

# From Climate Risk Diagnosis to Design Decisions in the Built Environment: An Indicator-Based Adaptation Workflow with Bat-ADAPT and depthmapX

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**Abstract.** Climate adaptation in mixed-use building assets requires methods that connect class-based risk diagnosis with feasible design decisions and explicit spatial localisation, a link that remains weak in existing screening approaches. This paper develops and tests a lightweight, indicator-based workflow to address this gap. Bat-ADAPT (R4RE), an indicator-based climate-risk assessment tool, assesses exposure and vulnerability and derives cross-risk classes. It is also used to simulate adaptation packages. depthmapX, a space-syntax-based spatial analysis tool, provides a complementary layer for locating selected measures within shared outdoor spaces. The workflow is applied to Cascina Fossata in Turin, Italy, through two assessment profiles representing a reused historic courtyard building and a new multi-storey construction. The baseline diagnosis identifies Heat as the priority hazard and “Rainfall & Floods” as the second relevant condition. Under the final packages, Profile 1 vulnerability decreases from High to Medium for both hazards, while Profile 2 reaches Low vulnerability for Heat and Medium vulnerability for “Rainfall & Floods”. Exposure remains unchanged in both profiles. The depthmapX analysis informs the placement of visual risk communication and the identification of candidate locations for cool refuge areas. The intelligibility test yields  $R^2 = 0.0193$  for the baseline configuration and  $R^2 = 0.9103$  for the controlled alternative configuration, indicating a stronger relationship between Connectivity and Visual Integration for the tested geometry. The case study indicates that the workflow can provide a traceable basis for early-stage adaptation decisions, while its outputs remain class-based and the spatial results do not demonstrate climate-risk reduction.

**Keywords:** Climate-risk assessment; Adaptation decision support; Bat-ADAPT; depthmapX; Space syntax

## 1. Introduction

Climate change is shifting the assessment of building performance beyond energy use towards safety and operational resilience [1]. In European urban contexts, heat stress and pluvial flooding pose growing challenges to the built environment [2, 3]. Heat can impair indoor comfort and occupant health, while reducing the usability of outdoor spaces [1, 4]. Intense rainfall can disrupt access and mobility and affect basements or technical spaces exposed to water ingress [3, 5]. These effects become more relevant in mixed-use assets, where different functions share buildings and open spaces under the same climatic conditions.

Despite growing attention to climate adaptation in the built environment, a gap remains between climate-risk diagnosis and implementable design decisions [6]. Screening tools and adaptation catalogues can identify hazards and suggest measures, but they often provide limited support for feasibility and localisation [7]. Feasibility requires adaptation measures to respond to the existing building fabric and to constraints of use, with added challenges where historic and new construction coexist [8, 9]. Localisation concerns measures whose effectiveness depends on their position within the spatial system of an asset [10]. This issue arises for risk communication and preparedness measures and for the designation of cool refuge areas during heat events [11, 12]. When feasibility and localisation are disconnected from the diagnostic process, adaptation strategies may remain generic or not well grounded in the conditions of the asset [6, 7].

The study brings together Architectural Engineering and Building Technology, with Drawing and Representation acting as a design interface. Architectural Engineering and Building Technology frame the interpretation of climate-related vulnerability and adaptation feasibility. Drawing and Representation support the spatial interpretation of evidence and its translation into design decisions. Their convergence provides the

basis for a workflow in which climate-risk information is connected with technological constraints and spatial evidence. Within this framework, graphic representation supports traceability by making assumptions and design implications visible rather than acting as an independent objective of the study.

To address the identified gap, this paper proposes and tests a lightweight, indicator-based decision-support workflow that combines Bat-ADAPT and depthmapX. Bat-ADAPT, developed within the Resilience for Real Estate framework (R4RE), structures building profiles and provides class-based outputs for exposure and vulnerability, from which cross-risk classes are derived. It also enables selected measures to be tested through controlled baseline–scenario simulations. depthmapX is a space-syntax-based spatial analysis tool [13, 14] used here as a complementary localisation layer. Within the proposed workflow, Bat-ADAPT guides the identification of priority hazards and feasible adaptation packages, whereas depthmapX informs the placement of measures that depend on spatial configuration. The workflow is intended for early-stage assessment and does not replace detailed engineering verification.

The primary contribution of the study is the integration of climate-risk diagnosis and feasibility-driven adaptation simulation with a selective spatial localisation step in a single traceable workflow. This contribution rests on three methodological choices. Building portions with different construction conditions are assessed through separate profiles so that their retrofit constraints are not averaged. Candidate adaptation measures are tested through a feasibility-first process. Retained actions must correspond to identifiable input changes and remain part of a package associated with a change in the relevant class-based output. The spatial component is then applied to measures for which configuration has a defensible role in implementation. On this basis, the study examines whether separate profiling improves the interpretation of vulnerability drivers and whether feasible adaptation packages modify vulnerability and cross-risk classes. It also examines whether visibility-based analysis informs the placement of preparedness and refuge-related measures.

