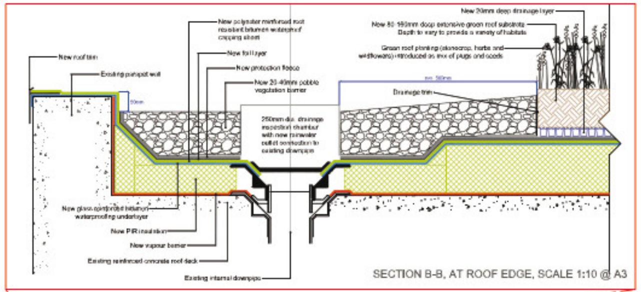
The over- arching aim of this project is to contribute to the climate proofing of vulnerable urban environments by retrofitting green and blue infrastructure. The £1.4 million project delivers a holistic package of climate change adaptation solutions in three social housing landscapes. It retrofits highly effective, affordable and socially acceptable alternatives to heavy engineering approaches by using Sustainable Urban Drainage Systems (SuDS), such as rain gardens, drought-resilient planting and green roofs supported by rainwater harvesting to minimise fresh water use for irrigation.

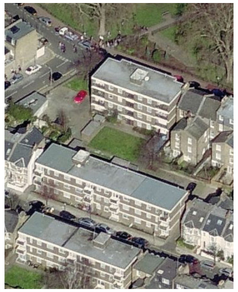
The selected sites also reflect different social housing contexts, property types and estate sizes. By targeting sites which are all situated in areas with high levels of multiple deprivation, the project also helps to reduce deprived communities' vulnerability to climate change. It demonstrates different mechanisms for resourcing the delivery of adaptation measures, e.g. by combining implementation with accredited training programmes for long-term unemployed local people, thereby creating local jobs. Transferable training modules for grounds maintenance contractors and social housing staff promote green infrastructure measures for climate-proofing housing landscapes, and cover the whole housing management cycle starting from adapting procurement policies and tender specifications to reflect adaptation principles, feasibility assessment, design, implementation and ongoing maintenance of the measures.

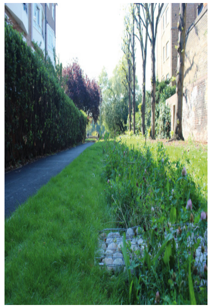
Another key aspect is in-depth community engagement and awareness - raising of climate change adaptation opportunities to secure the local residents' buy-in for the measures. The project on Queen Caroline Estate in west London, consisting of 17 residential blocks with incidental open space suffering from poor environmental performance, created two green roofs (400m2), living walls, rain gardens, Austrian gravel lawns (Schotterrassen), new trees and 1000 shrubs. Cyril Thatcher House and Richard Knight House have had green roofs (800m2), rain gardens and Austrian gravel lawns (100m2). There are 3-4 new trees and 50 shrubs. Cheeseman's Terrace has green roofs (800m2), rain gardens and gravel lawns (200m2), and new trees (30 new trees and 300 shrubs).

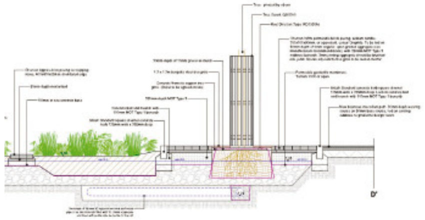
Qualitative and quantitative indicators of these improvements will be:

- Reduction in run-off can be measured in terms volumes entering selected downpipes from roof. Automated meters and dataloggers can be fixed to various downpipes for comparison. The key parameter will be reduction in run-off for selected rainfall events measured in litres/second. Reduction in run-off from extensive green roofs is typically 50% over the course of the year, therefore an improvement in excess of this is expected with the proposed package of measures.
- Increases in evapotranspiration can be calculated from reductions in run-off, which will be measured. Evapotranspiration will be expressed in millimetres (a rainfall equivalent) or litres/m2. Increase in evapotranspiration is related to reduction in run-off. An increase of 100% (doubling) is predicted in existing 'grey' locations over the lifetime of the project.
- Temperatures in fixed-point observation areas can be measured using thermal imaging and compared with untreated control areas. Ambient temperatures and precipitation can be recorded from on-site automated weather station. A reduction of 5 deg C in ambient temperature is expected on hot summer days. Electricity bills can be compared between periods and dwellings to measure energy savings during certain periods (eg summer warm periods). Electricity bills show the kilowatt hours (kWh) used. This can be converted to carbon equivalent using standard conversion factors and expressed as kgCO2/kWh. Savings of 4 kWh/m2/annum are typical for extensive green roof installations.
- Samples of run-off will be collected during rainstorms from rain garden and green roof outfalls and tested for Biological Oxygen Demand (BOD5 as mg/L), Dissolved Oxygen (DO in milligrams per litre mg/L), Ammonia (Total N in mg/L) and Phosphate (Total P in mg/L). These parameters are defined under the Water Framework Directive. Areas treated with green infrastructure interventions can be compared with untreated areas. A comprehensive SuDS approach, such as the one proposed here, is capable of reducing pollution in surface water run-off by 90%.
- Soil and vegetation cover will be measured and fixed point photography used to record quality during 4 seasons. The parameter used will be % vegetation cover for the area assessed. We believe that an increase of 100% of vegetation cover is feasible when roof greening is part of the scheme.
- Particulate matter in the air is expected to decline. This can be measured using standard equipment and techniques used to compare locations. Standards are published for PM10 pollution (particulates with diameter less than 10 microns) and this can be a metric for measuring air quality. PM10 is measured in micrograms per cubic metre of air equivalent µg/m3. Reductions of 2% in total particulate matter pollution of an urban area are predicted based on green roof effects.
- Biodiversity will be measured through annual vegetation surveys (species lists and composition). Faunal groups that will be studied are birds (records will be maintained as part of the resident engagement programme) and selected invertebrate indicator groups (spiders, beetles, wild bees). Specimens will be collected in pitfall traps and by annual sweep netting and sent to specialists for identification. There will also be a citizen science element to monitoring biodiversity with photographs taken by residents emailed to experts. Biodiversity will be expressed as species diversity (ie number of species of various selected groups of organisms (i.e. plants, birds, spiders, beetles, wild bees). Increases in the biodiversity of selected groups when conventional amenity vegetation is compared with a biodiverse treatment is expected to be of the order of 50%.



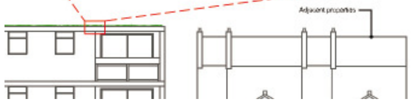






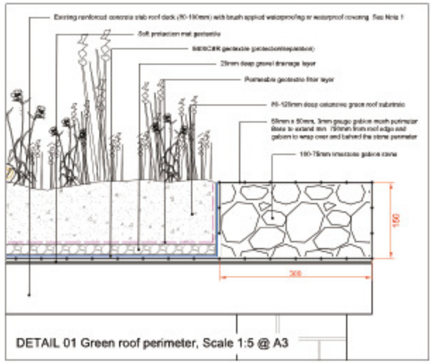
LIFE+ LBHF

- Low-level green roofs, rain garden & tree trench



LIFE+ LBHF

- Extensive green roof to Richard Knight House



LIFE+ LBHF

- Attenuation basins – soft & hard landscape

LIFE+

Climate Proofing Social Housing Landscapes

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CHANGING PLACES
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