Counters Creek SuDS Retrofit Pilot Study, London

SuDS used

- *Rain gardens*
- *Permeable block pavement / porous asphalt*
- *Attenuation basins (geocellular boxes)*

Benefits

- *Reduces runoff peaks*
- *Community involvement and endorsement*
- *Increased the level of green space and biodiversity*
- *Improved amenity value of the area*
- *Cost effective compared to traditional solutions*
- *Water quality improvements*

1. Location

– Melina Road, Shepherd's Bush, London W12 9HZ; 51°30'11.8"N 0°14'09.1"W

– Mendora Road, Fulham, London SW6 7NB; 51°28'56.3"N 0°12'29.1"W

– Arundel Gardens, Kensington, London W11 2LA; 51°30'50.7"N 0°12'19.5"W

2. Description

In recent years, over 2,000 properties across the Counters Creek catchment area, in West London (within Thames Water's area) have reported basement sewer flooding, with widespread flooding occurring in 2005 and 2007, following severe heavy rainfall. Since then, the local councils and Thames Water have been working together to address this problem and to help ensure that residents and businesses are protected against flooding. Ofwat approved the funds needed to undertake the Counters Creek Sewer Alleviation Scheme in December 2014.

The scheme includes a number of elements including introducing sustainable drainage systems into the local area to reduce surface water run-off entering the sewers.

The scheme is Thames Water's largest sewer flooding alleviation project and the aim is to deliver a long-term solution to basement sewer flooding specifically across west London. In addition to other sewer attenuation measures, this SuDS retrofit pilot project has been implemented to measure the effectiveness of sustainable drainage systems in controlling surface water flows to combined sewers in the Counters Creek area.

This submission focuses on three roads where SuDS have been implemented:

- Melina Road, Shepherd's Bush, London
- Mendora Road, Fulham, London
- Arundel Gardens, Kensington, London

3. Main SuDS components used

The Melina Road SuDS scheme has involved the installation of four new rain gardens in the existing pedestrian area at the southern end of the road. The rain gardens were constructed as typical bio-retention areas, with a topsoil surface that has allowed appropriate planting, and geocellular units beneath to provide the required attenuation.

Fig 1: Example of rain garden at Melina Road, Shepard's Bush:

The **Mendora Road** SuDS scheme comprises of linear permeable block paving within the existing parking bays on each side of the road, replacing the need for existing gullies. The south side of the road takes the runoff from the road and footpath and provides attenuation within the sub-base in a linear gravel trench installed beneath the block paving. On the north side of the road, a greater volume of attenuation is required because half of the roof area from the houses on the road drains to the highway. Attenuation is provided within a linear trench made of geocellular units.

Fig 2: Mendora Road, Fulham – block paving on each side of the road

At **Arundel Gardens, Kensington**, porous asphalt has been laid across the whole width of the road with enhanced attenuation within a shallow layer of geocellular boxes. This attenuation is separated in cascades with flow controls between them to maximise use of the attenuation and to minimise pass forward flows.

