160 Old Street, Islington (036 02 06 20)

SuDS used

- *Retrofit of blue roof and biodiverse roof systems to provide storm water attenuation on 16 different roof zones, incorporating green roof and decking surface finishes.*

Benefits

- *City centre location with no space to excavate ground level storage tanks, requiring a roof top storm water attenuation solution in accordance with GLA and CIRIA guidance for retrofitting of SuDS.*
- *Includes green roof systems and biodiverse surface finishes to attain the '4 pillars' of good SuDS design criteria (i.e.providing biodiversity, amenity, quantity & quality).*
- *A series of rooftop plant areas, roof terraces and green & biodiverse roofs creating new green spaces in an urban setting, with an environmental rating of BREEAM Excellent.*
- *Positive reduction in surface water runoff rates and volumes from the pre-existing position.*

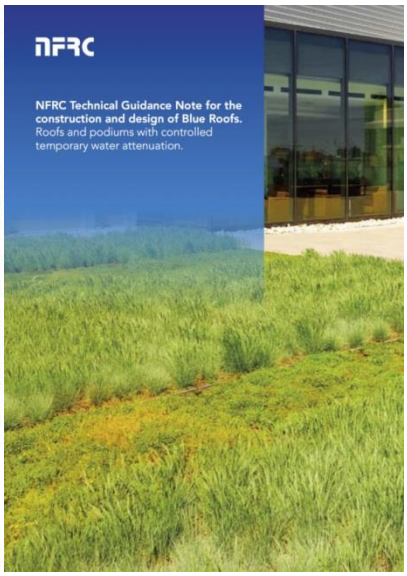
1. Location

160 Old Street, London, Islington, EC1V 9BS

2. Description

160 Old Street is a nine-storey office redevelopment scheme in London designed by Orms Architects on behalf of The Great Ropemaker Partnership, a 50/50 joint venture between Great Portland Estates plc and Ropemaker Properties Ltd. Formerly known as 148 Old Street and owned by Royal Mail, consent was awarded for the comprehensive refurbishment plans in 2015. Completed in 2018, the 14,920m^2 of office space comprises a complex array of 29 different roof zones over multiple floor levels, with 16 of the areas re-designated to blue roofs and or green/biodiverse roofs. This design encourages local biodiversity, and attenuates storm water at source to reduce the volume of surface water runoff and the associated risk of flash flooding. The blue roof option was deemed the most cost-effective SuDS solution for the restricted site, with the construction of a basement stormwater attenuation tank deemed impractical, prohibitively expensive and impacting plans for the majority of the basement to be converted into office accommodation.

For this reason, blue roofs were the preferred solution for SuDS compliance on the project. This is driven in part by climate change with more frequent and extreme rainfall events; as well as government planning policy which is encouraging rainwater runoff to be controlled as close to its source as possible. Increased awareness of the blue roof solution was being raised by key design guide documents, such as the 'National Flat Roofing Contractor's Technical Guidance Note for Blue Roofs' that sets out basic minimum performance criteria and includes advice on insulation, falls, waterproofing, exceedance overflows and surface finishes. More in-depth guidance on SuDS, including specific examples of dos and don'ts, is available in CIRIA's SuDS Manual.

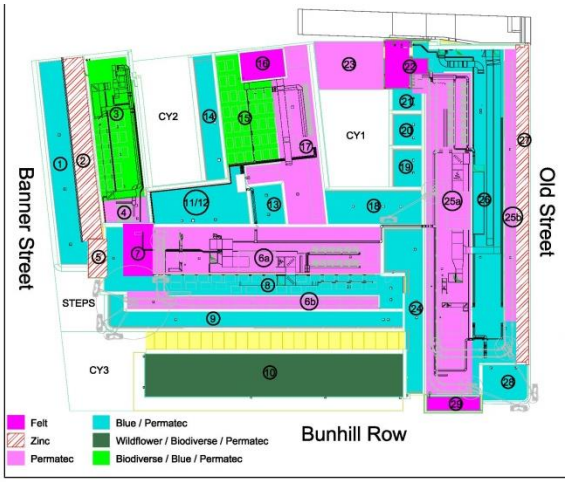


The SuDS Manual C753 from CIRIA ***NFRC blue roof guidance***

3. Main SuDS components used

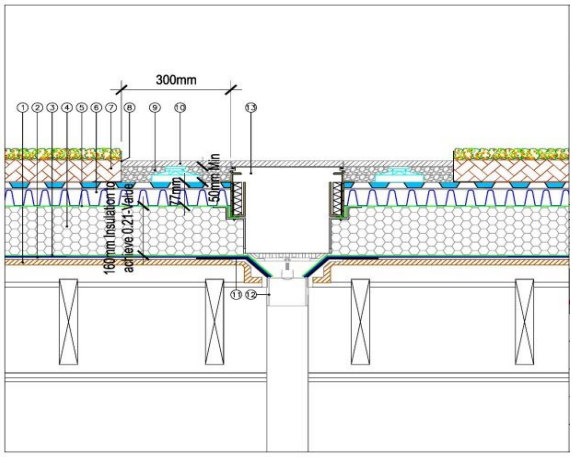
A combination of blue roofs surfaced with decking and biodiverse surface finishes, and a separate green roof area (with no 'blue roof' attenuation system) were specified by Orms Architects and Hilson Moran Engineers at design stage. The roofs maximum discharge rates were calculated in accordance with the planning team's SuDS requirements, as part of the design and build contract awarded to Wates Construction.

