Review of the Knightsbridge Neighbourhood Plan

POLLUTION MANAGEMENT – POLICY CASE STUDY

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ABSTRACT

Neighbourhood Plans are a mechanism in which local communities can shape the development of their immediate physical environment. It can provide a basis for future legislation involving land use. The Knightsbridge Neighbourhood Plan aims to be a blueprint for other future neighbourhood plans and to be an exemplar in sustainability by complying with international standards and best practices

Land use and planning policies can be utilised to target sources of emissions, disrupt pathways and protect receptors from harmful pollutants. The environmental policies currently proposed in the Knightsbridge Neighbourhood Forum Plan are ambitious in aiming to protect human health and the wider environment but therein lies areas for improvement. Our task was to examine this plan with regard to the scope, gaps and the evidence underpinning the measures, lay out the local issues and recommend further measures to bridge the gap between the current situation and the desired state.

We identified Waste to Resource Management, Air Quality, Energy Resilience, Surface Water Flood Risk, Urban Greening and Over-heating as priority areas and our recommendations ranged from food waste management plans for the Commercial and Industrial sectors, green infrastructure and sustainable building designs to deal with surface flood risk, over-heating and urban heat island effect, and mitigating the street canyon pollutive effect. We also have identified synergies and co-benefits of our recommendations, as well as its economic viability, technical feasibility and deliverability.

Our proposed measures will not only improve the well-being of the local population, but also contribute to the overall global efforts of climate change mitigation.

Introduction

The UK planning system aims to help communities develop in a sustainable manner by addressing their aspirations and needs in the social, economic and environmental spheres. The legislation of Localism Act in 2011 brought a structural change to the UK's planning hierarchy (Figure 1 shows the change in the England's planning hierarchy before and after the introduction of Localism Act.). It abolishes the regional tier of the statutory planning system and adds a new tier – Neighbourhood Plans, empowering local communities to produce and have a major role in implementing their Neighbourhood Plan.

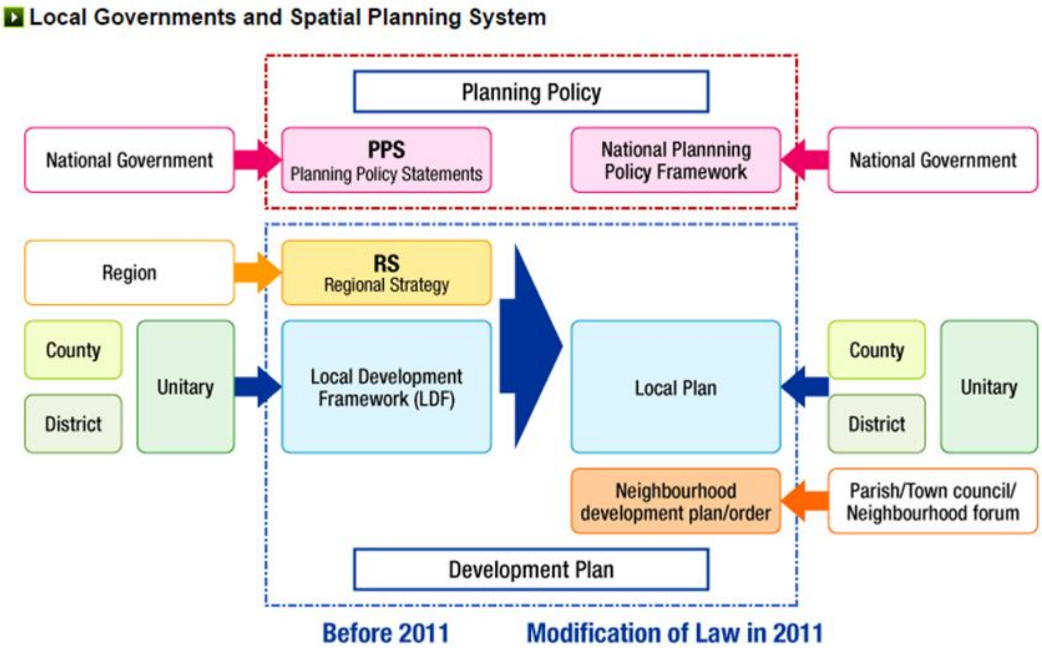


Figure 1: Local Governments and Spatial Planning System (Credit: Ministry of Land, Infrastructure, Transport and Tourism (MLIT) of Japan, 2015)

Challenges of the Planning System

Opportunities with the Localism Act include eliminating top-down bureaucracy in the planning hierarchy, devolving power, money and knowledge to the local planning authorities and community level and hence allowing a more contextualised approach to address local issues. However, there are also challenges with the Localism Act:

- *Uncertainty for Investment* - The business sector is risk avoidant and it is not desirable for them in invest in the different regulations set out in different neighborhood plans, which may bring additional business costs
- *Uncoordinated development* - One of the greatest challenges for the planning system in England is how to consider strategic issues that may affect a wider area than the individual plans. Localism without accountability and without such a strategic framework can only reinforce existing spatial inequity as well not ensuring

that the needs of future generations are met. For example, planning for biodiversity at a landscape-scale across local authority boundaries.

- *Vulnerability and exploitation* - The local residents may not have the necessary knowledge in drafting a feasible plan and they may lack the capacity to make informed choice in a referendum. There are potentials for corporate takeover as NDPs can provide apertures for big capital to exploit local communities' powers to achieve corporate ends.

- *Reinforcing existing spatial inequality* - Community Infrastructure Levy (CIL) is smaller for poorer neighborhoods as the land market is less active. Wealthier areas are thus more likely to make applications (and to be approved) for neighbourhood plan-making. CIL does potentially incentivise some communities and some reluctant players in communities to get involved. But it also reinforces inequalities by ensuring the rich get richer: for example, the poorer neighbourhoods will not be subjected to CIL as land markets will not bear these additional costs.

Reviewing the Knightsbridge Neighbourhood Plan

The Knightsbridge Neighbourhood Forum is the first local community in London to publish for consultation a Neighbourhood Plan (NP) that laid out their developmental objectives and strategies, which was put together after extensive engagement with the local residents, businesses and other stakeholders. The Plan aims to make the Knightsbridge area the best place to live, work, study and visit, of which a key objective is to be an "exemplar in sustainable development" by adhering to international standards, guidelines and best practices.

This report sets out our assessment of the Plan's environmental policies and provides evidence-based recommendations that would help the Knightsbridge community fulfil their sustainability vision.

METHODOLOGY

The first key action was to review the Knightsbridge Neighbourhood Forum Plan (KNFP) document as a whole *in terms of its scope, gaps in measures and evidence adequacy*. This involved the team reviewing not only the Plan itself but also information provided by our client.

Based on the initial review and interviews with our client on his concerns and requirements, we identified the following areas for research:

- Air Quality
- Waste to Resource
- Energy Resilience
- Surface Flood Risk

- Urban Greening
- Overheating

An essential part of our methodology was face-to-face interviews with our client, which aims to understand his concerns, and ensure the practicality of our findings and recommendations with regard to the Knightsbridge neighbourhood. His concerns were geared between balancing of environmental solutions, economic viability and technical feasibility, and preservation of the historical features of the area. In addition, in response to his request, our recommendations aimed to be as ambitious as possible.

Iterative discussions with the client helped to confirm the findings useful for the Knightsbridge Neighbourhood Forum. Based on these discussions evidence gathering was a key focus, and where possible, data was retrieved on Knightsbridge and Belgravia. When that was not possible, environmental data relating to the Westminster area was searched for. Once we had concluded our search findings, we had to review the most relevant data and legislations and include these in our reports.

To summarise, the objective of our research strategy for gaps and enhancements for the Knightsbridge Neighbourhood Forum Plan was to uncover information and data which would assist us in creating policy measures that can be directly applied and be effective in the objective of safeguarding the environment. In addition, the policies proposed are intended to have some level of applicability to other Neighbourhood Forum Plans.

The use of institutional websites and databases was an important joint decision made, and ensure the reliability of our data. This is not only beneficial for policy makers but also other stakeholders wishing to use our data.

The primary research undertaken was a descriptive research. This was done to systematically describe the current situation and trends which relate to the KBNF.

Most areas within the KNFP were subject to a feasibility study. This involved an investigation to determine the feasibility of the proposals.

RESULTS

Waste to Resource Management

Food waste (Commercial & Industrial) - Food waste needs to be tackled on a local, national and international level. In comparison to material waste, there are no substantive legislations or policies aimed at preventing food waste from occurring. They key reason why the management of food waste needs to be addressed is due to multiple water, land and energy needs for crops and livestock. Closely related is the contribution to greenhouse gases (GHG) that poorly managed food waste can create, which has an adverse effect on climate change. Furthermore, there is the large opportunity cost of food waste production.

Material Waste - Material waste is another area of concern, and should be tackled under NP. Three reasons why it needs to be tackled, is due to resource depletion, the UK 2020 target of 50% of household recycling rates (CIWM, 2016) and projected population growth.

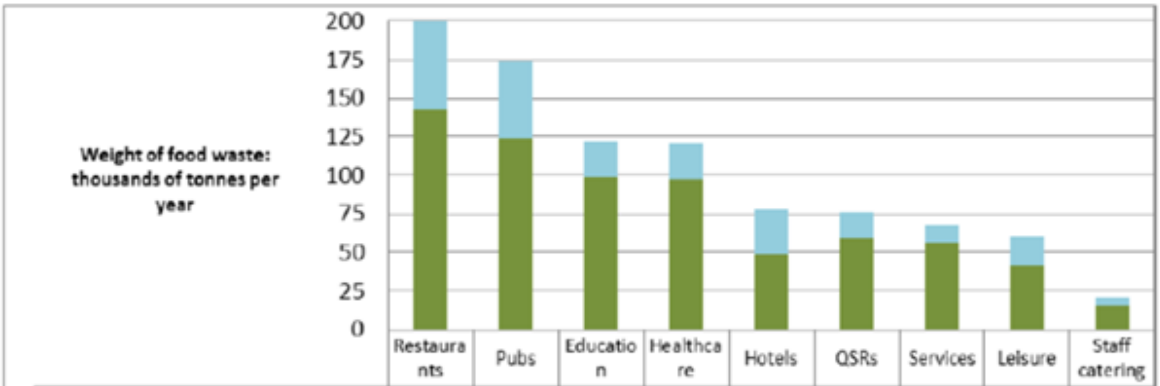
Influence of the Neighbourhood Plan - Due to the NP having the power to influence land-use and policies, it would be more effective to concentrate on the Commercial and Industrial sector and new housing developments as key areas of intervention for food waste solutions. Despite the relative micro impacts that the KNFP can have, it is important to give a scale of the food waste issue nationally. The use of micro was in reference to the area size of the neighbourhood, thus commentating on its magnitude rather than its significance.

