gov.uk
enquiries 020 7983 4100
minicom 020 7983 4458
ISBN
Photographs ©
Copies of this report are available
from www.london.gov.uk

CONTENTS

| | |
|---|-----------|
| Overview | 1 |
| SuDS description and parameters applied in the model | 2 |
| SuDS considered by the assessment | 2 |
| Solution design assumptions | 3 |
| Web Tool | 6 |
| Suggested Use | 7 |
| Apparent Anomalies | 8 |
| Orphaned soakaway | 8 |
| Same surface – two different solutions? | 9 |
| Bioretention in roads | 10 |
| Disconnecting downpipes | 11 |
| Direct drainage to the Thames | 12 |
| Different solutions, side by side | 13 |
| Apparently random SuDS solutions – aerial imagery vs OS Mastermap | 14 |
| No solution? | 15 |
| Bioretention in the road? | 16 |
| Building lean | 17 |
| Further Information | 18 |

Overview

Welcome to the London SuDS Opportunity Mapping Tool which has been developed to aid Local Authorities and other Risk Management Authorities in understanding the potential for SuDS within any given area, providing approximate volumes of surface water that require managing and assigning approximate costs to the SuDS features. When using SuDS Opportunity Mapping please bear in mind that it is a tool showing options and not necessarily definitive answers. It is meant as a “first stab” at identifying the potential and should in no way be used as a decision tool. The SuDS solution polygons shown by the tool do not indicate that a SuDS solution should cover the whole area of the polygon, but suggests that a solution could be installed within the polygon, to a size estimated by the model.

The tool does not have access to all the data that would be required to provide perfect accuracy. For example, it does not include data on underground obstacles such as pipes or cables for utilities. Further site investigations to assess additional constraints (utilities, changes in land use since the tool run, structural stability of the buildings to sustain green roofs, etc.) and discussions with land owners and other stakeholders for their preferences would narrow down the possible options for the site. The tool provides a high-level desk screening assessment of SuDS retrofit opportunity. Site investigations and detailed design of solutions will still be required.

Often a combination of proposed feasible solutions would be the most appropriate SuDS solution for the site, therefore it is important to take the palette of the results from the tool as a basis for future design and adaptation based on the site-specific conditions. As well as proposing the most cost-effective solution at each site, the approach tracks all available constraints at each site. This information is consequently available to engineers when assessing additional constraints in the future. It is advised that the outputs of this project should not be provided to developers or those outside the Boroughs, in case it is misinterpreted or misused. All findings from the GIS layers used in the analysis should be confirmed by approaching the relevant body for the most up-to-date information.

The tool has been run for a number of different rainfall scenarios as the feasible and preferred options will differ slightly depending on the scale of rainfall event that the SuDS features is required to manage. The scenarios that have been run include:

- **2yr** - 1 in 2 year rainfall event
- **Baseline** - 1 in 30 year rainfall event
- **CC** - 1 in 30 year rainfall event plus an allowance for climate change (+30%)
- **GI** - 1 in 30 year rainfall event but only including green infrastructure solutions

SuDS description and parameters applied in the model

The tables below provide a list of the SuDS measures and also the parameters the model has set. Although in reality these are fairly flexible, the model needs such thresholds in order to choose between SuDS solutions. As such they are a guide rather than rules when it comes to implementation.

