**Planning (Listed Buildings and Conservation Areas) Act 1990 Policy Briefing and Review**

In the United Kingdom, history is visible on every street. Protecting the historic built environment and cultural heritage of the UK while addressing modern challenges like climate change is a complex issue.

To protect the historic built environment, the Planning (Listed Buildings and Conservation Areas) Act was passed in 1990. This Act ensured additional protections to preserve or enhance the historic character of designated conservation areas, building on the 1967 Civic Amenities Act. There are approximately 10,000 conservation areas in England (Historic England, unknown) and 41% of these are urban (Historic England, 2017).

Conservation areas protect historic character, but contain strict planning regulations to do so. These regulations can cause significant issues for homeowners and residents in a warming climate, limiting possible energy efficiency improvements, such as installing double glazing.

In London, Haringey Council encourages energy efficiency adaptations to homes which “do not affect the character and appearance of the historic environment” – they describe energy performance improvements as “preferable” for historic buildings, but the main priority is conserving the historic character of the area (Haringey Council, unknown). Preservation is important, but it is crucial that urban areas are suitable for modern populations.

In this warming world, urban areas are warming quickest. Urban areas often see a ‘heat island’ effect, where heat is trapped and reradiated in the same environment, kept in by construction materials of surrounding buildings (Rizwan and Dennis, 2008). Urban residents must be able to keep their homes cool to adapt. London is the city in the world in which the urban heat island (UHI) effect has been studied most (Jones and Lister, 2009) and therefore will be my study area for this analysis.

The goal of this analysis is to highlight which London conservation areas have high urban heat, to assess the factors that may be causing this, and to evaluate whether current policy is suitable.

There is a wealth of literature on urban heat, but little research has been done on the interaction between historic conservation areas and high urban heat in the UK, specifically in London. Research has been conducted on the effects urban heat has on heritage buildings (Xia et al, 2024)and how nature-based solutions (NbS) can help mitigate urban heat in Beijing Old City (Su et al, 2022). The work by Su et al. addresses the challenges in implementing NbS in an area with strict heritage planning constraints.

Chandan and Kumar (2019) argue that, in the context of urban heritage conservation in India, UHI can be mitigated by landscaping and tree cover. While urban greenspaces have been shown to have significant urban cooling effects (Doick et al., 2014),small greenspaces do not offer substantial cooling (Vaz Monteiro et al., 2016). The types and health of vegetation plays a key role. Healthy vegetation provides more effective cooling, but in hot urban areas, water may be scarce and the cooling effects of urban greenspace may be lessened (Vaz Monteiro et al, 2019). Another benefit of urban greenspace is a lack of buildings and increased sky cover, allowing for easier heart dispersal (Vaz Monteiro et al, 2019) – this is not a feasible solution in existing historic conservation areas, buildings cannot be demolished for additional sky cover.

A two-pronged approach was taken in this analysis. A classification model was built to explore the strongest contributing factors in high urban heat in conservation areas, and as a pilot of a predictive model which could be applied to other cities. Then, a geographically weighted regression was conducted to investigate spatial relationships between urban heat and a number of factors, including the presence of historic conservation areas.

Analysis was done on a LSOA (Lower Super Output Area) level, using geographic boundaries defined in the 2021 Census. The study area was Greater London, using London Borough boundaries published by the Greater London Authority. The two main variables in this analysis were conservation area boundaries, published by Historic England, and data produced by Arup, a consulting firm, on behalf of the Mayor of London, published in the Properties Vulnerable to Heat Impact Report (Arup, 2024), containing Urban Heat Ranks (UHRs) for each London LSOA.

Additional variables used were building heights, building density, deprivation data, property vulnerability scores to urban heat, distances from rivers and greenspace, property overcrowding scores, and Point of Interest data. All data explored was to assess the impacts of social and environmental factors on urban heat.

All data was aggregated to LSOA level and standardised using z-scores, to allow accurate and representative analysis. LSOA distances from rivers and greenspaces were calculated using ArcGIS Pro.