The workflow is applied to Cascina Fossata in Turin, Italy, a regeneration project that combines a reused historic courtyard building with a new multi-storey construction around shared open spaces. The case study provides a common climatic context in which the workflow can be tested under two different feasibility conditions. Its role is to examine the implementation of the proposed method rather than to establish external validation or general applicability. The workflow provides a basis for early-stage prioritisation and traceability. It also informs selected spatial decisions. It does not yield calibrated physical risk estimates or detailed engineering design. The spatial analysis does not demonstrate climate-risk reduction.

Section 2 defines the methodology and replication protocol, while Section 3 describes its implementation at Cascina Fossata. Section 4 presents the results; Sections 5 and 6 discuss their implications and state the conclusions.

## 2. Methodology

### *2.1. Overall integrated workflow*

The study adopts a lightweight, iterative workflow to inform early-stage climate-adaptation decisions in architectural engineering and building technology (Figure 1). The workflow is intended for contexts with incomplete information and provides a traceable path from risk diagnosis to adaptation decisions without replacing detailed engineering verification. The process starts with separate assessment profiles for building portions that share the same site context but differ in construction conditions and retrofit constraints. This distinction preserves the vulnerability drivers and feasibility conditions of each profile.

For each profile, Bat-ADAPT (R4RE) [15] provides the baseline diagnosis and is used to develop an adaptation scenario. The diagnosis identifies priority hazards and interprets vulnerability drivers through the class-based outputs of the platform. Candidate measures are selected through a feasibility-first approach and tested through controlled baseline–scenario simulations. The package is refined in response to the class-based outputs. A measure may modify a platform input without changing the reported class unless it forms part of a package that crosses a class threshold.

The final stage introduces depthmapX [14] as a spatial decision-support layer for measures that depend on location. Its use is restricted to actions for which spatial configuration has a defensible role in implementation. In this study, this condition applies to visual risk communication and cool refuge areas. The integrated workflow thus connects climate-risk diagnosis with feasible adaptation choices and provides a spatial basis for selected actions.

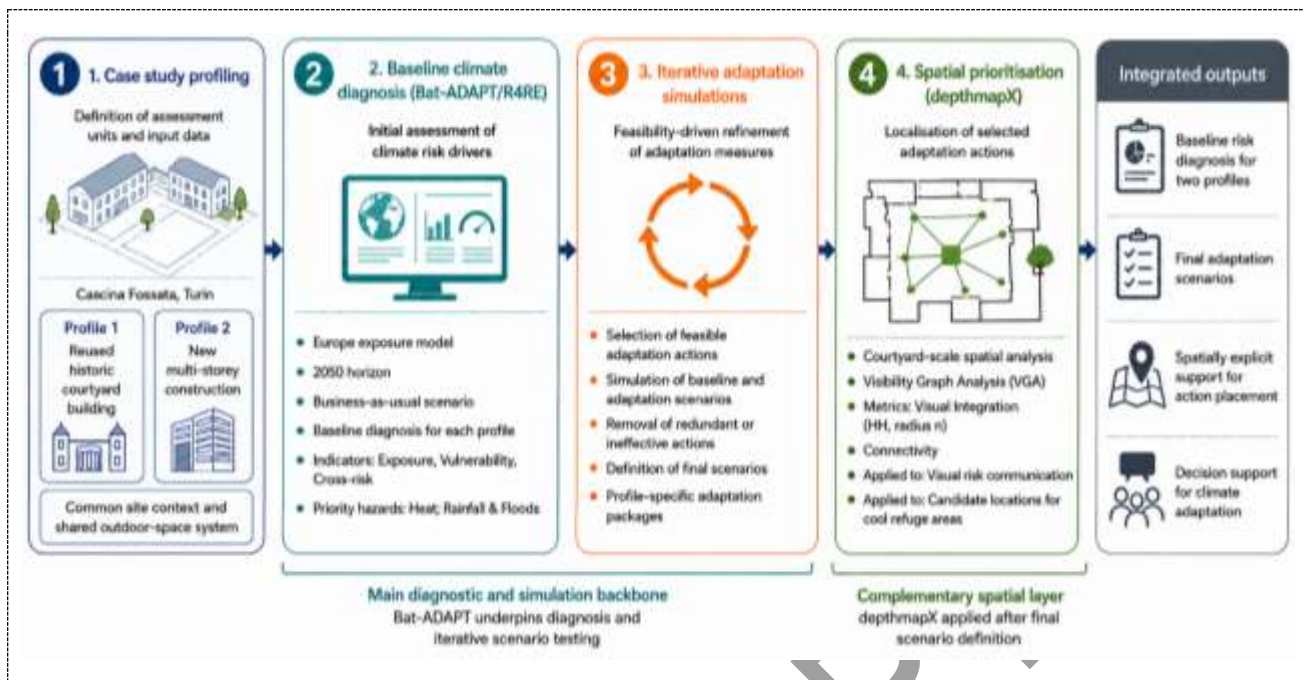


Figure 1. Integrated workflow.