SuDS considered by the assessment

| SuDS considered | Solution Code | Brief description |
|--------------------------|---------------|--|
| Attenuating rain gardens | RA | Landscaped planted depression in a form of rain garden with additional storage beneath planting (in a form of geocellular boxes) to maximise storage capacity |
| Bioretention | Bi | Landscaped planted depression that drains surface water from all areas (except residential houses) with some storage capacity provided between the edge of kerbs. Includes pocket infiltration, bioretention and multiple tree pits style solutions, |
| Direct drain to Thames | Wa | Diversion of drains direct to Thames with no attenuation |
| Disconnect downpipe | DD | Rainwater downpipes from large buildings disconnected into the underground geocellular storage |
| Filter drains | FD | Trench filled with gravel with attenuation within the gravel voids |
| Gravel paving | GP | Layer of gravel with attenuation within that gravel layer, suitable for minor car parks and driveways |
| Green roof | GR | Planted roof with limited storage suitable for large flat roofed buildings only |
| Permeable paving | PP | Permeable paving surface with underground geocellular boxes to maximise storage |
| Pond | Po | Body of water in large natural spaces |
| Rain garden (box) | RB | Box storage with planting tray on the top and gravel storage in the rest of the box, applicable to large buildings only |
| Rain gardens (surface) | RS | Landscaped planted depression (that drains residential houses) with some storage capacity between the garden edge kerbs, residential areas only |
| Soakaway | So | Excavation filled with gravel that enables infiltration and storage |
| Swales | Sw | Grassed ditches, linear and round solutions |
| Tree pit | TP | Single tree pits |
| Water butts | WB | Private attenuation tanks suitable for residential buildings |
| Wetland | We | Land marsh with storage within shallow depths |

Additional assumptions have been made regarding the potential for connectivity between sources and sinks:

- Only source areas within 30m of a sink can drain to the sink. For manmade surfaces that would ensure adequate gradients for connectivity. In the case of buildings, this reflects the possible

locations of downpipes, which may limit an entire roof area connecting to a particular solution at a certain location.

- Roads, railways and watercourses act as connectivity blockers, that is to say connections cannot be made that cross these features.
- Sources must be no more than 0.4m higher than the sink to which their solution is located on. This ensures that some connectivity is possible without significant re-landscaping being required to create a drainage path. This difference in heights is created by calculating the average height of every source and sink polygon, based on the digital surface model (DSM) LiDAR provided. The calculation of average heights is likely to be valid and reasonably representative for small areas in urban environments however may be less representative of large rural features (such as fields).
- Direct discharge to the Thames is prioritised where suitable
- Pavement solutions are considered suitable for infiltration based on the classification at the centroid of the pavement polygon.

Solution design assumptions

| Solution | Source parameters | Sink/solution parameters |
|---|---|---|
| Attenuating rain garden | No minimum or maximum source area. | Assumes 1m deep, 90% voids in attenuation. Sinks must have an average elevation less than 400mm higher than the source average elevation for a solution to be valid. |
| Bioretention | Buildings have a minimum source area of 100m ² , no maximum area. Other sources have no size constraints. Drains the equivalent of 20m ² of road. | Assumes 5 x 1 x 0.15m storage, locations every 20 metres. Needs minimum source area of 100m ² for building sources, 15m ² for all other sources. Where road is source and sink, a maximum of 12.5% of the road area can be used for a solution. Where manmade surface is source and sink, a maximum of 10% of the road area can be used for a solution. Solutions are only suitable in pavements wider ¹ than 2.5m. Natural spaces must have an average elevation less than 400mm higher than the road average elevation for a solution to be valid. |
| Direct drain to Thames | Source within 15m of River Thames | No constraints (includes docks, tidal waters, canals) |
| Disconnection of downpipes to geocellular storage | Minimum source area 100m ² , no maximum source area. Cannot be used on listed buildings. | Assumes 1m deep, 90% voids. Geocellular storage to be installed under manmade surfaces or natural spaces. This solution is only applied to non-residential sources. |
| Filter drains | Minimum source area of 30m ² , no maximum source area. | Assumes a linear feature, 1m deep (with 30% voids) and minimum 1m wide. No minimum sink area. Sinks must have an average elevation less than 400mm higher than the source average elevation for a solution to be valid. Solutions are only suitable in pavements wider than |

¹ Pavement width is assumed to be the median width of the pavement, calculated perpendicular to the road.