Credit: KBNF *Figure 2.*

Evidence from Defra states that over 90% of food waste from restaurants is disposed within residual waste nationally (Defra, 2015). In regard to Quick Service Restaurants this figure stands at 60%. Considering that the local area has several restaurants and QSRs, careful designing of land use and planning policies in the NP can have a positive effect in reducing the amount of food waste within residual waste.

In the UK, there is no exact legislative definition of food waste (European Union Committee, 2014). So, it would be beneficial to refer to an international definition as a substantive meaning of food waste. According to the Food and Agriculture Organisation of the United Nations, food waste is defined *as food that is fit for human consumption, but is not consumed and is left to spoil or is discarded of* (FAO, 2017). This definition of food waste complements the EU Directive's wider definition of waste which states 'any substance or object which the holder discards or intends or is required to discard’. In the absence of any legislative definition, the Knightsbridge Neighbourhood Forum should adopt the international definition, especially considering Brexit.

The amount of food wasted within the UK Hospitality and Food Sector adds up to the equivalent of 1.3 billion meals per year (WRAP, 2013). Most of the food waste from the restaurant and the QSR sector fall under the category of avoidable food waste. Avoidable food waste can be defined as food which was edible prior to its disposal and could have been consumed if it had been better portioned, managed, stored and/or prepared (WRAP, 2013). This used national definition provided by WRAP is in line with the FAO definition of food waste, but goes further to make the distinction between avoidable and unavoidable. It has been estimated that the annual carbon dioxide (CO_2) tonnage that avoidable food waste (UK) contributes to is 2.7 million tonnes (WRAP, 2013). In contrast, unavoidable food waste can be defined as waste that arises in the process of food prepared and is not edible, for example, egg shells.



	Restaurants	Pubs	Education	Healthcare	Hotels	QSRs	Services	Leisure	Staff catering
meals served (millions / year)	704	871	1134	1047	611	1977	261	523	880
total food waste as % of total weight of food purchased	23%	22%	17%	18%	19%	8%	28%	25%	3%
total food waste (kt / year)	199	173	123	121	79	76	68	60	21
unavoidable food waste (kt /year)	57	50	23	24	29	17	11	19	6
avoidable food waste (kt / year)	143	124	99	97	49	59	56	41	15

Credit: WRAP Figure 3.

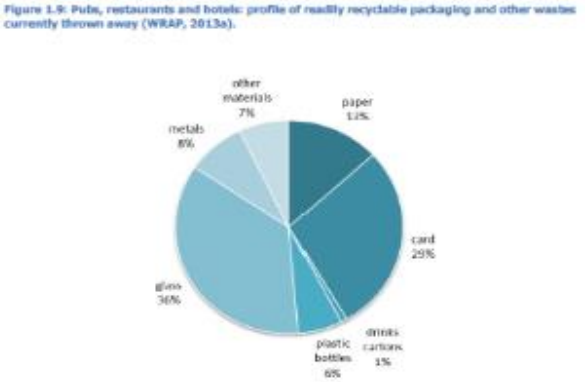
Within the UK, there were previous attempts to tackle the food waste being produced from the Hospitality and Food Sector through the formation of the Hospitality and Food Service Agreement. The objective of this agreement was to reduce food waste and associated packaging arising by 5% based on the baseline data from 2012 and was measured by CO_2 emission estimates (WRAP, 2017). The results that followed were an 11% reduction in CO_2 emissions. This was a voluntary agreement between food outlets and WRAP.

Packaging and Materials

Within the UK restaurant sector, 65% of packaging is recycled (WRAP, 2013), while 14%

of the material is not suitable for recycling such as disposable hand towels. For the QSR sector, the current recycling rate is 46%, of which the highest components are glass and cardboard. 25% of the total material and packaging waste material is not suitable for recycling.

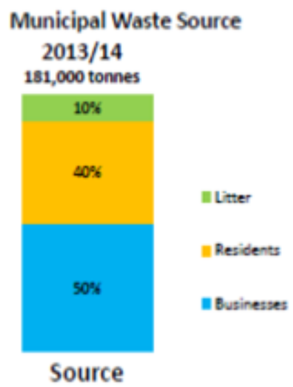
Regarding the restaurant and QSR sector, the potential of readily recyclable material disposed through residual waste is 21% and 29% respectively. With the objective of the NP to have an exemplary environmental policy, this would be a suitable arena to be tackled.



Credit: (WRAP 2017) Figure 4. *Credit: (WRAP 2017) Figure 5.*

Household Waste

Over 180,000 tons of municipal waste was produced in the Westminster borough (Westminster Council, 2014). A significant amount of this waste comes from households. In the year 2015/16, the household recycling rate for the Westminster borough was 17.3% (SITA, 2016). For the last five years preceding up to 2015/16, the recycling rate in the Westminster borough has been decreasing. The national target for household recycling rate is 50% by 2020. There are concerns of this objective not being reached especially in the London boroughs.



Credit: Westminster Council Figure 6.

An important driver is population growth. Within the borough of Westminster, the population is expected to grow by 7.8% in 2031 (Westminster City Council, 2013). Considering Hyde Park barracks may be developed into a housing complex, the neighbourhood may experience a significant population rise above current trends. This will put a strain on the existing household waste management system.

Westminster council has recognised that to reach zero waste to landfills and to increase recycling there needs to be more effective communication. Westminster council is running schemes to create greater community engagement. These schemes include hosting roadshows and outreach programmes. So the remit over land use and policies relating to this, will aid in the borough's objective.

Currently, there is no baseline data for recycling rate on a ward level e.g. the Knightsbridge and Belgravia area. However, there are useful variables provided on a ward level such as the Knightsbridge and Belgravia ward having a higher percentage of second homes in the area in comparison to Westminster as a whole. Currently, it is at 16% in the ward area, whilst in the borough of Westminster, it is currently 5%. Although there is no noticeable literature regarding a correlation between second home frequency and household recycling rates.

<u>Air Quality</u>

State of Air Quality and Health Impact

Our group compared available monitoring data of the criteria pollutants against the World Health Organisation's Air Quality Guidelines (WHO AQG) and EU Limit Values. Of immediate concern to our group are oxides of nitrogen (NO_x) and nitrogen dioxide (NO_2). In 2016, the London Air Quality Network reported that Knightsbridge breached the EU one-hour limit value for NO_2 222 times while the annual mean limit value for that year was exceeded at 77$\mu g/m^3$.

Fine particulate matter ($PM_{2.5}$) is another pollutant of significance. Based on monthly averages published by London Datastore and utilising the WHO AQG method of calculation, the annual level of PM2.5 in the City of Westminster is estimated to be 11$\mu g/m^3$ [1], exceeding the WHO AQG of 10$\mu g/m^3$.

The health impact on the residential population from these exceedances should not be underestimated; data published by the Greater London Authority (GLA) showed that an approximate 83% of the population in Westminster were exposed to NO_2 levels beyond the EU annual mean limit value of 40$\mu g/m^3$ in 2013 (GLA 2013), second only to the City of London, while Public Health England estimated that the proportion of adult mortality in Westminster "attributable to anthropogenic particulate air pollution" in 2015 is 6.7% (PHE, 2017), the highest among boroughs in Inner London. With a daytime population of visitors

[1] PM2.5 monitoring data is not publicly available/accessible for the Knightsbridge area.

and workers three times that of residents, the cumulative public health impact from high exposures could be much higher (Oxley, 2013).

Causes of Air Pollution

Source apportionment data published by the GLA showed that transport emissions contributed to 64.9% of $PM_{2.5}$ and 57.9% of NOx, while combustion of gas on commercial and domestic premises form 11.5% of total emissions of $PM_{2.5}$ and 32.2% of NOx.

Aside from emissions from point sources, the high density of roads and buildings which affected the air ventilation within the borough is also a contributing factor to the high levels of NO_2 and $PM_{2.5}$ (Westminster City Plan, 2013). In the case of particulates, emission modelling conducted by the Imperial College Centre for Environmental Policy in 2015 estimated that London sources contributed 26% of the $PM_{2.5}$ mass, and "long range and non-anthropogenic sources" an estimated 60% (Oxley, 2015).

Mitigating Measures

Literature search revealed four main air pollution mitigation strategies which could be implemented in Knightsbridge: i) control of emissions at point sources, ii) enhancement of pollutant dispersal, iii) enhanced deposition of pollutants, and iv) protection of receivers. Emission controls is through establishment of limits on the source, either through specifying the fuel used, vehicle technology such as higher Euro standards and low NOx boilers or regulating vehicular movements in areas of high emissions, amongst others. As these are not under the direct ambit of the Neighbourhood Plan, focus were given to the remaining strategies (ii) to (iv), which together with their corresponding measures, are summarised in table 1.

Strategy	Measures	Findings
Enhance pollutant dispersal by increasing air flow in the urban setting	Changing building aspect ratios and street geometry Providing setback distance from the roads and enhancing building porosity Buildings of varying heights promotes turbulence and lower pollutant levels	The higher the building relative to the street width invokes a skimming flow (Oke, 1988) and vortices leading to retention of pollutants. (So et al, 2005) Building setback coupled with building separation (porosity) encourages air flow. (Chao Yuan, 2014) (Ng, 2014) (Baik, 2012) Varying building heights in a canopy tends to increase turbulence and lower pollution level (Advances in Building Energy Research, volume 3)
Enhance deposition of pollutants through use of vegetation	Planting of trees, hedgerows Green walls	No consistent reduction of pollutant levels through deposition in 19 simulations (Vos, 2013) Reduction of NO_2 and PM_{10} by 7% and 11% in a single street canyons of height width ratio of 1 (Pugh, 2012)
Protection of receivers through use of passive controls to physically block or alter air flow (McNabola, 2010)	Artificial and natural barriers such as hedges and low wall boundaries	Effectiveness depends on positioning of trees relative to wind direction (Brantley, 2014) (Dabbous, 2014) Other factors are wind conditions, porosity and form of the barriers (NICE, 2016)

Table 1: Air pollution mitigating strategies

Incorporating passive controls in urban planning is emerging as an important strategy to reduce human exposure to air pollution as medical research on the effects of particulates become increasingly compelling.