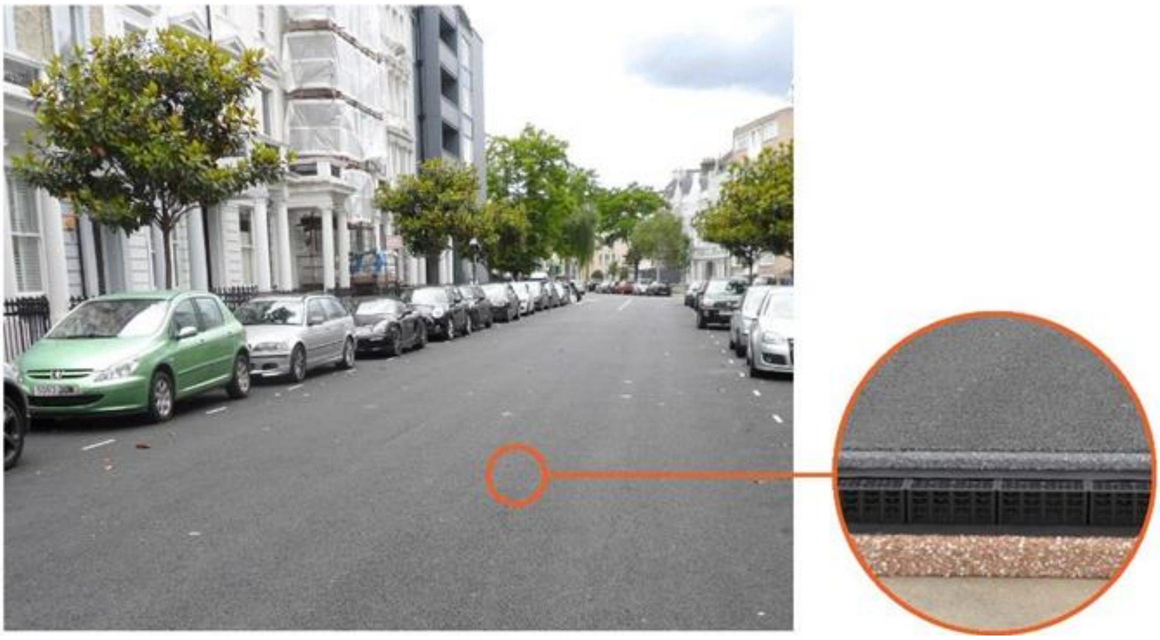


Fig 3; Arundel Gardens, Kensington showing the porous asphalt across the road

4. How it works

Melina Road – Surface water runoff is conveyed by gullies from the road and resin bound material with a flow channel made of geocellular units located under the pedestrian areas, directly into the attenuation layer of the rain gardens.

Mendora Road – Surface water runoff from downpipes, footpath and the road is conveyed through the permeable block pavement directly into the attenuation beneath. The permeable pavement strip on each side is divided into four sections separated by a flow control orifice, which maximises the attenuation capacity of the system.

Arundel Gardens – Gullies within the road have been removed and surface water runoff from the footpaths and the road is conveyed directly via porous asphalt into the attenuation beneath.

Attenuation in all three streets has been provided by lining the drainage system with an impermeable membrane that will prevent runoff infiltrating the ground.

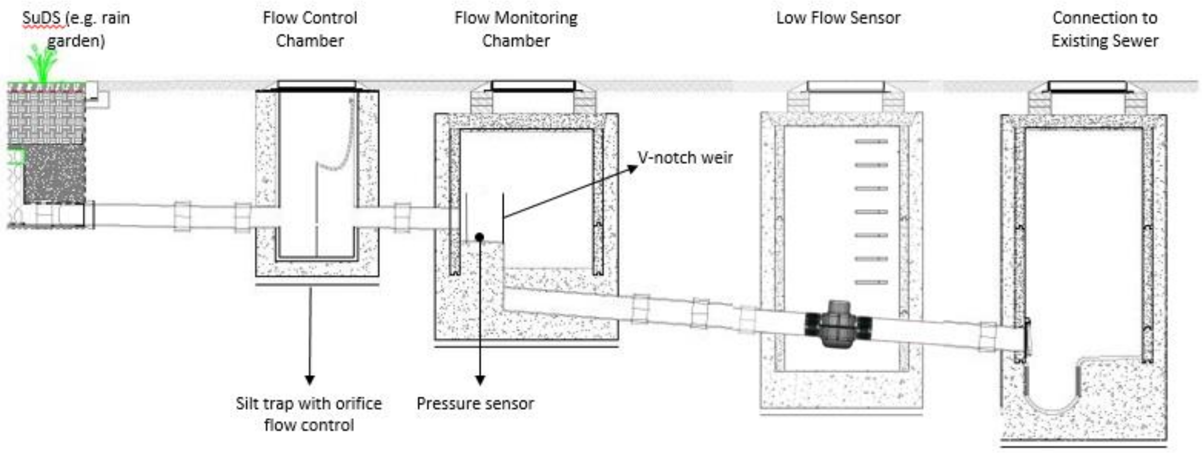
SuDS elements in all three streets have been designed to hold a one hundred-year storm event, with allowance for climate change within the underground system. It was noted that for systems that are collected via gullies, temporary ponding on the road would appear during high intensity storms. Interception losses were not calculated as part of the initial design.