| | | |
|-----------------------|--|--|
| | | 2.5m. |
| Gravel paving | For manmade surface, minimum source area of 50m ² . | 1m deep with 30% voids |
| Green roofs | Minimum source area 100m ² , no maximum source area. Cannot be used on listed buildings. | 50% of roof at less than 10o slope. |
| Permeable paving | For manmade surface, minimum source area of 50m ² . | Assumes 1m deep, 90% voids except pavement solution which is assumed 500mm deep with 90% voids. Pavements must be at least 1.5m wide. |
| Pond | Minimum source area of 100m ² . | Minimum sink area of 300m ² . 1m deep, 100m ² minimum size, buffer 3m for maintenance. Maximum sink area used is 30%. Sinks must have an average elevation less than 400mm higher than the source average elevation for a solution to be valid. |
| Rain garden (box) | Minimum source area 200m ² , no maximum source area. Cannot be used on listed buildings. | Minimum sink area 100m ² . Maximum area of sink used is 10%. |
| Rain garden (surface) | Minimum source area 30m ² , 200m ² maximum source area. Cannot be used on listed buildings. (Will only connect to MasterMap fields corresponding to "General Surface", "Multiple" and pavement.) | Minimum sink area 15m ² . Maximum 12m ² area of rain garden, with maximum water depth of 250mm, to give maximum capacity of raingarden in gardens as 4200 litres. Can't be more than 20% of size of garden. Can use pavements wider than 2.5m to install rain gardens in front of houses. For rain gardens on pavements, depth is limited to 150mm to give a maximum capacity of 1800 litres, whilst 50% of the sink area can be used by the SuDS solution. |
| Soakaway | Minimum source area 30m ² , 400m ² maximum source area. | Infiltration must be possible. No minimum sink area. 1m deep with 30% voids. Natural surface sinks must have an average elevation less than 400mm higher than the manmade surface source average elevation for a solution to be valid. |
| Swales | Minimum source area of 30m ² . | Assumed 1m deep, min 2m wide with 1:2 slopes. Minimum area of sink polygon 100m ² . Maximum sink area used is 50%. Sinks must have an average elevation less than 400mm higher than the source average elevation for a solution to be valid. Solutions are only suitable in pavements wider than 7m. |
| Tree pits | Minimum source area 30m ² , 100m ² maximum source area. | Maximum water depth of 350mm, and can't be more than 10% of sink size where sink is road, roadside or pavement. Solutions are only suitable in pavements wider than 2.5m. |

| | | |
|-------------|--|---|
| Water butts | Minimum source area 30m ² , maximum source area 100m ² . Cannot be used on listed buildings. | Maximum capacity of 100 litres, minimum sink area 15m ² . |
| Wetlands | For all sources, minimum source area of 400m ² . | Minimum wetland area of 300m ² . 350mm deep, 100m ² minimum size, buffer 3m for maintenance. Maximum sink area used is 30%. Sinks must have an average elevation less than 400mm higher than the source average elevation for a solution to be valid. |

Web Tool

A web tool has been created by the Greater London Authority to enable flood Risk Management Authorities to view the results without the need for expertise in GIS and access to specific software. The tool is password protected with unique logins for organisations which takes the user to their specific part of London. However, the tool also allows users to look beyond borough boundaries so that SuDS can be examined on a catchment basis.

Upon loading the web tool the volume versus cost hexagonal layer is automatically loaded which shows the average volume (litres) removed for a pound of investment (TOTEX) for the 30 year rainfall event. Selecting any hexagon will display the averages for all return periods. Alternative hexagon layers have also been created for users to toggle on and off which show the number of Green Roofs that are deemed to be a feasible option within the hexagon (Green Roofs as a Feasible Option) and the number of times a green infrastructure solution is deemed to be the dominant option (GI Solution as the Dominant Option). These hexagon layers have been developed to help users identify where they might like to concentrate their efforts by showing where the greatest volume reductions can be made for their investment, where the greatest opportunities for green roofs are and where green infrastructure is deemed the most suitable to help reduce surface water runoff.

The tool also contains context layers including the live EA flood risk mapping feed, the Transport for London Road Network, Public Land Ownership, Combined Sewer Network, Business Improvement Districts, Opportunity Areas, Index of Multiple Deprivation and the London Development Database.