160 Old Street building & roof levels



Plan showing the 29 different roof zones & 6 types

The blue roof systems were installed on top of a hot-melt membrane waterproofing layer, favoured for its robustness and compatibility with the building's concrete roof deck. For the inverted roof configuration, a layer of 180mm thick XPS rigid insulation was used above the waterproofing and overlain with a water flow reducing layer. The blue roofs attenuation void former layers were installed above with an additional drainage or reservoir geocomposite product used, especially in the case of the biodiverse roof areas on roofs 3 and 15 and in the separate green roof system build-up installed on roof 10.

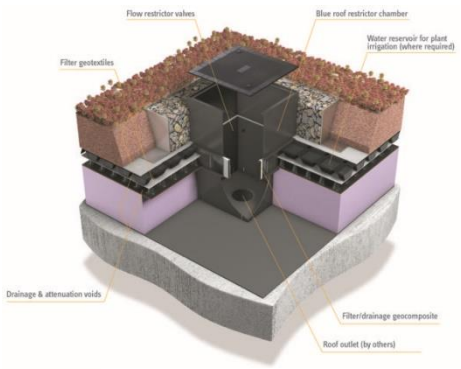


Inverted roof, blue roof build-up & configuration

Blue roof restrictor chambers (42 in total) with integral geotextile filters were positioned above each rainwater outlet to slowly release storm water into the local drains following the key design storm events. Accessible from above for regular maintenance access, the restrictor chambers are key to the SuDS performance of the 'blue roof' systems. In total 976m^2 of blue roofs were installed, providing attenuation capacity designed to restrict flow to 23.1 l/s in the event of a 1-in-100 storm event, plus 30% for climate change.

4. How it works

Designed to facilitate controlled attenuation following heavy rainfall or storms, blue roofs are suitable for a wide range of building types and applications, including green roofs, terraces, podiums and general amenity areas. They place storm water attenuation within the building footprint, making them ideal for urban environments where ground space is limited. In average rainfall events the water permeates through the system and into the drainage outlets as normal. During high intensity and prolonged rainfall events however, the 'blue roof' attenuation voids start to backfill as the rainwater flows are slowed/controlled by the sized control orifices in the blue roof restrictor chambers to reduce the runoff rate. The water is then slowly discharged into the RWOs. In the unlikely event of an exceedance event or problems on the surrounding roof area, there are integral overflow positions in every blue roof chamber.



Restrictor chamber diagram

In the combined 'blue roof' and green roof system design, a reservoir board helps to retain the optimal amount of water for the plants to flourish. The reservoir board's core is perforated to allow excess water to drain away, preventing pooling and oversaturation of the plants. A bonded geotextile provides elements of moisture retention, separation, filtration and protection and also helps provide a fully wrapped, SuDS blue roof system.

5. Specific project details

As part of planning condition 20, the Flood Risk Assessment prepared by Hilson Moran defined a roof top storage volume of 80m^3 to negate the need for below ground, attenuation tanks. The proposed ABG blue roof design further increased this capacity to 100m^3 to mitigate the effects of climate change on rainfall runoff over the lifetime of the proposed development. The redevelopment of the roof areas provided environmental/biodiversity enhancement and reduced flood risk. The development achieved two BREEAM Pol 03 'surface water runoff' credits as a result of not increasing the impermeable surfacing compared to the pre-existing condition.

For the green roof and biodiverse roof areas, large stones, sand piles and native hardwood logs have been placed to support invertebrates and other wildlife. All the growing media substrates were plug-planted with 3 native or naturalised sedum species and a range of wildflowers plugs, including the species listed below:

Agrimony, Kidney Vetch, Common Knapweed, Viper's Bugloss, Lady's Bedstraw, Perforate St John's Wort, Wild Candytuft, Field Scabious, Rough Hawkbit, Oxeye Daisy, Common Toadflax, Birdsfoot Trefoil, Musk Mallow, Wild Marjoram, Hoary Plantain, Salad Burnet, Cowslip, Selfheal, Bulbous Buttercup, Wild Mignonette, Wild Clary, Small Scabious, Bladder Campion, Wild Pansy.

The biodiverse growing medium was installed directly onto the drainage/reservoir board, built up and mounded to a depth from 80 - 150mm. This was composed of recycled/crushed brick, fine grade topsoil (certified to BS 3882) and composted recycled material (certified to PAS 100). Both the top soil and compost used met strict soil association standards; and as required by GRO Guidance, a separate ballast border of 20-40mm washed stone was used for the fire break perimeter.