Passive controls could range from physical solid barriers between the receptors and point source emissions, to vegetation that also enhances the rate of pollutant deposition. Evidence on the effectiveness of passive controls, however, had been inconsistent. A meta-analysis by the National Institute for Health and Care Excellence showed varying reduction of pollutants and, in some cases, increase in pollutant levels as a result of the intervention. An editorial in the Atmospheric Environment journal also concluded that the strategic siting of such barriers should also take into account meteorological conditions and street geometries to ensure the measures were not counter-productive (McNabola, 2010).

Energy Resilience

The Plan has the power to influence land use policy, therefore in term of energy resilience, the energy efficiency of the building development will be the focus in this section to maximize the use of energy in the NP area. Due to the shortage of baseline data for the Knightsbridge and Belgravia ward, we decided to obtain the data from the Westminster city council. Reason being, it was the most relevant available data.

Building Energy Efficiency in Westminster and CO_2 Impact

The City of Westminster has the highest relative stock of historic buildings in UK. Approximately 67% of Westminster housing was developed before 1915, with half prior to 1870. The buildings constructed at that time did not utilise appropriate energy efficiency measures and their degradation over time can further lead to the lower energy efficiency when compared to new-builds. Low energy efficiency in buildings within Westminster is confirmed by the Domestic Energy Rating data for Westminster in 2015, provided by London data store and represented in table 2 below. It illustrates that the majority of buildings in Westminster fall in the category C, D, and E for energy rating (DCLG, 2016). Energy rating of D and E indicate that energy use in those buildings are less efficient than the average.

Energy Rating	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Percentage of total building in Westminster (%)	0.1	9.7	36.5	34.9	13.6	4.0	1.2

Table 2: Domestic energy efficiency in Westminster borough (DCLG, 2016).

In terms of domestic energy supply, only ~230 buildings out of 116,843 buildings in Westminster obtained renewable energy from Photovoltaic (PV) Panel, none of the other renewable energy sources as wind, hydro, anaerobic digestion were installed (DECC, 2016), demonstrating a heavy reliance on fossil fuel for energy consumption across Westminster.

Inefficient use of fossil fuel for energy supply for buildings is responsible for 90% of CO_2 emission in Westminster, which is significantly higher than the national value of 50%. Therefore, increasing building energy efficiency in Westminster is an effective solution for mitigating Climate Change. Retrofitting old buildings along with new construction of "Zero net carbon building" could be one of the measures to optimize the energy use.

The Climate Change Tracker suggest that "fossil-free and near zero energy by 2020 for new building" and "increase building retrofitting rate from <1% to 5% by 2020" are top short-term measures to help the world achieve the Paris Agreement's 1.5°C limit in Global Temperature increase (Climate Action Tracker, 2016). Moreover, these two measures also help to meet Major of London CO_2 reduction target of 60%, compared to 1990 emission.

Surface Water Flood Risks

Surface water flooding (SWF) is a common problem for highly developed areas like Knightsbridge. SWF happens when intense rainfall cannot naturally penetrate the ground because of a high area of impermeable surface like asphalt, concrete, stone. Hence, higher flow rate of surface run-off water potentially cause surplus in the drainage capacity. Due to extreme weather caused by climate change, SWF is expected to be more severe because of more frequent and intense rainfall.

The Environmental Agency (EA) has established a long-term surface flood modelling website. The future flood map of Knightsbridge area, obtained from EA website, is shown in the figure 7 below (EA, 2017). According to the flood map, Knightsbridge area has an overall low risk area of SWF. However, there are still some hot spots of medium to high risk (3% risk).

In order to give appropriate suggestions to control flood risk, site visits were conducted to those areas with a high risk of SWF, which are Ennismore Garden Mews and Princes Gate Garden Mew. The GIS data in Knightsbridge area show that those area have un-even terrain. (See figure 8,9, 10):

Figure 7 Long-term SWF risk in Knightsbridge (EA, 2017)

In Ennismore Garden Mews, differences in elevation (4m) causes a significant flow rate to the lowest point. Not all water will enter the drainage system, the rest continues to flow into the lowest point. The lowest point in Ennismore Gardens Mews accumulates the water flown in from several roads. Hence this area tends to have high flood risk, as confirmed by the EA flood prediction map. In Princes Gate Mews, the cause of flood risk is similar to Ennismore Gardens Mews.

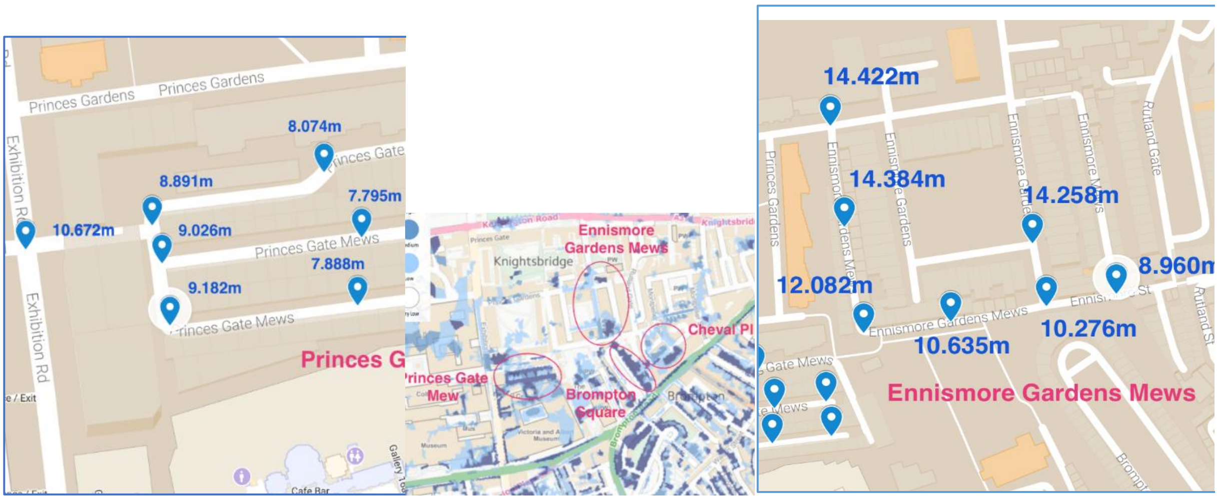


Figure 8, 9 and 10: Site survey and elevation data of surveyed area[2]

Urban Greening and Sustainable Drainage System

Green roof has been demonstrated that it would be beneficial throughout a wide range of rainfall conditions (Hyder Consulting, 2006). This is also agreed by (Defra, 2004), they stated that living roofs are a proven source control technique to mitigate the flood risk in London caused by future severe weather. Moreover, by removing up to 75 per cent of total suspended solids from runoff, the green roof could act as a water run-off pollution control technique (Auckland Regional Council, 2003).

[2] https://www.daftlogic.com/sandbox-google-maps-find-altitude.htm GIS data

Moreover, green roof also have other co-benefits such as reducing energy consumption by acting as additional roof insulation, and improving air quality. The benefit corresponding to each type of green roof are summarized in the figure 11. Furthermore, green roof can be co-installed with PV panel as shown in figure 12, which could help to maximize the utilization of renewable energy as well as countering the effect of surface water flooding (GLA, 2008)

Roof Type	**Potential Benefit**			
	Climate Change	Building Energy Balance	UHIE	SUDS
Intensive	✓✓	✓✓	✓✓✓	✓✓✓
Extensive – mat-based <40mm	✓	✓	✓	✓
Extensive – substrate-based >75mm	✓✓	✓✓	✓✓	✓✓
Recreation	✓ *	✓ *	-	-

* These advantages are only realised on recreation roofs if vegetation, introduced in the form of planters and cool roof technology, are also utilised.

Figure 11: Potential benefit for each type of green roof

Green Roofs and Photovoltaic Panels in Germany; Photo Source: ZinCo

Figure 12. Co-existence of green roof and PV panels

<u>Urban Greening and Biodiversity</u>

Green roofs and green walls can provide habitats for wildlife species and valuable green links and stepping stones for animals such as birds and invertebrates. English Nature

(2003) recognises the potential biodiversity benefits of green roofs as:

- helping to remedy areas of deficiency, i.e. providing new habitats in areas which are currently lacking in wildlife habitats
- creating new links in an intermittent network of habitats, thereby facilitating movement and dispersal of wildlife
- providing additional habitats for rare, protected or otherwise important species.

Green roofs used in the London area have been identified as being beneficial for rare invertebrates. According to English Nature (2002), a survey of eight green roofs in the London area recorded a number of uncommon species, including some not previously recorded in the London area. Green roofs can provide a flower-rich habitat for *Bombus humilis* (bumble bees), and this measure has the potential to meet the London Biodiversity Partnership's statement for the species. (Jenrick, 2005) Whereas for birds, research shows that green roofs offer the opportunity to benefit local biodiversity action plan species within London (black redstart, house sparrow) and potentially a number of UK Biodiversity Action Plan priority species including the skylark.

The importance of green roofs and walls is now increasingly recognised in the UK, including through planning policies. In London the use of green roofs to help meet policies and targets is encouraged in both the Mayor's Biodiversity Strategy and the London Biodiversity Action Plan. The London Plan included a policy requiring major developments to incorporate living roofs and walls where feasible. (Greater London Authority, 2008)

<u>Overheating Risks</u>

The exposure to high temperatures and heat waves is one of the greatest direct climate change-related threats for the UK. According to the UK Climate Change Risk Assessment 2017, heat waves in the UK like that experienced in 2003 are expected to become the norm in summer by the 2040s. In combination with the growing, ageing population, the number of heat-related deaths in the UK is projected to increase by around 250% by the 2050s (median estimate), from a current annual baseline of around 2,000 premature heat-related deaths per year.