The tool is currently released as a beta version with work still being undertaken to it. Suggestions for amendments to the web tool are welcomed and should be directed to george.warren@london.gov.uk.

Please note that the raw modelling results are available upon request.

Suggested Use

The tool can be used for a number of different scenarios, a few key ones that have been identified are briefly listed below, however this is by no means an exhaustive list.

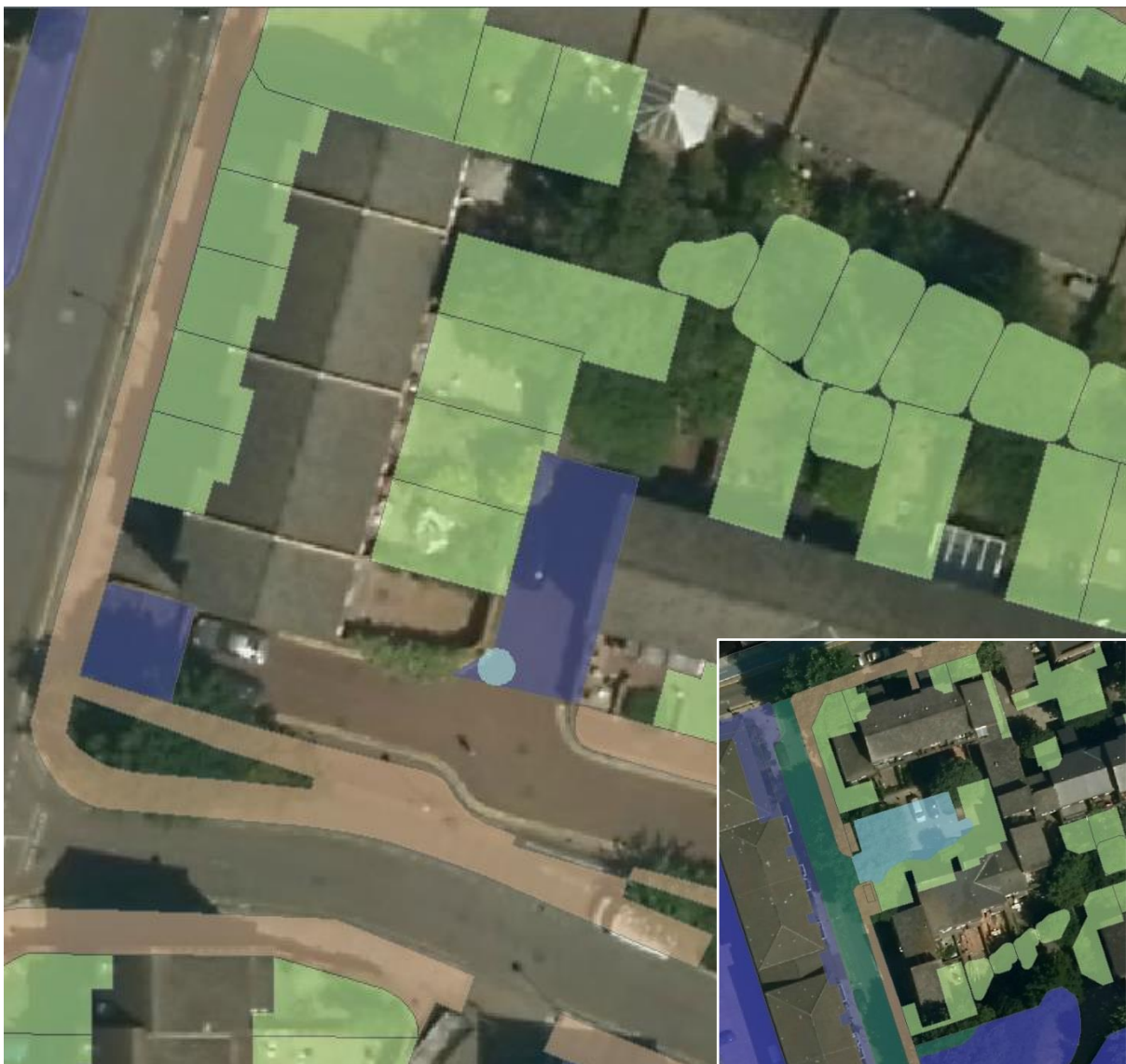
- Lead Local Flood Authorities could use the data to identify areas within their authority where there is the greatest potential for SuDS incorporation based on budgetary constraints.
- Highways teams could use the data to identify solutions associated with planned maintenance or resurfacing.
- Housing trusts, schools and corporate property managers could use the data to identify opportunities associated with maintenance or development.
- Tree officers might be interested in knowing potential sites for additional or amended planting.
- Outputs can be used to influence planning policy and decision making
- Outputs can be an evidence base document for flood policy review
- Outputs provide indicative runoff volumes/capacities for checking planning applications
- Outputs provide indicative solutions for applications and can be used as a reality check on schemes
- Outputs can be used to inform public realm SPDs