## 2.2. Bat-ADAPT/R4RE: climate-risk diagnosis and adaptation simulations

Bat-ADAPT was configured with the Europe perimeter, which applies to assets located outside France [15]. The assessment adopted a 2050 time horizon under a business-as-usual assumption. This assumption excludes adaptation or mitigation conditions external to the asset, apart from the measures introduced in the simulations. For each hazard, the platform reports exposure and vulnerability classes, which are combined into a cross-risk class. A reliability index provides an additional indication of the completeness and specificity of the form-based input profile.

The reliability index served as a quality-control signal for interpreting results. It does not constitute external validation or replace technical verification. The platform does not disclose its internal weighting or scoring rules, and the thresholds used to assign classes are not exposed to the user. The outputs are therefore interpreted through controlled comparisons between the baseline and adaptation scenarios rather than as calibrated risk values. All simulations retain the same modelling assumptions except for the input fields changed by the tested measures.

In this study, pluvial flooding denotes the relevant flood mechanism, while “Rainfall & Floods” is retained when referring to the corresponding Bat-ADAPT category and outputs.

Vulnerability was interpreted through the sensitivities of its components to connect building conditions with adaptation choices. For Heat, the platform distinguishes envelope and cooling components. It also reports use and outdoor components. For the Bat-ADAPT category “Rainfall & Floods”, the platform distinguishes ground-floor and basement components, and also reports use and outdoor components. These components support identifying vulnerability drivers that can be addressed through adaptation. Each selected measure can therefore be linked to a specific driver rather than treated as a generic catalogue recommendation.

Hazard prioritisation followed two criteria. The baseline diagnosis had to indicate a relevant exposure–vulnerability condition. The platform also had to provide diagnostic components that could be linked to feasible adaptation measures. Hazards that did not meet these conditions were retained as contextual outputs and were not carried forward to adaptation testing.

The adaptation simulation module used the baseline profile as a fixed reference. Each simulation was exported in spreadsheet format to record the tested action and the corresponding input change. The same record was used to compare vulnerability and cross-risk classes between the baseline and each simulated scenario. A measure was retained in the final scenario when it changed an identifiable platform input and remained part of a package associated with a change in the relevant class-based output. Measure selection also followed a feasibility-first criterion: each action had to address an influential vulnerability component and remain compatible with the constraints of the assessment profile.

### 2.3. *depthmapX: spatial analysis and configurational assessment*

depthmapX provides a spatial prioritisation layer that complements Bat-ADAPT. Bat-ADAPT identifies priority hazards and candidate adaptation measures, whereas depthmapX informs decisions about where location-dependent measures may be placed within the asset. The spatial component is used as a localisation tool for shared open spaces and not as a climate-performance model [14, 16].

Two outputs were used for zone-based spatial prioritisation [16–18]. Visual Integration (HH, radius n) identifies areas with a central role in the visibility network and supports the interpretation of movement and orientation. Connectivity describes local visual access and helps identify blind spots or weak links in wayfinding.

The spatial component was applied to visual risk communication and cool refuge areas, as both depend on legibility and access. The analysis provides visibility-based evidence for their placement. It does not assess thermal comfort or shading. It also does not simulate surface temperature or hydrological behaviour. This restricted use keeps the spatial analysis aligned with the research question and prevents claims beyond the scope of the configuration metrics.

A controlled alternative configuration was tested through an intelligibility test. Intelligibility expresses the relationship between local visual access and the global structure of the spatial system [13, 18]. The alternative was treated as a controlled configurational test rather than as a redesign proposal.

Intelligibility was assessed through scatterplots and the coefficient of determination for the baseline and controlled alternative configurations. The comparison tests whether changes in routes and open-space organisation can strengthen the relationship between local and global spatial structure. The test informs the interpretation of wayfinding and refuge-area placement but does not provide evidence of climate-risk reduction.

### 2.4. *Input-data hierarchy, assumptions and replication protocol*

A data hierarchy was adopted to support transparency and reproducibility. Each key field was assigned a provenance status. Documented information was distinguished from methodological settings. Assumptions were recorded as a separate status. Where a mandatory field required completion and source evidence was incomplete, a conservative baseline assumption was recorded. Values that could not be reconstructed from the retained material were marked as not documented in the available record. Interpretive assumptions used for feasibility judgements were identified as such. Inputs were also distinguished between shared site information and profile-specific information. Variables changed during the adaptation simulations were recorded as a separate set.