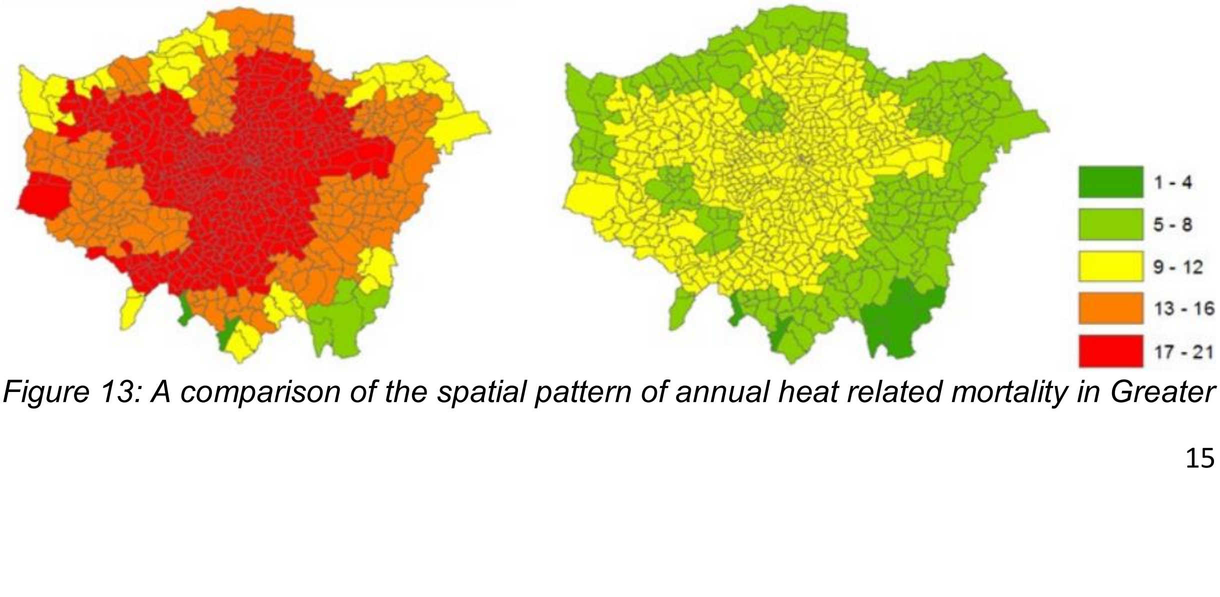


Figure 13: A comparison of the spatial pattern of annual heat related mortality in Greater

London for the 2050s (median result, high emission scenario) with no adaptation (left) and adaptation (right). The results suggest that adaptation measures for mitigating overheating risks is required. (Hall, J, 2013)

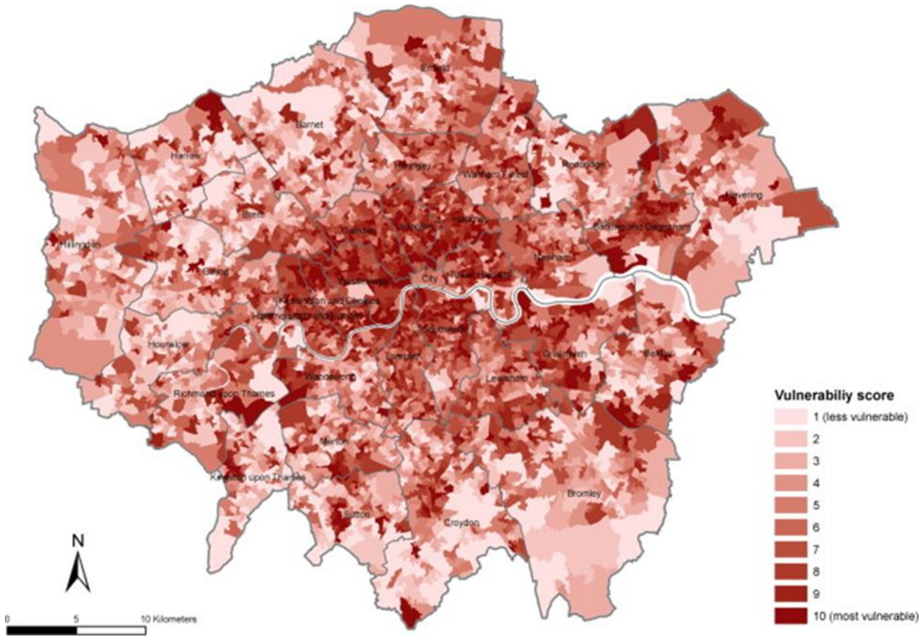


Figure 14. Spatial distribution of the heat vulnerability across Greater London as categorised by 10 heat vulnerability classes. (Tanja, W, 2013)

From Figure 14, it can be seen that a part of the Knightsbridge Neighbourhood area (e.g. area near the Brompton Road) is classified as vulnerable to overheating. The Knightsbridge and Belgravia Ward has a higher percentage of population aged over 65 compared to the average in the City of Westminster (Westminster City Council, 2015), who are more sensitive to health risks posed by high temperatures and heat waves as they have to stay at home during the daytime. This constitutes significant health risks and may lead to longer-term wellbeing impacts for residents in the Knightsbridge neighbourhood area in the timescale of this neighbourhood plan and beyond.

At present, there are no comprehensive policies in the UK to reduce the risk of overheating in new and existing homes or other buildings, apart from promoting urban greening measures. (GLA, 2017) In a regional context, the London Plan Policy 5.9 has set out a cooling hierarchy to prevent overheating over the scheme’s lifetime. The GLA also issued the Sustainable Design and Construction Supplementary Planning Guidance in 2014. The Chartered Institute of Building Services Engineers (CIBSE), working in conjunction with the GLA, also developed the Design Summer Years for London (TM49: 2014) to provide a risk-based approach guidance for developers to address the challenges of urban heat island effects and an uncertain future climate.

In criterion 3 of Part L 2013 of the Building Regulations, there are requirements to limit the effect of heat gains in summer, which is implemented for new dwellings as set out in Appendix P of Standard Assessment Procedure (SAP) 2012. For non-domestic buildings this is implemented through a specific test in Simplified Building Energy Model (SBEM) and summarised in the Building Regulations UK Part L (BRUKL) output report. Hence, developers have to undertake certain basic overheating compliance tests in order to demonstrate compliance with Building Regulations.

DEFRA is currently reviewing its National Adaptation Programme (NAP). It is possible for the Knightsbridge Neighbourhood Plan to lead as an example for developing adaptation policies scalable from neighbourhood to the regional and national levels.

DISCUSSION

Environmental quality, including air quality and waste-to-resource management, is a strategic issue for London, not only because of its impact on the health of the local population but also the city’s competitive edge as an international hub for finance, culture and education. Environmental health is an indicator considered in many international Quality of Living indices, such as Mercer's Quality of Living Rankings.

Waste Management

Food Waste

Restaurants, cafes and eateries fall under the A3 category of land use. Before planning permission is granted, business owners should demonstrate their commitment to manage food waste effectively, by devising a food waste management plan. The planning application process should be revised to be more favourable to those who make substantive attempts to redistribute the food as to prevent food waste from occurring, as supported by the Waste Hierarchy. In addition, life cycle assessment also plays a crucial part in the decision on why food redistribution is emphasised ahead of other treatment method such as creating animal feeds. Due to the geographical location of Knightsbridge, the transportation to the centre where food waste can be transformed into animal feed may be located some considerable distance away. Thus carbon offsetting is a criteria area.

Credit: UNDP Figure 15.

Economic Viability - For the retailers, redistributing the food can result in lower waste disposal costs, as less waste will be disposed of. In terms of the distribution cost, this will be upon the food waste distributors. For example, City Harvesting stated that they would pick up 'nutritious surplus food' (City Harvest, 2017). Storage should not be an economic constraint, as the food will be retrieved as soon as it is made available to the partner organisation.

Technical Feasibility - There are currently organisations, groups and app platforms operating within London which will assist in facilitating the food redistribution measures. For example, the OLIO operates as a mobile application, in which potential recipients of the food can directly see what produce is available. In addition, depending on the quantity of the food waste produced volunteers can be dispatched to the food premises to collect wanted food for individuals and groups.

On the other hand, although food may be edible for human consumption, it may not be suitable due to cross contamination of food items. This is prevalent within the restaurant industry. However, it may not be as prevalent in QSRs as food is often prepared prior to ordering.

Deliverability - In the case of A3 land-uses, prior approval is required in respect of matters such as waste management. If the land use and planning framework does not make it necessary for potential retailers to submit a food waste management plan. Guiding principles should be adhered to, the principles, as follows:

- Food waste prevention should be prioritised
- Stock management and stock storage should be optimised.
- Food disposal via residual waste should be minimised

These measures will support sustainable development goals in which it is aimed for a 50% global reduction in food waste.

Material Waste

Restaurants, cafes and eateries should also provide a material waste management plan, emphasising the increase of recycling rate of material waste produced. This can include providing adequate amount of space for source separation.

Economic Viability - Increased recycling rate can help to reduce the waste collection costs to businesses. There are two measures of recycling materials within a business; Source Segregated and Mixed Recycling. City of Westminster, in their 2016 report, stated that source segregated waste is the most cost-effective method for businesses (City of Westminster, 2016).

Most preferred option	⟷	Least Preferred option.
Source Segregated	**Mixed Recycling**	**Residual Waste**

Figure 16.

Technical Feasibility - Westminster council can assist in providing the recycling bins and caddies for businesses, both onsite storage and offsite storage. Although the providers of the larger bins are often private waste management firms. So, depending on the space of the premises, a range of source separated provisions can be made.

Deliverability - Regarding the planning regulation and A3 land use, at the minimum it can be requested that all business provide sufficient space to allow some element material recycling unit onsite. As previously stated A3 land use prior approval is needed on a range of areas, one of these areas include waste collection (Planning Portal, 2017).

Household Waste

Any new housing development within the area must provide infrastructure which allow for a source separation of waste. The source separation of material will allow for a higher quality of newly recycled materials. In addition, depending on the scale of the housing development a composting unit should be available near the complex. The feedstock for the composting unit will be the food waste from households which have been collected through caddies. The produce should be applied to the housing and local greenery. In addition, this would support the proximity principle in which waste is being treated as close as possible to the source.

Economic Viability - By deploying source-segregated provisions, potentially resource management firms may buy the materials off the local council. Regarding the composting unit, the average UK household throws away 240kg of waste per year (WRAP, 2008). Recuperating the initial cost, will depend on the expected number of households within the complex. Based on the average amount of food waste thrown per year, and the number of households, there are a number of recommended composting units as summarised in table 3. The One Planet housing complex in Brighton currently uses the T60 model. In Sweden several housing complexes have successful brought these installations. For a standard piece of machinery, the input to product ratio is 5:1. So for every 100g of food input, 20g of compost will be produced (Imperial College London, 2017).