Although the outputs can be used as a great starting point for the formation of decisions it is strongly advised that the outputs are always accompanied with text that explains their constraints.

Apparent Anomalies

The following are examples of where SuDS Studio findings may at first appear erroneous. However, the model is typically performing in a logical fashion, and apparent anomalies can frequently be explained by examining how the model operates and what the data underlying the model is showing.

Orphaned soakaway



The extract above shows potential opportunities in a residential area. The dominant options are front and rear garden rain gardens, permeable block paving on the footpaths and filter drains bordering the driveways. The light blue circle overlying an area with potential for a filter drain is a soakaway.

In this instance the dominant SuDS measures have been selected as a suite of solutions – they work together. If a soakaway is selected, the volume that the soakaway can address has been accounted for in the volume of other solutions selected in the same interconnected group. Whichever option was cheaper per m³ water addressed is maximised, with the next option taking the residual. For example, if a rain garden is cheaper, SuDS Studio will introduce the largest rain garden possible within the spatial constraints, and then build the next cheapest solution (soakaway in this case) up to the maximum solution size that the second solution can take.

The user can still select the soakaway to find out more details. It can be harder to do this though where there are several dominant solutions selected for a site (for two solutions you can just do “all” minus “dominant” to get the info on the second solution). Underlying British Geological Survey infiltration data suggests that a soakaway is feasible.

Same surface – two different solutions?



Here we can see that for the northern pavement the model has identified a filter drain as the dominant solution, whereas the southern pavement has been allocated permeable block paving. The pavements look the same though so why have they not been assigned the same solution? There can be several reasons why the model has selected different solutions. In this instance it is because the average width of the pavement polygons (derived from underlying OS Mastermap mapping data) is slightly different. The northern pavement is on average slightly wider and so meets the width threshold for filter drains. The model has used this width threshold to rule out a filter drain for the southern pavement and instead gone for what it thinks is the most cost effective remaining option – permeable paving. This same situation can also occur frequently with other SuDS measures that utilise thresholds, for example swales.

Where the model has identified different solutions for very similar areas users should not rule out utilising the same option for both areas and utilise findings from a location study to rule options in or out.