6. Maintenance & operation

Regular site inspections preceded integrity/quality tests for both the waterproofing and blue roof elements. As part of the green roof establishment, thorough watering was required during and immediately following installation, and before the planting was installed. This was to fill the underlying reservoir board so that some water retention is already provided for the planting and to moisten the growing media.

The pre-grown vegetation (mat/plugs) were thoroughly watered after installation, or as soon as a sufficient area of planting was installed, using either a hose pipe with spray attachments or sprinkler system. All newly installed sedum blanket vegetation required watering-in for at least the first month after completion, with the subsequent frequency of watering then dependent upon the time of year and current weather conditions.

For the hand cast wildflower seed mix, it was important to apply seed directly to the moist growing media layer and leave to germinate and establish at its own pace, then requiring irrigation only in prolonged drought conditions, once established.

For all green or biodiverse roof installations there is always a requirement for a water supply at each roof level prior to the delivery and installation of the vegetation, with a minimum of 3 bar pressure required to provide sufficient pressure to operate up to four sprinkler units simultaneously during the establishment and watering-in periods of the planting.

7. Monitoring and evaluation

The installation contract included the first year's maintenance, with on–going bi-annual maintenance required beyond this period, which was agreed and continues between the client and their approved maintenance team. The facilities team from Great Portland Estates were perhaps the most proactive team we have ever worked with on a project.

8. Benefits and achievements

- The project achieved a BREEAM 'Excellent' rating.
- 171 m^2 of blue roof system with biodiverse finish installed for roof zones 3 & 15, and 120 m^2 of green roof for roof zone 10, using 73.75 m^3 of biodiverse mix, including a specific London wildflower seed mix, 8,600 plug plants, and log, sand and rock hibernacula.
- Over the 15 roof zones with blue roof components, 976m^2 of blue roof system and void formers and 42 blue roof restrictor chambers were installed, along with drainage geocomposites, reservoir boards and geotextile wrap.
- For the green roof perimeters, 121m^2 of Sudspave permeable paving and 300 bags of 20-40mm pebble were installed.
- A two man Geogreen team installed the roofs over a period of 48 days.

9. Lessons learnt

The nature, number and complexity of the roof areas meant a single source approach to the design, manufacture and installation was beneficial to reduce product incompatibility and avoid split responsibilities and product warranties over the waterproofing and 'blue roof' systems. It also simplified the onsite programme, ensuring that the 'blue roof' was installed directly after the waterproofing work, avoiding potential damage to the membrane layer by follow-on trades or use of the roof as storage space (both very common issues on sites).

The project's geographical and tight urban location was key, and determined what type of SuDS process could be utilised to meet the planning authorities' strict site discharge requirements.

The green roof planting was carried out during very hot weather, and took a while to establish due to insufficient watering during the interim periods between maintenance visits. Remote irrigation systems were recommended to avoid this scenario, or for facilities management to carry out more frequent watering to these areas to aid the development of plant and seed growth. The biodiverse roof eventually established following implementation of a more regular watering regime.

10. Interaction with local authority

As part of the planning application, careful consideration was given by Islington Borough Council to the required attenuation capacity, water treatment and filtration, roof space function, and environmental/greening potential. The ability to balance these needs was key to good SuDS practice, and required close cooperation of the project team from the outset. The application also included the BREEAM 'Excellent' pre-assessment work to protect existing ecology and make the fullest contribution to enhancing biodiversity (CS10, DM6.5) e.g. by maximising the inclusion of green/biodiverse roofs, ecological landscaping, greening of facades and artificial nesting sites.

11. Project details

Construction completed: April 2018.

(Green roof/biodiverse roof and blue roof maintenance programmes ongoing, as required by planning).

Cost: Redevelopment of £25m / SuDS incorporating blue roofs £150k

Extent: Internal office floor area 14,920m^2 / SuDS attenuated roof areas of 976m^2

12. Project team

Funders & Clients	• Ropemaker Properties Ltd • Great Portland Estates	GREAT PORTLAND ESTATES
Designers	• Hilson Moran Engineers • Orms Architects • ABG (blue roof design)	HILSON MORAN SIG DESIGN TECHNOLOGY abg

Contractors	• Wates Construction (with SIG D&T/IKO) • Geogreen (blue roof & biodiverse roofs) • Tilbury Contracts (flat roofing)	
Planning Team	• London Borough of Islington	

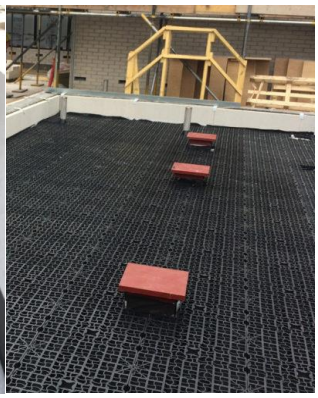
Roof zone 15 with the biodiverse area visible surrounding the PV panels

Biodiverse zone showing stone & log pile to support insect life

Amenity terrace area decking boards above 'blue roof'

Penetration detail around man safe post

Geotextile wrap to void former at parapet wall



Void formers & restrictor chambers

Blue roof restrictor chamber