Size of Complex (Households)	***Amount of estimated food waste input per annum (kg)***	***Compost production per annum (Kgs)***	***Measures to make Economic viable.***
50	*12,000*	*2,400*	*Install T60*
75	*18,000*	*3,600*	*Install T60*
100	*24,000*	*4,800*	*Install T120.*
125	*30,000*	*6,000*	*Install T120*
150	*36,000*	*7,200*	*Install T240*
200	*48,000*	*9,600*	*Install T240*

Table 3: Big Hanna's Recommended Composting Capacity

Technical Feasibility - Having a self-contained source segregated facility may involve having four separate waste channels to over 10. Cities such as Hong Kong have rolled out source-segregated waste schemes in a selected number of districts, and the results are positive (Environmental Protection Department, 2016). Westminster Council will be able to assist in providing collection for source-segregated wastes as some pre-existing estates and mansion blocks have recycling bins for recyclables and are collected by the council (Westminster Council, 2017). The collection and transportation already exists, although there is room for improvement.

Deliverability - By having control over land-use and policies, the source-separation of waste should be deliverable. In addition, due to Westminster Council's commitment of zero waste to landfills and increasing recycling rates across the boroughs, support could be expected.

Air Quality

Achieving the WHO AQG

The Plan sets out ambitions to achieve the WHO AQG by 2020. While this is feasible for pollutants which are not in breach of EU value limits e.g. carbon monoxide and ozone, it would be a challenge for $PM_{2.5}$, given that 60% of mass contribution lies outside of London (Oxley, 2015). Regardless, any reduction in pollutant levels has health benefits due to lack of thresholds for particulates (WHO, 2005).

Reducing Emission at Source

Low NOx boilers are encouraged and included in many planning guidance. However, given that Knightsbridge has a disproportionately high NO_2 level, policy measure in KBR42 which required developments to use grid electricity will prevent additional emission sources in a neighbourhood already vulnerable to the cumulative emission impact of gas boilers. This measure, however, is a trade-off between urban air quality and climate warming targets, depending on the energy sources for the electricity. Moving energy needs to grid electricity could potentially mean higher reliance on existing electricity infrastructure, increased transmission power and generation of emissions outside of the city[3].

Source reduction is still the most effective strategy in improving air quality. However current policies to tackle the biggest emissions in London as a whole, i.e. transport and energy generation are subjected to vagaries in the political landscape and will take time to yield results. In the interim, protection needs to be conferred to the residential protection and visitors, workers to the areas.

Protection of receptors

Adaptation measures by manipulation of the urban form (Whiston,1986) and implementation of passive controls in public spaces offered substantial promise. Given Knightsbridge's worsening air pollution level, such measures should be considered in planning considerations both at development level and district-wide.

(i) Developments

At development level, evidences are compelling that building designs and their aspect ratio, as well as height relative to the width of streets, are critical factors in preventing the build-up of pollutants. In an area of rich architectural value and few new developments, the potential of overhauling the building forms through use of planning permissions would be limited. In such a situation, we would propose that any developments requiring planning permission for refurbishments i.e. A1 land use be required to conduct modelling on the impact of their developments on the build-up of pollutants in the neighbourhood. Such modelling should include wind flow simulations, sun-shading modelling and the impact of their building design on pollution level, and taking into consideration existing emission sources.

Where there is potential for the street canyon effects to happen, the developers should consider passive controls such as green roofs or green walls where modelling showed its effectiveness, considering the meteorological conditions. In addition, developers should judiciously site their air-intake points away from traffic sources and discharge points for boilers away from areas with high human traffic.

(ii) City Level

We would also encourage the local authority to conduct a microclimatic study which could underpin a long term planning strategy for not just Knightsbridge but the City of Westminster as whole. Such a study would ensure that the city harness the flushing and dispersal potential of wind flow. The study would also determine the optimal siting of

[3] In 2015, 52% of UK's electricity is generated from fossil fuels.

public spaces and areas of transient congregation such as traffic lights and entrances to tube stations. This however needs to be carefully balanced between providing shelter and increasing wind permeability in the city, given the temperate nature of London's climate.

Energy Resilience

The current KBNP has sustainable measures that could help achieve London Mayor's CO_2 reduction target. We would like to suggest enhanced measures to the current plan to ensure that the development proposal can effectively reduce CO2 emission. They are:

- Implementing international standard as Building Research Establishment Environmental Assessment Mode (BREEAM) **'outstanding rating'** as a guideline for building sustainability for all development.
- Encouraging **retrofit** of listed buildings and buildings in conservation, while
  - Ensuring the **compatibility** of retrofitting material.
  - Ensuring sustainable measures **not to damage** the original structure.
  - **Safeguarding the special characteristic** of these heritage assets for the future.
- Encouraging the utilisation of **fuel cell technology** to generate energy for major development.

BREEAM is recommended as an assessment tools for the developments because BREEAM focuses on variety of sustainable area including Energy efficiency, Health being, water, pollution, management, innovation, waste, and transport (BRSIA, 2012).

Technical Feasibility - 'Outstanding' is the highest standard of BREEAM, which require the building to achieve >85% credit available as well as meeting all minimum BREEAM standard in each category (BRSIA, 2012). For energy category, BREEAM 'Outstanding' is only awarded for those buildings which achieve Energy Performance Ratio for New Constructions (EPR_{NC}) of 0.6 and 40% in CO_2 reduction compared to building regulation 2010.

Based on the evaluation of BREEAM certified building, BREEAM "Outstanding" assessed buildings are able to reduce CO_2 emission up to 55% when compared with building regulation Part L 2010. (BREEAM, 2015)

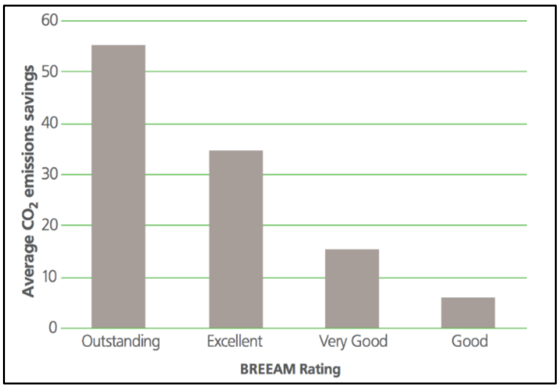


Figure 17: Average CO2 emission saving for each type of rating compared to building regulation Part L 2010

The value of BREEAM 'Outstanding' is further demonstrated through the case study of Five Pancras Square London, a 14-floor mixed-used building. This building achieved BREEAM 'Outstanding', scored 97.6% which is highest score in BREEAM in 2015 (Kier Construction, 2015)

The building reduces the CO_2 emission by 64% compared to original building and overall 50% compared to 2010 Building Regulation, in which 12 tonnes of CO_2 saved by PV panel annually) (Kier Construction, 2015).

This case study along with Assessing carbon emissions in BREEAM report can prove that BREEAM 'Outstanding' help new buildings to significantly reduce CO_2 emission and energy consumption. Moreover, it is technically feasible to achieve BREEAM 'Outstanding' for new developments.

Economic Viability - The "Value of BREEAM" reported that achieving Outstanding BREEAM standard can result in increase in capital cost, varying from 4.8% in Industrial and Mixed use buildings, up to 10.1% for retail stores, as shown in the figure 18 (BREEAM, 2016). The increase in capital cost arises from innovation measures that benefit the building in terms of energy and CO2 emission reduction, health and management, which further reduce the operational costs of the building with pay-back in 2 to 5 years (BRE, SWEETT, 2014). Building assessed by BREEAM are potentially lifecycle cost saving (BSRIA, 2012).

Rating	Education School	Retail Retail	Office Office	Mixed Use Mixed Use
Very Good	0.2%	0.2%	0.2%	0.15
Excellent	0.7%	1.8%	0.8%	1.5%
Outstanding	5.8%	10.1%	9.8%	4.8%

Figure 18: Increase in capital cost for different building types and certificate rating (BREEAM, 2016).

BREEAM helps to increase the productivity of staff and improve occupant satisfaction by improvement in indoor lighting and air quality. Of the 544 projects assessed by BREEAM, it found that 91%, 57% and 77% of those projects improve their internal and external lighting, the indoor air quality and the thermal comfort of their occupants respectively (BREEAM, 2016). Staff costs typically accounts for a large proportion of a business' operating costs, hence increasing in staff productivity directly affect the business net profit.

Deliverability - Both the City of Westminster and the London Mayor Office support the objectives of gaining greater energy efficiency and reducing CO_2 emissions from buildings. There is currently flexibility in deciding the tools to be used to reach this objective. As the Mayor of London has a target for CO_2 reduction, political support for the implementation of BREEAM can be expected.

Encouraging retrofit of listed buildings and buildings in conservation area

In terms of building retrofitting, the policy DES 9 Unitary Planning Policy of Westminster city council requires retrofitting projects to comply with conservation area requirements - to preserve or enhance the character or appearance of conservation areas and their settings. Knightsbridge area is directly affected by this policy because a large part of the Knightsbridge area is within the boundary of conservation area, as indicated by the area within the red boundary line in figure 19.