Bioretention in roads

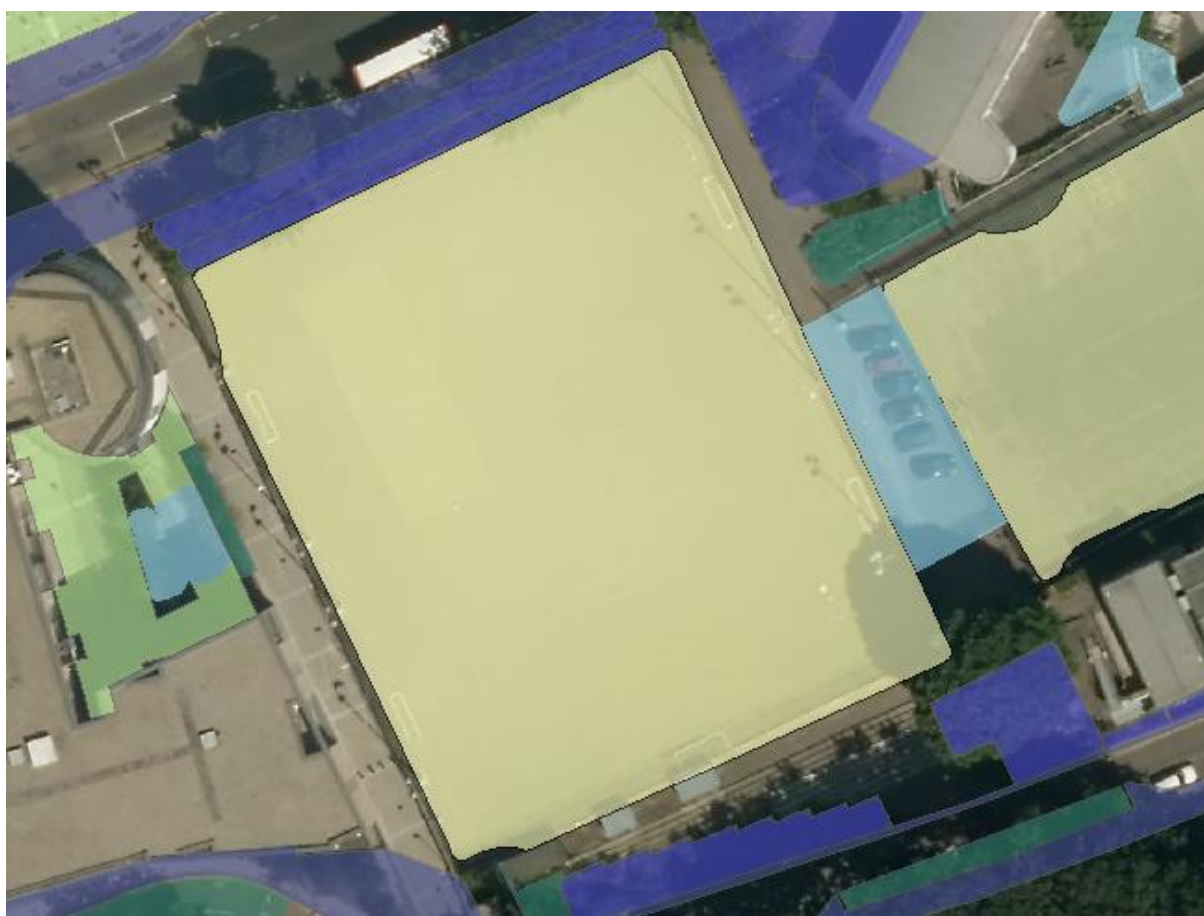


Bioretention solutions are landscaped planted depressions that drain surface water from all areas, except residential houses – which is where they mainly differ from rain gardens. Bioretention solutions include pocket infiltration, bioretention and multiple tree pits, with some storage capacity provided between the edge kerbs on roads.

The snapshot above identifies bioretention in the middle of the road, which would not be feasible. On closer inspection, the section of road identified is a traffic calming measure. The model has identified the potential for bioretention in the form of a bump-out or similar avoiding the middle line of the road.

Also in the image above the model has identified potential for a filter drain in the pavement, and swale in the adjacent natural space. The pink polygon to the right of the image suggests a green roof, when the underlying aerial imagery shows that it is a building site. This is because the model uses underlying building polygon data (OS Mastermap) that instead captures the building pre or post development, rather than the demolition phase shown by the aerial imagery.

Disconnecting downpipes



This extract shows a sports pitch identified with potential for disconnecting downpipes. At first this can be confusing – since the pitch is flat and at ground level. However, the model is suggesting the

downpipes from nearby buildings could be directed to the pitch, with underground geocellular storage under the playing surface.