Several Bat-ADAPT fields are not reported in open project sources for real-world assets. Examples include window-to-wall ratio, insulation type, airtightness and flood-protection devices. When such information was required to complete the assessment, baseline assumptions were selected to match the known construction profile of each building portion. During adaptation simulation, changes were restricted to fields linked to the selected measures. Examples include solar protection and glazing class. Roof configuration and basement equipment location were also used as scenario levers. When a baseline value was not documented in the retained material and was not used as a scenario lever, no value was inferred in Table S1. This approach separates baseline assumptions from intervention choices and allows the baseline–scenario comparison to be traced to recorded input modifications.

For replication in another case study, the procedure follows the same sequence adopted in this work. The assessment unit is first defined and the baseline dataset is recorded, with each key field assigned the provenance status used in Table S1. Bat-ADAPT is then used to identify priority hazards and vulnerability drivers. Candidate measures are selected against the constraints of each profile and tested through controlled baseline–scenario simulations. When a retained measure depends on location, depthmapX is added as the spatial assessment step. The replication record preserves two links: from each adaptation measure to its modified input and from each spatial decision to the configuration evidence that supports it.

The key baseline assumptions and simulated changes are summarised in Table S1. The table reports the key baseline values for Profile 1 and Profile 2 where these can be established from the retained material and identifies their provenance or assumption status. Fields for which a baseline value cannot be reconstructed are marked as not documented rather than assigned a new value. The table also records the fields modified in the final scenarios and the associated class-based outputs. The vulnerability reliability index is included as a quality-control signal. This documentation creates an audit trail for the baseline–scenario comparison and facilitates application of the workflow to other building assets.

### 3. Case study and workflow implementation

#### 3.1. Cascina Fossata and the two-profile modelling strategy

The case study is Cascina Fossata, a mixed-use complex combining social housing and services, located at Via Ala di Stura 5 in Turin, Italy [19]. The project includes the adaptive reuse of a historic courtyard building and a new multi-storey construction organised around two internal courtyards. These courtyards form shared open spaces that support access and circulation within the complex. Figure 2 documents the transformation of the former cascina into the regenerated mixed-use asset.

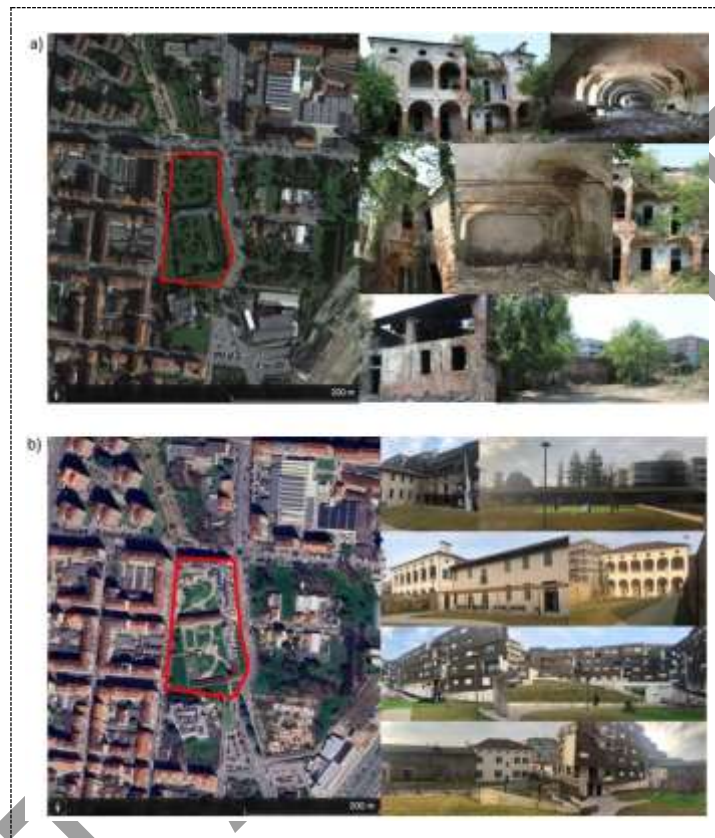


Figure 2. Cascina Fossata: (a) pre-recovery condition; (b) regenerated mixed-use complex.

The programme includes residential and hospitality uses, with services for the surrounding neighbourhood. This mix creates different occupancy conditions and concentrates circulation and collective activities within the courtyard system. The courtyards therefore function as active shared spaces rather than residual outdoor areas. Their role in access and shared use makes them relevant to the application of the adaptation workflow. The case includes two building portions with different construction conditions and intervention constraints. Profile 1 represents the reused historic courtyard building. Its conservation context and limited intervention margins favour reversible measures with limited physical impact. Profile 2 represents the new multi-storey construction, where the roof and envelope allow a broader range of adaptation measures. Both profiles share the same site context and outdoor-space system but retain distinct building characteristics and feasibility conditions.

#### 3.2. Case-specific input data and assumptions

The case-specific dataset was assembled from the project information and operational records available for Cascina Fossata. The retained material was used to characterise the two building portions and their shared site context, including the courtyard system and access routes. Each key Bat-ADAPT input was assigned the provenance status defined in Section 2.4 and reported in Table S1.