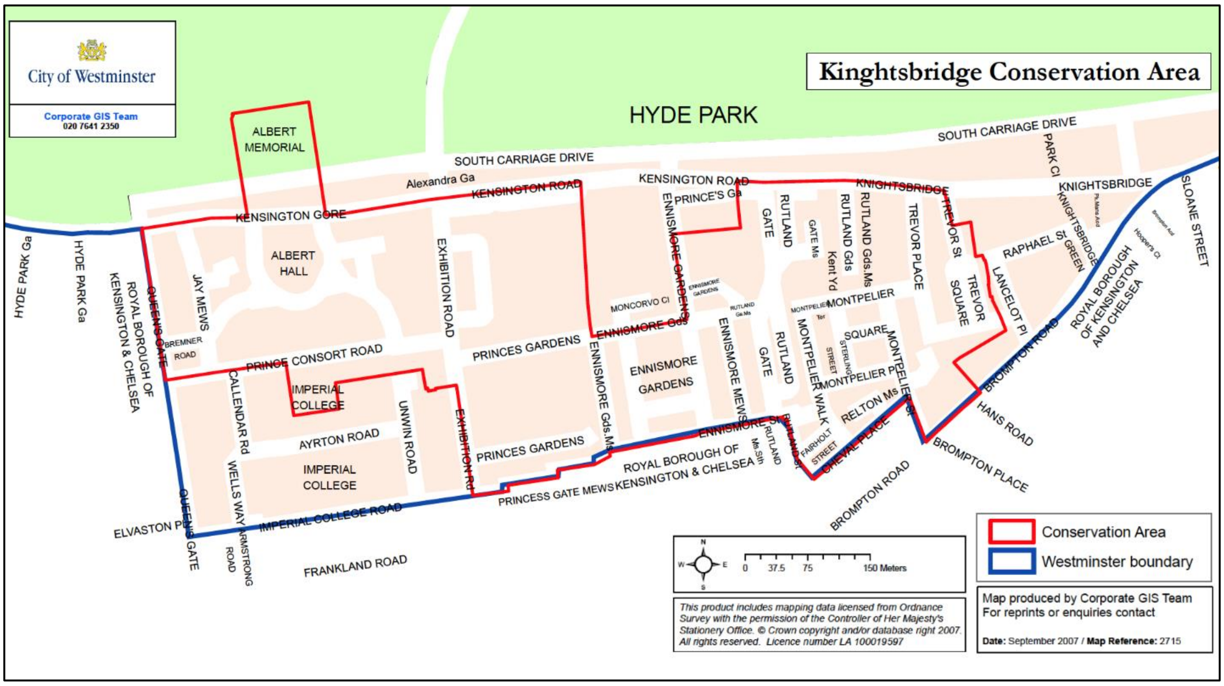


Figure 19. Knightsbridge Conservation Area

Retrofitting old building in conservation area is sensitive because the conservation policy requires any alterations and extensions to building to have to preserve the historic character of the building and enhance the appearance of the area. There are energy efficient measures such as double glazing or uPVC window and door which tend to be rejected as they alter the heritage appearance of the building. The inappropriate use of modern roofing or recladding materials may also adversely affect the character and appearance of the conservation area. In general, all alterations and extensions should use materials which match the existing decor or in keeping with the character and appearance of the conservation area (Westminster, 2009).

Apart from the conservation policy barrier, the technical barrier could also challenge the retrofitting project. Compared to new buildings, traditional buildings perform differently in term of moisture and thermal control due to the difference in materials and structural forms. They usually heat up and cool down more slowly. In term of moisture control, those buildings rely on semi-permeable fabric, sunshine, wind, heating, and adequate internal ventilation through windows, chimneys and draughts to control the moisture level inside buildings. Any inappropriate changes to fabric performance, heating and ventilation can alter this balance and result in overheating, moulds and damp (Sustainable Traditional Building Alliance, 2012). According to (WHO, 2009), living in damp or mouldy condition directly increases the risk of respiratory symptoms, respiratory infections and the exacerbation of asthma. Moreover, concerning fabric decay, studies including Ridout (2000) and Viitanen (2010) clearly show the link between high moisture levels and timber decay as well as links with fabric damage to plaster, masonry and other materials.

Technically feasibility - There are sustainable measures that could satisfy both requirements of conservation area policy as well as maintain the performance of traditional building. This has been proved by the refurbishment of 119 Ebury Street Building, which is a grade II listed building. This analysis produces a series of sustainable measures that together help 119 Ebury Street's to be the first refurbishment project to achieve BREEAM 'Outstanding'.

With sustainable measures such as fabric restoration, installation of permeable insulator, lower tightness windows and doors along with the smart utilisation of renewable energy reduce 80% of CO_2 emission in the building, from 29 tonnes to 6 tonnes, while safeguarding all heritage features including; sash windows, the original staircase, cornices and mouldings, joinery, original replaces, wall and ceiling finishes. All sustainable measures in 119 Ebury development are visualized illustrated in figure 20 below (Building, 2015).

This is evidence of technically feasibility for a sustainable retrofitting of old buildings while complying with all conservation policy.

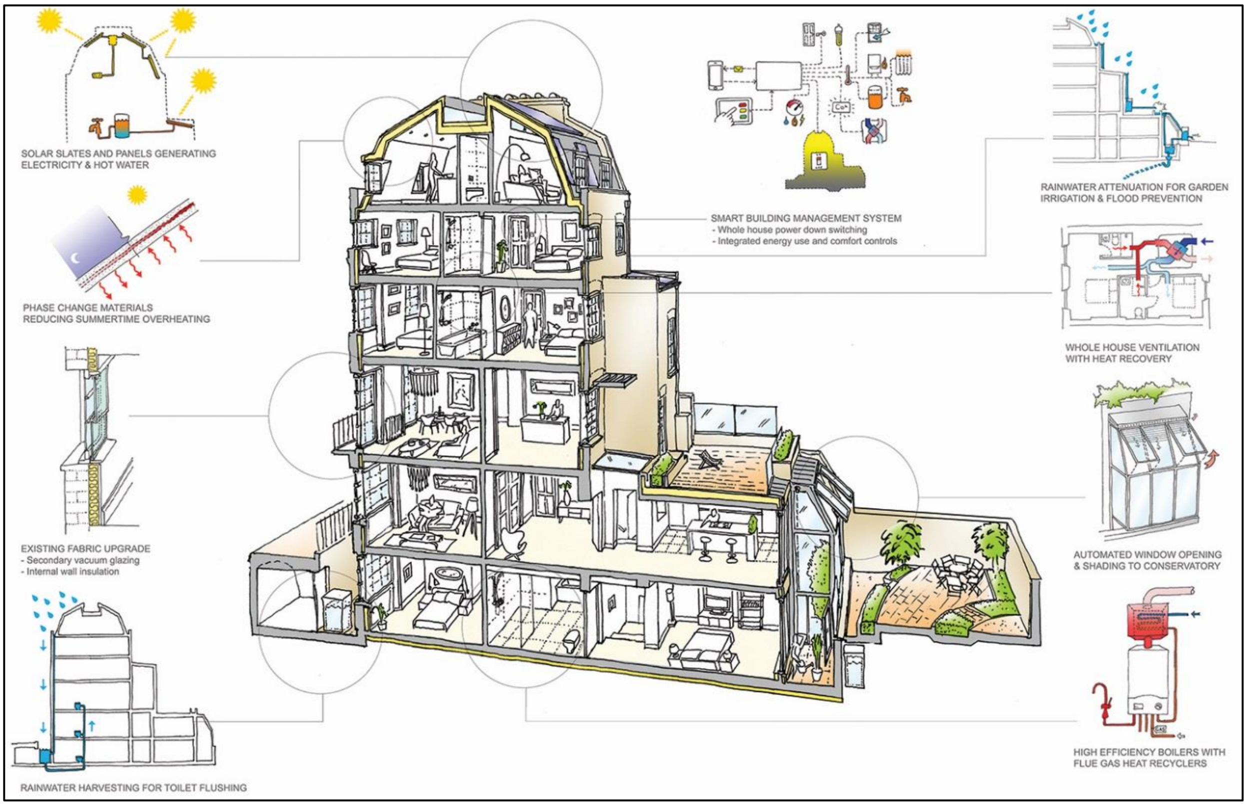


Figure 20: Sustainable measures involved in 119 Ebury development (Building, 2015)

Surface Flood Risks

Sustainable Drainage System (SUDS) approach could help to tackle long-term surface water flooding. SUDS create temporary storage for rain water run-off and improve natural infiltration of surface rain water to the ground hence minimising the volume of water run-off closet to the source. Minimising water run-off is an effective measure to prevent SWF in high risk area, mentioned previous part. In addition, natural infiltration of water could restore ground water resources and maintain flows in surface watercourses during dry weather. Measures from SUDS includes Rain Harvesting system, Green Infrastructure and Permeable Paving.

Suggested measures:

- Implement Sustainable Drainage Systems (SUDS) measures from BREEAM as a guideline for the water management system as well as flood prevention.
    - Apply to new development and major refurbishment.
- Implement Sustainable Drainage Systems (SUDS) measures for infrastructure in high flood risk area.
- Implement emergency flood defence plan to mitigate the consequence of flooding.

Technically Feasibility – Rain water harvesting system and green infrastructure like Green roof and green wall are proposed to be solution for SWF mitigation in building development.

Rain water harvesting (RWH) system is shown in figure 21. RWH system in the building captures and stores the rain water for non-portable use such as car washing, toilet flushing and garden irrigation. RWH are an effective solution to control storm water runoff at the source. (Burns et al., 2013) Because RWH system effectively collects rain water in a temporary container, thus the rain surface water run-off could reduce, eliminating SWF risk. (Palla., 2017) evaluated 2125 rainfall events and found that the average peak and volume rate reduced by 33% and 26% respectively when the building was equipped with RWH system. Two case studies mentioned in the energy resilience section also equip RWH system, saving 1,600 litre per day by collecting and recycling rain water in 5 Pancras Square.

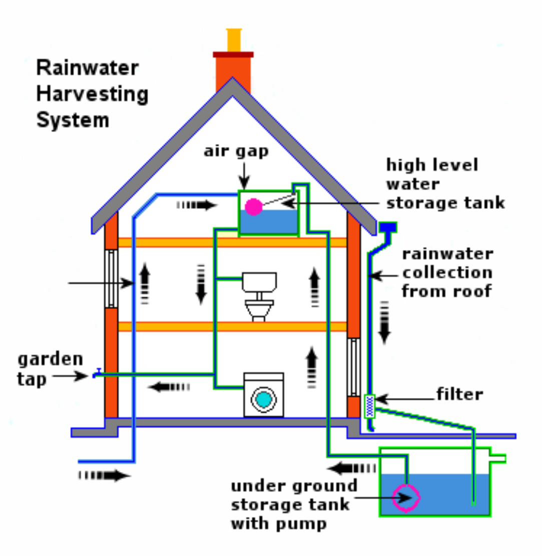


Figure 21: Rain harvesting system

Economic Viability - Haskoning UK published a report in cost effectiveness of SuDS in 2012. They illustrated that the unit capital costs of SuDS decreases with development size as economies of scale, while costs reduce for higher density developments. Several of the case studies considered also developed theoretical capital costs for an equivalent traditional piped drainage system. This report also found that SuDS systems in new developments are reasonably more cost-effective to install than the traditional drainage solution with equivalent piling system and capacity. Table 3 compare the capital cost of SuDS and Traditional drainage system (Haskoning UK, 2012).

Development Density	Capital Cost per Property (£)					
	Small (<100 properties)		Medium (100-500 properties)		Large (> 500 properties)	
	SuDS	Tradditional	SuDS	Tradditional	SuDS	Tradditional
Dense (urban) (100 properties/ha)	No data	No data	500	1000	No data	No data
Moderate density (40 properties /ha)	5,500	6,000	1,000 – 4,500	3,000 – 5,000	1,000	No data

Table 3 Capital cost of SuDS and Traditional Drainage System per property (Haskoning UK, 2012).