Direct drainage to the Thames



The only constraint for direct discharge to the Thames is that the run-off source must be within 15m of the river. In the example above the highlighted section of road is further than 15m from the river. However, since OS Mastermap considers this to be a single polygon attached to the riverside road, it has been flagged as having potential for direct drainage.

Please note that the Thames is the only waterbody that SuDS Studio considers as viable for direct drainage. Canals, docks, tributaries etc. have not been considered due to a lack of data regarding water levels. However, locally held information may reveal other waterbodies that it is safe to discharge directly to as the most cost-effective way to manage surface water run-off.

Different solutions, side by side

The image above shows two solutions for different sides of the same landscaped area. A filter drain has been selected for the northern section, and a swale for the southern. This is because the model applies a minimum threshold sink area of 100m^2 for a swale (which is the most cost-effective option). The OS Mastermap polygon in the northern section is under 100m^2 . This is a function of how OS Mastermap divides land use areas into polygons – in this case the landscaped areas are divided by a path. In reality an engineer would probably see the areas as one space and apply the same SuDS solution to both. The yellow shaded path area has been identified as having potential for underground storage fed by disconnected downpipes from the surrounding roofs. Again, a site assessment would quickly reveal whether just one SuDS measure (e.g. a swale) could be used to address the local surface water run-off for all.

Apparently random SuDS solutions – aerial imagery vs OS Mastermap



In the main image above a small area with potential for permeable paving has been identified at a warehouse. From the underlying aerial image it is not clear what this relates to. However, OS Mastermap reveals this has been identified as a man-made courtyard or similar in front of the entrance to the warehouse.

The inset snapshot shows another discrepancy between OS Mastermap and the aerial imagery. It has identified a small area in a car park suitable for a rain garden. This is because the underlying land parcel has been classified by OS Mastermap as natural land – as we can see from the image any previous natural surface has now been paved for additional parking space.

These anomalies will crop up as there are discrepancies between the imagery and the OS Mastermap polygon classifications. However, they are generally small and easily dismissed – in the inset the user can clearly see that the predominant option that SuDS Studio has suggested as most cost-effective

for the car park area is downpipe disconnection to underground storage, potentially with filter drains around the perimeter of the car park.

No solution?



The above example shows a couple of garden polygons with no apparent SuDS solution. This could be perfectly valid since the expected run-off from surrounding sources might be managed sufficiently by using the surrounding rain garden sinks.

Bioretention in the road?



Numerous SuDS solutions have been suggested for the example above. The light green shading over the road is for bioretention. Although the whole road is identified, the bioretention solution is only being suggested (and scaled accordingly) for measures to the side of the road or as part of traffic calming measures. The road has been classified by OS Mastermap as minor. Presumably bioretention has not been suggested for the northern section of the road because surface water run-off is fully managed by adjacent SuDS solutions in a more cost-effective manner. In reality, it might be more cost-effective from a delivery perspective to stick to one type of SuDS solution (if feasible) when concentrating works in a specific area.

Building lean



Here, it appears that SuDS studio has identified a linear SuDS solution going through a building. However, it is actually referring to a suitable area around the base of the building (such as a footpath), which cannot be seen on the aerial image due to “building lean” – an error in the imagery that has not been rectified.

Further Information

The following information is available upon request for Lead Local Flood Authorities and relevant Risk Management Authorities:

- Raw modelling output data in GIS format – note that this data is large and may require the provision of an external hard drive to be provided to City Hall for transfer
- Suggested colour palette for raw data visualisation
- Individual Borough Summary Reports – these reports were created on the delivery of the modelling data and contain summaries of the modelling results in tabular and map form

Other formats and languages

For a large print, Braille, disc, sign language video or audio-tape version of this document, please contact us at the address below:

Public Liaison Unit

Greater London Authority
City Hall
The Queen's Walk
More London
London SE1 2AA

Telephone **020 7983 4100**
Minicom **020 7983 4458**
www.london.gov.uk

You will need to supply your name, your postal address and state the format and title of the publication you require.