Profile 1 and Profile 2 were compiled as separate Bat-ADAPT assessment units. General site-context inputs

were shared between the two profiles, whereas building inputs and profile-specific outdoor-space quantities followed the corresponding assessment records. Where the retained material did not support a mandatory baseline value, a conservative assumption was used when required for the assessment. For example, external solar protection and mineral-surface colour were represented using conservative baseline assumptions. By contrast, fields not used as scenario levers were marked as not documented when their baseline value could not be reconstructed. This applies, for example, to glazing performance in Profile 2 and roof type in Profile 1. Basement conditions required separate treatment because they affected the interpretation of the “Rainfall & Floods” vulnerability. For Profile 1, the assessment record indicated the presence of sensitive equipment in the basement, and its relocation was tested in the final adaptation scenario. For Profile 2, the corresponding baseline value could not be reconstructed from the retained material and was not inferred because the field was not used as a scenario lever. Table S1 records these assumptions and model-record values together with the input changes introduced in the final scenarios.

### 3.3. Spatial model and Z1–Z5 implementation

The spatial model covered the two courtyards and their immediate access and connection paths. The analysis perimeter was restricted to areas relevant to the location-dependent measures examined in the study. Figure 3 shows this perimeter and the Z1–Z5 zoning scheme used for the depthmapX analysis.

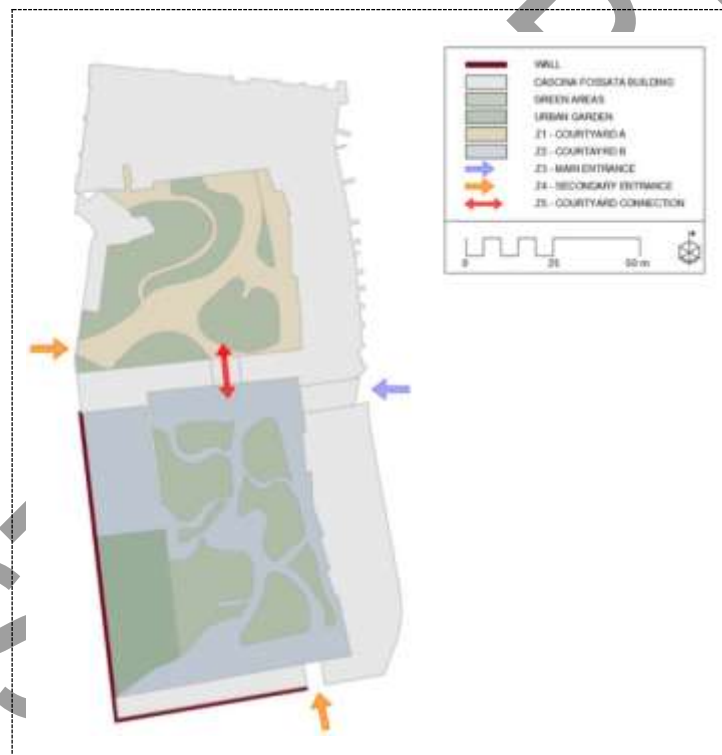


Figure 3. Case study and depthmapX analysis perimeter.

A plan-based model was derived from the available DXF file and prepared for import into depthmapX. The representation retained the building footprints and main boundaries. Physical elements that interrupt visibility were also retained. Minor furniture and playground elements were removed to avoid fragmentation of the visibility graph. Paths between green areas were retained as part of the accessible open-space system and were not represented as visual barriers. The model was kept at real scale, with metres as the reference unit.

Visibility Graph Analysis was performed in depthmapX v0.8.0 using a 1 m grid [14, 16]. The zones Z1–Z5 were defined a priori from functional and morphological differences within the courtyard system. Each zone grouped the 1 m<sup>2</sup> VGA cells within the corresponding area. Visual Integration and Connectivity were then interpreted at the zone level to support comparison within the analysed perimeter.

High, Medium and Low classes were assigned based on the normalised colour gradients generated by depthmapX. Red and orange tones were classified as High, while blue and light-blue tones were classified as

Low. Intermediate ranges were classified as Medium. These classes represent a relative intra-site hierarchy and do not constitute absolute thresholds transferable to other case studies. No fixed numerical cut-offs were applied to define the three classes.

A controlled alternative configuration was also modelled while retaining the building perimeter and overall courtyard system. The alternative strengthened visual and pedestrian continuity between the two courtyards and regularised the main connection axis. Green and open areas were reorganised to reduce interruptions along the principal routes. The test examined whether limited changes to paths and open-space organisation could strengthen the relationship between local visual access and global spatial structure. The alternative was therefore treated as a configurational test rather than as a redesign proposal.