Distribution of conservation areas across London can be seen in Figure 1, and UHRs of different LSOAs can be seen in Figure 2.

Conservation areas are concentrated in central London, and in the south-west, but at least one can be seen in most boroughs. High UHRs also seem to mainly be found in central London. This aligns with expectations – higher urban heat is expected in central London due to its built-up nature (Jones and Lister, 2009).UHR generally gets lower further from central London, but LSOAs with the highest urban heat can be seen at the boundaries of London.

A map of a city

AI-generated content may be incorrect.

Figure 1: Map of conservation area distribution across London boroughs.

A map of a city

AI-generated content may be incorrect.

Figure 2: Urban Heat Ranks (UHRs) across London.

A t-test was conducted on urban heat in conservation areas and in non-conservation areas. The t-statistic was 10.24 and the p-value was 2.33e-24. The high t-statistic shows a significant statistical difference between the two groups, and the low p-value demonstrates strong evidence against the null hypothesis.

While the mean for both groups are 3, the median UHR, UHR in conservation areas tends to skew a little higher than UHR in non-conservation areas as seen in Figure 3. This validates the importance of exploring potential factors in higher UHR in conservation areas through this study.

A green and red leaves

AI-generated content may be incorrect.

Figure 3: Violin plot showing mean urban heat rank of LSOAs containing conservation areas and those without.

A map of a city

AI-generated content may be incorrect.

Figure 4: Map showing LSOAs containing conservation areas, with high UHR. Conservation area boundaries are overlaid.

Out of the 4945 LSOAs within the London boroughs, 1046 (21%) contained conservation areas and had an Urban Heat Rank of 4 or above, as seen in Figure 4. These LSOAs are 12% of the area of London**,** and contain 20.8% of London’s population.

Due to the large geographic area and the large populations of these areas,current policy is visibly insufficient to deal with the scale of the problem. Policy must be adapted in order to ensure the best protections for the historic environment and for current residents from an ever-increasingly warming climate.

A Random Forest classification model was then implemented. This model was run both as a trial, for potential policy application on a local level to targetnecessary climate adaptationsin conservation areas, but also to determine feature importance in contributing to high urban heat in conservation areas. The model attempted to predict the likelihood of an LSOA containing a conservation area and having a high UHR given a selection of social and environmental factors.

Due to the imbalanced group sizes, Synthetic Minority Oversampling (SMOTE) was used to generate synthetic samples of the minority class and the class weight was set to balanced to enhance performance on the minority class. Both methods were used to improve model performance in accurately predicting presence of LSOAs containing conservation areas with high UHRs.

The most significant factor in the model was mean housing density, followed by amounts of points of interest, and mean building height. The least impactful feature in the model by far was distance of an LSOA from a greenspace.

The low importance of greenspace in this model highlights a significant limitation of this analysis. Greenspace is widely considered to be a key feature in reducing urban heat, but this analysis could address nuances in the urban cooling effect of greenspace due to the scale of the project – factors such as quality and size of greenspace (Vaz Monteiro et al, 2019), as well as proximity, are key.

The model performed well, but could be improved. The weighted average F1 score of the model was 0.84, but when predicting the presence of an LSOA with high UHR intersecting a conservation area, the F1 score was 0.67. 76% of these LSOAs were correctly identified by the model. This model could be used to predict where conservation areas are at risk of high urban heat with further model tuning and more samples from other urban areas. The amount of LSOAs in London was a limiting factor in this analysis and in the predictive power of this model – the inclusion of more cities would help fit the model to UK urban areas, not just London.

A geographically weighted regression (GWR) was conducted to analyse spatial distribution of factors which potentially contribute to urban heat levels. The key independent variable was the presence of a conservation area within an LSOA, but other factors such as occupancy score and distance from greenspace were included. Features found to have limited importance in the classification model were excluded, but greenspace was included due to its importance throughout the literature on mitigating urban heat. POI count was also excluded as it seemed to interfere with the final GWR results.