In term of maintenance cost, there is limited evidence from the case study to compare the operational cost between traditional system and SuDS. However this report also stated that the operational cost could increase but not that significant (Haskoning UK, 2012).

SuDS can help to harvest rain water and recycle it for non-portable purpose like washing, toilet flushing and irrigation, reducing reduced water bills up to 50% (The Renewable Energy Hub, n.d). Moreover, the benefit of flood risk mitigation is also an important factor to SuDS, however it is hard to quantify in monetary value due to the uncertainty of flood risk and its severity (Haskoning UK, 2012).

The current evidence base for SuDS limits the potential for the assessment of their costs and benefits. However, it is clear that SuDS is more cost effective than traditional drainage system. Although the monetary value of SuDS benefit has not been determined, the benefits of SuDS in water saving, flooding mitigation, quality improvement and biologically enhancement are strongly understood and accepted by professionals. Hence, the utilisation of SuDS is recommended.

Urban Greening

Per the current measures proposed in KBR12 and KBR44, development proposals for new buildings or replacement of existing buildings are required to include the provision of green roofs and green walls where physically feasible.

Research showed that green roofs could be designed to maximise biodiversity by using native plants and soils, varying topography, bare patches and using wood and rocks. Hence, we would like to recommend measures from the Green Roof Organisation's Code of Practice (2014) and encourage the following measures.

Our recommended design principles for green roofs or green walls are:

i. Green roofs and green walls should be conspicuous so that they could be appreciated by the public as well as capture associated well-being benefits of greenery
ii. Choice of plant types should demonstrate resilience to disease, pests and climate change, which is in line with Policy KBR45 (Trees)
iii. Design should ensure low maintenance effort and costs
iv. Design must comply with all relevant structural design criteria to ensure it is structural safe. A feasibility study or structural survey may be required to ensure the roof structure will bear the weight of the green roof.
v. Fire risk must be mitigated by the specification of the build-up and the incorporation of fire breaks.
vi. Design should enhance biodiversity by replicating local habitat conditions. Recommended design specifications for green roofs are:
    - A biodiversity-based extensive substrate green roof is preferred;
    - Substrate should be native regional soils and between 80 and 150mm deep;
    - Mounds 30cm high and 3m in diameter should be randomly built to foster insect life; and
    - Vegetation should be a mix of native plant species.

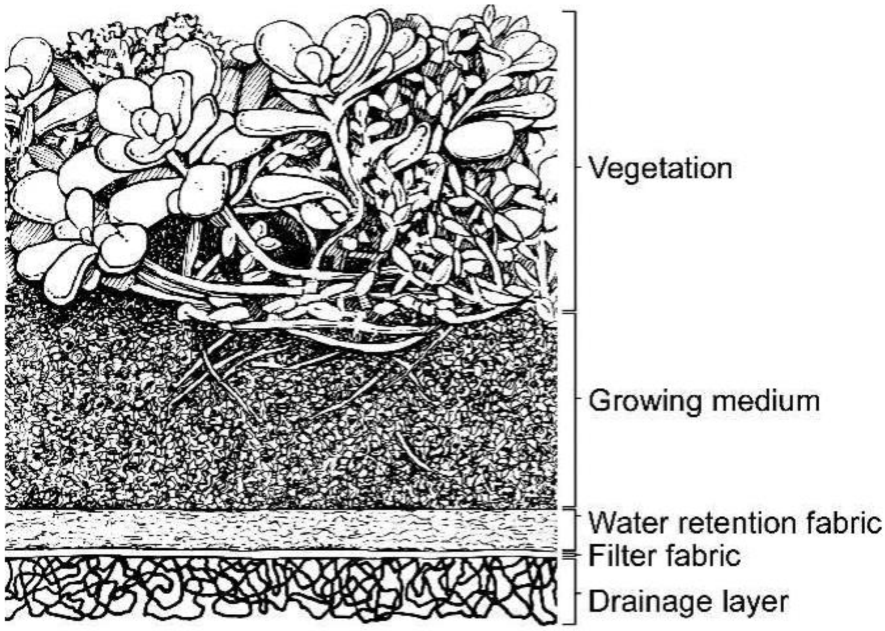


Figure 22: Green Roof System

Figure 22 shows the cross-section of a representative extensive green roof system including typically used layers. The drainage layer is place over a root barrier that covers the roofing membrane. The water retention fabric is optional and the media depth and plant material vary depending on design specifications.

Life-Time - A green roof lasts about twice as long as a conventional flat roof. The estimated lifespan for a green roof in Europe is 30 to 50 years.

Green roof maintenance should include:
- Weed control
- Pest and disease control
- Checking and adjusting irrigation, with supplemental watering during dry periods
- Checking the drainage system
- Periodic roof inspections for possible leaks and other issues
- Planting for special occasions, seasonal blooming plants or replacement of poor-quality plant material.
- Documentation of any changes or issues.

However, maintenance requirements for extensive green roof are minimal. Extensive roof need little extra maintaining than other flat roofs covered with bitumen, paving slabs or chippings. Roof manufacturers recommend this as being twice yearly, as with all roofs, although in Germany 'most companies stop green roof manufacturers' recommended maintenance regimes after several years as they have fulfilled the planning criteria and have let the roofs go 'wild'' (Living Roofs, 2005)

Economic Viability - The economic returns from investing in green roofs and green walls are well-established. A green roof helps to save on heating or cooling costs as it insulates in winter and cools in summer resulting in energy savings varying from 2-44% depending on roof insulation measures separate from the green roof. It also doubles the lifetime of roof water proofing by protecting it from weathering effects compared to conventional flat roofs (Ministry for Environment and Energy of Germany, 2016).

Research in Germany shows that the cost to install and maintain a green roof for 40 years is about 43 euros (£37) per m² compared to a possible saving of 70 euros (£60) per m² from the reduced maintenance, energy saving, city water fee and increased life (Herman, 2003).

In the United Kingdom, currently it costs around £100 per m² of extensive green roof, and around £150 per m² for the intensive variety. There are currently no UK government grants to help with the initial cost of installing a green roof. At present, the material cost for installing domestic green roofs in UK can be relatively cheap, where the greater expense is needed to employ the services of a landscape gardener to design the green roof. For a site that is 8 m², the raw materials cost of retrofitting a green roof is between £500 and £800. For the same project using a qualified installer would cost another £500-£1,000. (The Renewable Energy Hub, 2016)

It is suggested that the lower cost of green roofs in Germany is a result of more than twenty years of development and the availability of thin green roofs. Whereas for newer markets like in the UK, there is little market competition and no economies of scale exist, labour is more expensive due to lack of experience and there is a tendency to use custom-design systems. (Nurmi V et al, 2013) A study conducted by Toronto and Region Conservation (2007) suggested that the costs of a green roof would go down by 33%-50% as the industry establish itself.

Technical Feasibility - Green roofs should be installed by a professional horticulturist in collaboration with a building's architect and engineer. The following criteria should be examined in a Feasibility Study. (Growing Green Guide for Melbourne Project Group, 2013) The list of assessment criteria includes:

1. Type of structure and load bearing capacity - Type of structure influences existing capacity. Heavy load bearing capacity will enable deeper substrates.
2. Water proofing - If flexible membrane is in good condition no additional waterproofing may be required.
3. Roof slope - Slopes greater than 30 degrees will require additional support for resistance to slip.
4. Shading / sunlight availability (aspect) and exposure - Aspects with full sun will increase irrigation water demand.
   Aspects will full shade will limit species diversity.
5. Wind considerations - Sites with high exposure to wind effects will require design against wind action, especially with regard to substrate/ballast stability (prior to planting establishment) and vegetation shear.

6. Size of useable area - Large areas will provide greater benefits (albeit with a higher cost).
7. Height of building - Low height green roofs may be more visible from street level improving visual amenity; tall buildings create higher wind loads
8. Access for construction and maintenance - Roofs with easy access and protection from fall from height will require fewer measures for OH&S compliance.
9. Access to utilities (water, electricity) - Sites with advantageous hydraulic and electrical services provision will facilitate irrigation water reticulation.
10. Opportunities for site capture and storage of water for irrigation - Proximity of available roof areas for collection of storm water run-off will provide increased site irrigation water capture and re use opportunities.
11. Safety considerations (parapet height/railing requirements)
12. Fire risk

Deliverability - Numerous studies have shown that green roof retrofitting is possible for residential, commercial and industrial buildings and installing green roof on both flat and sloping roofs is possible. The only real limit to retrofitting is the structural capacity of the existing roof and the building structure. An award winning example of implementing green roof in an urban setting is Gold Lane Social housing Project, Edgware, London. (Figure 23, 24,25). This was London’s first green roofed social housing project and it incorporated green roof into modern building design. Residents have noted the thermal comfort and wellbeing benefits of the green roof. Other examples of successful green roof projects can be found in the Mayor of London’s ‘Living Roofs: Case Studies’ document.

Figure 23, 24, 25: Photos of Gold Lane Social housing Project

Overheating Risks

We support the existing measures in the Neighbourhood Plan which requires developers to demonstrate mitigation and adaptation measures in design that address climate change risks including urban heat island effects (KBR40 and KBR47). Also, urban greening measures adopted in the plan (KBR12) would contribute to mitigating the urban heat island effects.

We recommend that development planning applications pass the Overheating Risk Assessment (ORA) following the procedure set out in CIBSE TM52 (The Limits of Thermal Comfort: Avoiding Overheating in European Buildings 2013). TM52 outlines three criteria – a room or building that fails any two of the following three criteria is classed as overheating:

i. The number of hours that the operative temperature can exceed the threshold comfort temperature (i.e. Threshold temperature exceeded ≥ 3% of occupied hours per year)
ii. The severity of overheating within one day – this is function of both temperature rise and it’s duration (i.e. Daily weighted exceedance (degree hours) ≥ 6)
iii. An absolute maximum daily temperature for a room, beyond which the level of overheating is acceptable (i.e. Temperature ≥ upper limit)

The guidance is for this test to be run using CIBSE DSY weather files, but it would also be required to run against future weather files. The dynamic thermal modelling should be in addition to any assessment of overheating risk obtained from the Part L Building Regulation compliance tools SAP and SBEM.