## 4. Results

### 4.1. Baseline diagnosis: Profile 1 and Profile 2

The baseline diagnosis identifies Heat as the priority hazard for both profiles, with “Rainfall & Floods” as the second relevant condition. The outputs are class-based results generated under the same modelling assumptions and should not be interpreted as calibrated risk estimates. Since the two profiles share the same climatic and general site context, differences in vulnerability and cross-risk reflect the profile-specific inputs represented in each assessment.

For Profile 1, Heat exposure is Very high, vulnerability is High and cross-risk is Very high. The diagnostic decomposition indicates relevant sensitivities in the envelope and use components. For “Rainfall & Floods”, exposure is Medium, while vulnerability and cross-risk are High. Basement and ground-floor components contribute to this vulnerability condition.

For Profile 2, Heat exposure is Very high, vulnerability is Medium and cross-risk is High. The diagnostic decomposition indicates Medium contributions from the envelope and cooling components, with an additional contribution from use. For “Rainfall & Floods”, exposure is Medium, while vulnerability and cross-risk are High. Basement and use components remain relevant, whereas the ground-floor component is less sensitive than in Profile 1.

Other hazards were retained as contextual outputs. Geotechnical drought exposure is Low and cold exposure is Medium. Several other hazard families are not quantified under the Europe model. According to the prioritisation criteria defined in Section 2.2, Heat and “Rainfall & Floods” were carried forward to adaptation testing because they presented relevant exposure–vulnerability conditions and diagnostic components that could be linked to feasible measures.

Table 1 reports the baseline exposure, vulnerability and cross-risk classes for the two selected hazards. The vulnerability reliability index is 5/5 for both profiles and is treated as a quality-control signal rather than as external validation.

Table 1. Baseline diagnosis summary: Profiles 1 and 2.

| Hazard            | Exposure (P1) | Vulnerability (P1) | Cross-risk (P1) | Exposure (P2) | Vulnerability (P2) | Cross-risk (P2) |
|-------------------|---------------|--------------------|-----------------|---------------|--------------------|-----------------|
| Heat              | Very high     | High               | Very high       | Very high     | Medium             | High            |
| Rainfall & Floods | Medium        | High               | High            | Medium        | High               | High            |

### 4.2. Final adaptation scenarios and baseline–scenario performance

The iterative simulation process produced one final adaptation scenario for each profile. Retained measures corresponded to identifiable input changes and formed part of packages associated with changes in the relevant class-based outputs. Measures that did not contribute to the retained packages were excluded. Figure 4 summarises the baseline–scenario changes in vulnerability and cross-risk for Heat and “Rainfall & Floods”.

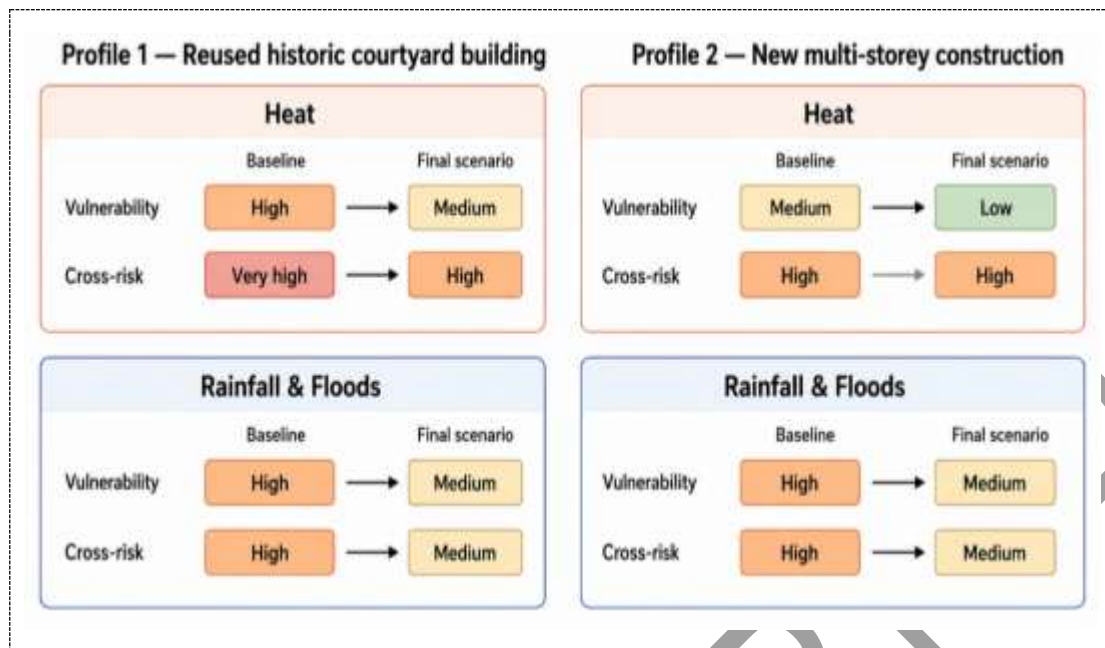


Figure 4. Baseline-scenario changes in vulnerability and cross-risk classes for Heat and “Rainfall & Floods”.