Flow Controls

Flows from all three streets are controlled by the same type of controls. Removable plates with orifices and weirs are located within the flow control chambers. Orifice plates in control chambers are holding water within the attenuation tanks and pass forward a maximum 5 litres/second for events of up to a thirty-year return period frequency. For less frequent events, the flows will overtop the plate over the weir to allow passage of events of up to a hundred-year return period frequency.

Monitoring Chambers

Flow control chambers are followed by a monitoring chamber (where monitoring equipment is installed) before final discharge to the combined sewer system.



Drawing: Typical set up for monitoring chambers for all three streets

Water Quality

Although water quality improvements were not the primary driver for these schemes as they discharge to a large combined sewer, water quality improvement of road runoff would be achieved using permeable block pavements, resin bound material and porous asphalt.

Runoff inflow from the carriageway in Melina Road, through the top of rain gardens that would have contributed to water quality improvement, was not possible due to the layout of the site. Additional catchpits are installed before attenuation, when the runoff is collected via gullies to reduce the amount of silt reaching the attenuation tanks.

Multifunctionality

Use of block paving and porous asphalt has meant that parking at Mendora Road and Arundel Gardens was unaffected. Rain gardens at Melina Road enrich the biodiversity and enhance the local environment near the school. The community also has an interest in the maintenance of the rain gardens with 'ownership' of one specific garden, while a local senior school's gardening club is directly involved in the care of two of the gardens. The fourth rain garden has been allocated to a local Nursery School so that the children can be involved with the planting.

5. Specific project details

Compared with traditional drainage, the implemented scheme reduces runoff peaks and elongates the time of entrance to the combined sewer system. Impermeable lining prevents substantial reduction of runoff volume. However, flow controls attenuate the water in the storage layers before draining into the main sewer after storm events cease.

Street	Catchment area (ha)	Proportion of SUDS footprint
Melina Road	1.68	2.31%
Mendora Road	1.11	8.50%
Arundel Gardens	1.02	17.66%
Total	**3.81**	**8.22%**

Table: Percentage of catchment area covered by SuDS footprint

In relation to entire Counters Creek catchment, 0.0125% has been transformed into SuDS.

6. Maintenance & operation

Thames Water has funded the construction of the project and will monitor and maintain the scheme for a period of 24 months following completion. Once this 24-month period has expired, the monitoring and maintenance responsibilities will lie with the local Councils thereafter.

7. Monitoring and evaluation

Thames Water and Imperial College London are undertaking monitoring and are ensuring that these pilot projects remain robust in terms of measurable outcomes so to influence the nature of future schemes.

An Independent Advisory Group of leading experts is also in place to scrutinise the process of modelling and monitoring. Each of the discharge structures from the SuDS is equipped with a level monitoring device either side of a calibrated V-notch weir. For Melina and Mendora Roads, level monitors are also fitted to the orifice plates so that levels with the geocellular storage/gravel can be measured.

A fine scale conceptual model will be developed to simulate hydrological processes within SuDS, including precipitation, evapotranspiration, interception losses, surface runoff, and infiltration. A network of rain gauges covering the entire catchment provides measurements of rainfall. Those measurements combined with the flow survey from main sewers helped understanding the rainfall-runoff processes in each street to identify the sub-catchments draining through SuDS. This enables computation of inflow to SuDS, while outflow from SuDS is obtained from monitoring of discharge at the outlet of each device by a calibrated v-notch weir.