New development proposals should also apply the cooling hierarchy in Policy 5.9 of the London Plan. Measures that are proposed to reduce the demand for cooling should be set out under the following tiers of cooling hierarchy:

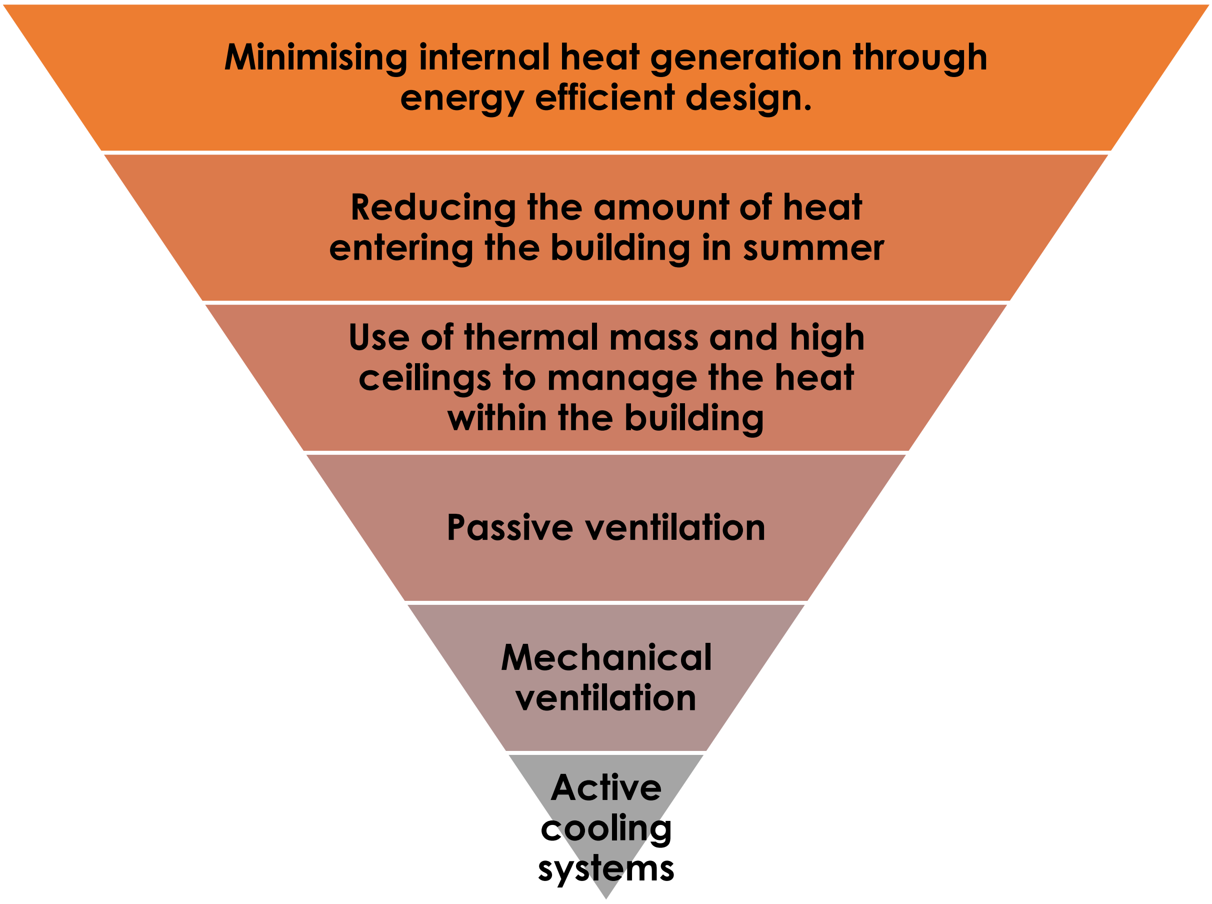


Figure 26, Cooling hierarchy set out in in Policy 5.9 of the London Plan

Where reliance on energy intensive mechanical ventilation or cooling systems should be avoided if possible.

According to the Sustainable Design and Construction SPG section 3.2.4, the specific measures to mitigate overheating risks are as follows:

Passive measures:

- avoid designing small south facing units;
- use materials with a high thermal mass;
- use green roofs and green walls to keep the heat out, and keep the building and its surroundings cool;
- use materials with high albedo surfaces;
- locate spaces and uses that need to be cool or that generate heat on the north side of development;
- use smaller windows on the south and western elevations with low g-value glazing;
- use carefully designed shading measures, including balconies, louvers, internal or external blinds, shutters, trees and vegetation;

- design the building and its internal layout to enable passive ventilation, including openable windows, a shallow floor plan, high floor to ceiling heights, the stack effect, a double façade;
- minimise internal heat gains by using energy efficient lighting and insulating hot water pipes and infrastructure as well as thermal stores;
- design in vegetation, including green roofs and walls, and water features for passive cooling; and

Active measures:
- energy efficient lighting and equipment to minimise internal heat generation

Technical Feasibility - Retrofitting options that address overheating will need to be tailored to each building (type, construction), occupancy pattern, location and orientation. No single solution fully addresses the overheating risk so a combination or package of adaptation options is likely to be needed to reduce the risk of overheating.

Community Resilience to Extreme Weather (CREW) has developed an online tool to assist home owners and developers when choosing retrofit adaptations to mitigate overheating risk during heat waves and examined its implications on annual heating energy use and cost. The CREW project based their study on 2003 heat wave and considered house type and age, orientation and daytime occupancy in their research.

Results suggested that external shading is the most effective option for almost all house types researched which delivered more than 50% reduction in overheating risk. Flats (especially in middle and upper floors) are the most exposed to overheating risk. Detached, solid wall terraced and semi-detached houses are the less exposed to overheating risk, with the exception of modern (designed to 2006 Part L) detached houses which show increased risk of overheating. The web tool is available for online access at http://www.iesd.dmu.ac.uk/crew/ .

Economic Viability - Retrofitting adaptation measures to avoid overheating at homes would typically add 10-15% cost in refurbishing houses. For a semi-detached house built in 19 century with 3 bedrooms, west facing windows and unoccupied during the day, a sample retrofit package of £13,000 could reduce up to 70% in overheating risk and 30% in heating energy.

Cost of sample adaptation package from CREW project

Adaptation options	**Cost**
Low-e triple glazing	£9,500
Reflective wall coating	£1,200
Louvered internal shading	£2,200
Cavity wall insulation	£200 (subsidised price)
Total	£13,100

(ARCC, 2012)

CONCLUSION
The Knightsbridge Neighbourhood Plan is comprehensive and ambitious. In the review process, we have identified the following:

Gaps	Enhanced Measures
• Waste to Resource • Flood Risk • Overheating Risk	• Air Quality • Energy Efficiency • Urban Greening

All of our findings are evidence-based and our recommendations are developed to reap the synergies presented by separate measures to enhance air quality, urban greening, energy resilience and UHI reduction.

For example, the judicious planting of trees, the introduction of green walls in street canyons and green roofs in developments present a large potential to reduce air pollution, urban heat island effect and surface water runoff in Knightsbridge, as well as encourage urban biodiversity. The co-benefits of green infrastructure is presented in the diagram below.

Reduce Urban Heat Island Effect	• Reduces ambient temperature • Shading surfaces/people • Breaks vertical air flow which then cools the air as it slows down
Improve Air Quality	• Captures airborne pollutants and atmospheric deposition on leaf surfaces • Filters noxious gases and particulate matter
Improve Energy Efficiency & Reduce Overheating Risk	• Limits movement of heat through thick vegetation mass • Reduces ambient temperature via shading and plant processes of evapotranspiration
Reduce Flood Risk	• Delays the downstream passage of flood flows • Reduces the volume of runoff through interception
Improve Health & Wellbeing	• Increases life expectancy and reduced health inequality • Improves levels of physical activity and health • Improves psychological health and mental well-being
Enhance Biodiversity	• Increases habitat area • Increases populations of some protected species • Increases species movement

Figure 27: The co-benefits of green infrastructure measures

The vision of sustainability involves consideration of how urban living impacts greenhouse gas emissions. Measures in waste to resource, energy efficiency and air quality contributes to the plan's GHG ambition both directly and indirectly, and will also go a long way to enhance the health and well-being of the Knightsbridge community. Building energy efficiency measures, in particular, will help reduce demand on existing gas boilers, which is a key emission source of NOx and PM, and hence improving overall air quality.

The addition of these measures will help cement the Knightsbridge Neighbourhood Plan to become a blueprint for not only London-wide plans but other Neighbourhood Plans nationally.

Our recommendations for <u>developments</u> are summarised as follows:

Area	Planning Policy
Waste to Resource	• **Commercial and Industrial sector** i) Before approval to operate an A3 unit, the operators should devise a food waste management plan. ii) Before having approval to operate an A3 unit, the operators should devise a material waste plan. iii) Guiding Principles • Food waste prevention to be prioritised • Stock management and stock storage should be optimised • Food disposal via residual waste to be minimised. • **Household Sector** iv) Any new housing development must have a self-contained recycling unit which allows for waste source segregation. v) Depending on the scale of the housing development a composting unit should be available which will turn food waste into compost. This produce will be used on the local greenery, instead of chemical fertiliser when appropriate.
Air Quality	• Encouraging developments, particularly those fronting major roads, to incorporate designs that reduce the street canyon effect and conduct microclimatic modelling to ensure they go not impede dispersal of pollutants • Requiring developments to site residential dwellings away from traffic emission sources and discharge points of existing gas boilers
Urban Greening	• Encouraging the installation of green roof/ green wall according to recommended design guidelines • Requiring feasibility study for retrofitting green roof/ green wall
Energy Resilience	• Implementing international standard as Building Research Establishment Environmental Assessment Mode (BREEAM) 'outstanding rating' as a guideline for building sustainability for all development. • Encouraging retrofit of listed buildings and buildings in

Area	Planning Policy
	conservation, while • Ensuring the compatibility of retrofitting material. • Ensuring sustainable measures not to damage the original structure. • Safeguarding the special characteristic of these heritage assets for the future.
Overheating Risks	• Development proposals should pass the Overheating Risk Assessment (ORA) • Recommend the use of overheating mitigating measures according to the cooling hierarchy
Surface Flood Risk	• Implementing Sustainable Drainage Systems (SUDS) measures from BREEAM as a guideline for the water management system as well as flood prevention. • Implementing Sustainable Drainage Systems (SUDS) measures for infrastructure in high flood risk area.

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