For Profile 1, the final scenario combines retrofit-compatible building measures with site actions. Preparedness measures are also included. The package includes changes to solar control and glazing. It also includes surface interventions and operational measures documented in Table 2. Under this scenario, Heat vulnerability decreases from High to Medium, while Heat cross-risk decreases from Very high to High. For “Rainfall & Floods”, vulnerability and cross-risk both decrease from High to Medium. Exposure remains unchanged for both hazards, so the observed class changes arise from the vulnerability component of the assessment. For Profile 2, the final scenario combines building and site measures with a green-roof intervention. Preparedness measures are also included. Under this scenario, Heat vulnerability decreases from Medium to Low, while Heat cross-risk remains High. The persistence of the cross-risk class is consistent with the Very high exposure condition and the threshold-based structure of the platform output. For “Rainfall & Floods”, vulnerability and cross-risk both decrease from High to Medium. Exposure remains unchanged. Table 2 records each retained action and its corresponding input modification. The feasibility notes describe case-specific implementation conditions and do not represent detailed technical verification.

Table 2. Final adaptation packages and traceability.

| Profile                                               | Adaptation action                             | Hazard driver | Modelled change – platform field            | Feasibility note                                                              |
|-------------------------------------------------------|-----------------------------------------------|---------------|---------------------------------------------|-------------------------------------------------------------------------------|
| <b>Profile 1 – Reused historic courtyard building</b> |                                               |               |                                             |                                                                               |
| P1                                                    | Installing solar protection devices           | Heat          | External sun protection: Partial → Complete | Reversible shading; limited physical impact.                                  |
| P1                                                    | Limiting and adapting glazed façades          | Heat          | Glazing: Double → High selectivity          | Retrofit film or selective replacement; heritage compatibility to be checked. |
| P1                                                    | High-albedo pavements on impermeable surfaces | Heat          | Impermeable mineral surface: Dark → Light   | Surface specification; glare and heritage compatibility to be checked.        |

| Profile                                          | Adaptation action                              | Hazard driver                | Modelled change – platform field                                                    | Feasibility note                                                             |
|--------------------------------------------------|------------------------------------------------|------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| P1                                               | De-sealing impermeable surfaces                | Heat and “Rainfall & Floods” | Impermeable surfaces: 3000 → 2000 m <sup>2</sup>                                    | Phased site intervention; drainage performance requires verification.        |
| P1                                               | Communicating climate risks to occupants       | Heat and “Rainfall & Floods” | Risk communication: No → Visual communications                                      | Low-cost measure; signage protocol required.                                 |
| P1                                               | Creating cool refuge areas                     | Heat                         | Refuge areas: No → Cool refuge area                                                 | Operational designation; access and comfort conditions require verification. |
| P1                                               | Moving sensitive equipment out of the basement | “Rainfall & Floods”          | Sensitive equipment in basement: Yes → No                                           | MEP reallocation; continuity-of-use measure.                                 |
| <b>Profile 2 – New multi-storey construction</b> |                                                |                              |                                                                                     |                                                                              |
| P2                                               | Installing solar protection devices            | Heat                         | External sun protection: Partial → Complete                                         | Design-integrated measure; passive-first strategy.                           |
| P2                                               | Creating a green roof                          | Heat and “Rainfall & Floods” | Roof type: Dark → Dark + green roof; roof strata: No vegetation stratum → 1 stratum | Feasible in new construction; structural and waterproofing checks required.  |
| P2                                               | High-albedo pavements on impermeable surfaces  | Heat                         | Impermeable mineral surface: Dark → Light                                           | Surface specification; glare and visual comfort to be checked.               |
| P2                                               | De-sealing impermeable/mineralised surfaces    | Heat and “Rainfall & Floods” | Impermeable/mineralised surfaces: 400 → 300 m <sup>2</sup>                          | Landscape and paving redesign; drainage performance requires verification.   |
| P2                                               | Communicating climate risks to occupants       | Heat and “Rainfall & Floods” | Risk communication: No → Visual communications                                      | Low-cost measure; relevant to transient users.                               |
| P2                                               | Creating cool refuge areas                     | Heat                         | Refuge areas: No → Cool refuge area                                                 | Operational designation; access and comfort conditions require verification. |

Across both profiles, exposure classes remain unchanged. Profile 1 reaches Medium vulnerability for both priority hazards. Profile 2 reaches Low vulnerability for Heat and Medium vulnerability for “Rainfall & Floods”. These results describe the response of the final simulated packages and do not isolate the effect of any single measure.

### 4.3. Spatial prioritisation and intelligibility results

The depthmapX analysis identifies a relative configurational hierarchy within the courtyard system. The highest values of Visual Integration and Connectivity occur in Z3 and along the connection system involving Z5 and the Z1–Z2 axis. These areas occupy more central positions within the analysed visibility network and offer stronger configurational support for orientation-related measures.