The adjusted R² score was 0.401 showing that, after adjusting for model complexity, the model only explains 40.1% of the variability in the data. This is a significant improvement from the global regression results of 0.276, or the exploratory OLS regression which had an adjusted R² of 0.281. High UHR in London is an inherently spatial issue.

The key variable explored in this regression was conservation area presence. The beta coefficients of conservation area presence have been mapped in Figure 5. In some areas, presence of a conservation area was associated with lower UHR. These areas were mostly on the borders of London, but also, highly concentrated within Westminster. In other boroughs, such as Islington and Lewisham, conservation area presence is associated with an increase in urban heat.

This analysis highlights boroughs in which planning policy must be further investigated by local authorities, to ensure that policies that protect the historic built environment also support climate resilience - safeguarding both the past and the future. However, more work is needed to take into consideration the different built characteristics of these boroughs and the exact reasons why the designation of conservation areas would negatively impact climate resilience in some areas but not others.

A map of the united kingdom

AI-generated content may be incorrect.

Figure 5: Map showing beta coefficient of conservation areas in urban heat analysis across London.

The analysis had some inherent limitations. Choosing LSOAs as the spatial unit was potentially problematic due to the data aggregation needed. However, this was the smallest spatial unit which allowed for analysis of social and environmental factors. Categorising conservation area presence as a binary True/False variable within an LSOA loses nuance in conservation area size and the historic character of an area, but the data had to be standardised geographically for analysis.

Current historic preservation policy is not fit for purpose. The vagueness of the Planning (Listed Buildings and Conservation Areas) Act 1990 in precisely what alterations are allowed does permit for a holistic approach to be taken – different historic conservation areas have different elements which contribute to their historic character. However, this ambiguity trickles down to local authorities, and to homeowners who are left without sufficient guidance, leading to confusion about what future-proofing changes are permitted and risking fines.

As seen in the spatial relationship between UHR and conservation areas in Figure 5, the current approach is too broad and leads to conservation area presence potentially contributing to higher urban heat levels. Restrictions on modifications within conservation areas could be limiting the adoption of cooling or climate-adaptive interventions, or these restrictions may not be strict enough and could enable mass housing developments which only contribute further to urban heat issues. Policies must be revisited and revised at the local level, with input from heritage and environment professionals, to better balance historic conservation with environmental resilience.

Bibliography:

Arup, 2024. *Properties Vulnerable to Heat Impacts in London: Prioritisation for adaptation interventions.* [Online]. London: Greater London Authority. [Accessed 10 May 2025]. Available from: https://www.london.gov.uk/programmes-strategies/environment-and-climate-change/environment-and-climate-change-publications/properties-vulnerable-to-heat-impact-report

Chandan, S., and Kumar, A., 2019. Review of Urban Conservation Practices in Historic Cities. *International Journal on Emerging Technologies.* [Online]. **10**(1), pp. 74-84. [Accessed 12 May 2025]. Available from: <https://www.researchgate.net/publication/333356509_Review_of_Urban_Conservation_Practices_in_Historic_Cities>

*Civic Amenities Act 1967*. London: The Stationery Office.

Doick, K.J., Peace, A. and Hutchings, T.R., 2014. The role of one large greenspace in mitigating London's nocturnal urban heat island. *Science of the Total Environment*. [Online]. **493**, pp.662-671. [Accessed 15 May 2025]. Available from: <https://doi.org/10.1016/j.scitotenv.2014.06.048>

Haringey Council, unknown. *Energy efficiency in conservation areas*. [Online]. [Accessed 11 May 2025]. Available from: https://www.haringey.gov.uk/planning-building-control/planning/planning-policy/design-conservation/conservation-areas/conservation-areas/development-conservation-areas/energy-efficiency-conservation-areas

Historic England, unknown. *Designating and Managing a Conservation Area.* [Online]. [Accessed 12 May 2025]. Available from: https://historicengland.org.uk/advice/planning/conservation-areas/

Historic England, 2017. What is a Conservation Area? 28 September. *The Historic England Blog.* [Online]. [Accessed 15 May 2025]. Available from: <https://heritagecalling.com/2017/09/28/what-is-a-conservation-area/>

Jones, P., and Lister, D., 2009. The urban heat island in Central London and urban-related warming trends in Central London since 1900. *Weather*. [Online]. **64**(12), pp. 323-327. [Accessed 15 May 2025]. Available from: <https://doi.org/10.1002/wea.432>

*Planning (Listed Buildings and Conservation Areas) Act 1990.* (p.II). London: The Stationery Office.