The performance indicators considered in this study are mainly quantitative. These are the peak flow reduction and lag times between existing sewer peaks and SuDS outflow peaks.

8. Benefits and achievements

This project's greatest achievement has been the success of collaboration. Thames Water, the Royal Borough of Kensington and Chelsea together with the London Borough of Hammersmith and Fulham worked together, as one, with their contractors and suppliers to bring the project to fruition.

Communication was key to ensuring that the residents were supportive of the pilot project. To install sustainable drainage systems in residential roads, this required road closures and associated disruption to residents. The project team needed to ensure that the residents were fully aware, in advance of forthcoming project requirements. Regular project updates were hand delivered to all residents and a simple questionnaire to all residents at completion of installation provided evidence of the approval of residents that they had been kept sufficiently well informed. Over a period of eighteen months of work, only one complaint was received. The method of communication used for the SuDS project was adopted by the London Borough of Hammersmith and Fulham for their own projects, such was the evident success of a simple and pictorial flyer.

9. Lessons learnt

The essential key challenge was 'the unknown'. The project had been planned but the installation of these types of sustainable drainage systems under residential roads in urban London was untried. The installation of such extensive installations, including monitoring chambers was a challenge with potential objections from residents and technical difficulties for the project team but it was realised that good communication was key to overcoming potential problems.

Residents were kept well informed at all times and the project team communicated regularly and jointly overcame technical difficulties in the early stages.

Project design was revised numerous times to adapt to unexpected requirements – such as a high voltage cable under a pavement; excessive concrete surrounding a water main that required a design change for the SuDS; passive watering systems that could not be installed and required a change of design; rain garden designs that needed to be adapted to allow high pedestrian footfall from the Academy; disabled spaces that needed to be extended; and resurfacing required at Mendora Road due to unexpected third party paint spillage. The project was very much a pilot project that had to adapt to the circumstances in which it was being rolled out. The fact that the project was such a success is specifically due to communications and a flexible team of designers and contractors.

10. Interaction with local authority

Good working relationships with the local authorities was essential for a successful project outcome. An open and honest dialogue was necessary at all times to ensure that potential hazards and problems were considered. As the project progressed, the relationship between Thames Water and the local authorities became stronger and more collaborative. Presentations to external organisations were given jointly; decisions were made jointly and communication was regular and detailed, and communications to residents were co-branded at all times.

11. Project details

Construction completed and Costs:

Melina Road
Start Date – 11/02/2016, Finish Date – 20/03/2017 (Completion Certificate Date)
Final Actual Construction Cost - £522,881.15

Mendora Road
Start Date – 11/02/2016, Finish Date – 20/03/2017 (Completion Certificate Date)

Final Actual Construction Cost - £1,368,684.81 (this includes the requirement to undertake a water main diversion)

Arundel Gardens
Start Date – 21/11/2016, Finish Date – 17/03/2017 (Completion Certificate Date)
Final Actual Construction Cost - £737,167.43

Extent:

The following table shows the percentage of catchment area covered by SuDS footprint:

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12. Project team

Funders	• This project was unique in that a Funding Agreement was drawn up between Thames Water and the two Borough Councils and their Term Maintenance Contractor.
Designers	• Under CDM 2015 the following responsibilities were assigned: • Project Sponsor – Thames Water / SMB JV • Clients – London Borough of Hammersmith & Fulham and Royal Borough of Kensington & Chelsea • Principal Designers – AECOM, Mott McDonalds and Atkins
Contractors	• Principal Contractor – FM Conway • Subcontractor and Supplier – SEL Environmental
Monitoring	• Thames Water, Imperial College and Atkins

13. Project pictures / images

Fig 4: Permeable block paving being installed at Mendora Road, Fulham

Fig 5; Local school engaged in planting at Melina Road, Shepard’s Bush

Fig 6: Resurfacing Arundel Gardens, Kensington with porous asphalt