Rizwan, A.M. and Dennis, L.Y., 2008. A review on the generation, determination and mitigation of Urban Heat Island. *Journal of Environmental Sciences*. [Online]. **20**(1), pp.120-128. [Accessed 16 May 2025]. Available from: https://doi.org/10.1016/S1001-0742(08)60019-4

Su, W., Zhang, L., and Chang, Q., 2022. Nature-based solutions for urban heat mitigation in historical and cultural block: The case of Beijing Old City. *Building and Environment.* [Online]. **225**, 109600. [Accessed 12 May 2025]. Available from: <https://doi.org/10.1016/j.buildenv.2022.109600>

Vaz Monteiro, M., Doick, K.J., Handley, P., and Peace, A., 2016. The impact of greenspace size on the extent of local nocturnal air temperature cooling in London. *Urban Forestry & Urban Greening.* [Online].**16**, pp. 160-169. [Accessed 8 May 2025]. Available from: <https://doi.org/10.1016/j.ufug.2016.02.008>

Vaz Monteiro, M., Handley, P., Morrison, J.I.L., and Doick, K.J., 2019. *The role of urban trees and greenspaces in reducing urban air temperatures.* [Research note]. [Accessed 10 May 2025]. Available from: https://cdn.forestresearch.gov.uk/2019/01/fcrn037.pdf

Xia, J., Kang, J., and Xu, X., 2024. Global Research Trends and Future Directions in Urban Historical Heritage Area Conservation and Development: A 25-Year Bibliometric Analysis. *Buildings*. [Online]. **14**(10), 3096. [Accessed 10 May 2025]. Available from: https://doi.org/10.3390/buildings14103096

Datasets:

Arup, 2024. Properties Vulnerable to Heat Impacts in London. *London Datastore.* [Online]. [Accessed 2 May 2025]. Available from: <https://data.london.gov.uk/dataset/properties-vulnerable-to-heat-impacts-in-london>

Emu Analytics, 2024. London Building Heights. *Emu Analytics.* [Online]. [Accessed 3 May 2025]. Available from: <https://www.emu-analytics.com/post/data-packs-from-emu-analytics>

Emu Analytics, 2024. London Housing Density. *Emu Analytics.* [Online]. [Accessed 3 May 2025]. Available from: <https://www.emu-analytics.com/post/data-packs-from-emu-analytics>

Greater London Authority, 2024. Statistical GIS Boundary Files for London. *London Datastore*. [Online]. [Accessed 2 May 2025]. Available from: <https://data.london.gov.uk/dataset/statistical-gis-boundary-files-london>

Historic England, 2025. Conservation area. *Ministry of Housing, Communities and Local Government*. [Online]. [Accessed 3 May 2025]. Available from: https://www.planning.data.gov.uk/dataset/conservation-area

Office for National Statistics, 2023. Overcrowding and under-occupancy by household characteristics, England and Wales: Census 2021. *Office for National Statistics*. [Online]. [Accessed 4 May 2025]. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/housing/datasets/overcrowdingandunderoccupancybyhouseholdcharacteristicsenglandandwalescensus2021

Ordnance Survey, 2025a. OS Open Greenspace. *EDINA Digimap.* [Online]. [Accessed 6 May 2025].

Ordnance Survey, 2025b. OS Open Rivers. *EDINA Digimap.* [Online]. [Accessed 6 May 2025].

Ordnance Survey, 2025c. Points of Interest. *EDINA Digimap.* [Online]. [Accessed 6 May 2025].