Lower values occur in parts of Z2 and in Z4. These areas occupy more segregated positions within the visibility network and offer weaker configurational support for orientation. Measures placed in these areas may require additional wayfinding support. This interpretation concerns spatial configuration and does not establish actual movement patterns or user behaviour.

Figure 5 presents the two VGA outputs used in the analysis. Panel (a) shows Visual Integration (HH, radius n), while panel (b) shows Connectivity. Z3 and Z5 show the strongest overall configurational conditions, while Z2 and Z4 contain areas with lower values. The outputs informed the placement of visual risk communication and the identification of candidate locations for cool refuge areas.

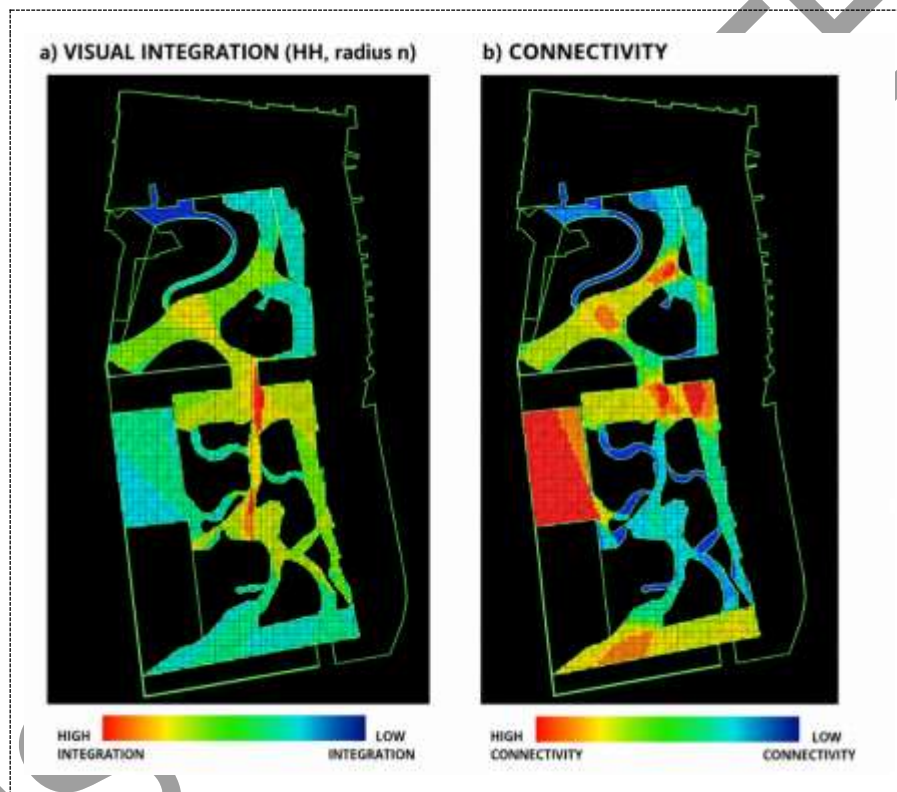


Figure 5. depthmapX VGA results: Visual Integration (HH, radius n) and Connectivity.

Table 3 summarises the zone-based interpretation and the corresponding design implications.

324 Table 3. Zone-based spatial synthesis and design implications.

| Zone | Visual Integration class | Connectivity class | Spatial interpretation                                 | Design implications                                                                             |
|------|--------------------------|--------------------|--------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Z1   | Medium                   | High               | Intermediate connector with strong local visual access | Wayfinding support; candidate location for a cool refuge area, subject to comfort verification. |
| Z2   | Low                      | Medium             | More segregated courtyard sector                       | Additional wayfinding support; refuge use requires clear signage and comfort verification.      |
| Z3   | High                     | High               | Integrated area and main access node                   | Primary location for wayfinding and visual risk communication.                                  |
| Z4   | Low                      | Low                | Segregated area near the secondary access              | Secondary signage support; refuge use requires separate operational and comfort justification.  |
| Z5   | High                     | Medium             | Integrated connection between the courtyards           | Directional signage and orientation support between courtyard spaces.                           |

325 Note: High, Medium and Low are relative intra-site classes defined according to the procedure reported in Section 3.3.  
326 They do not represent fixed thresholds that can be transferred to other case studies.

327  
328 The zone-based results support two forms of spatial application. Integrated areas can serve as primary points  
329 for visual risk communication. Areas with weaker positions in the visibility network may require additional  
330 support. Locations for cool refuge areas are treated as candidates rather than verified comfort zones. Their  
331 suitability requires separate assessment of microclimatic and operational conditions.

332 The intelligibility test provides a separate configurational comparison between the baseline and controlled  
333 alternative configurations. In the baseline configuration, the relationship between Connectivity and Visual  
334 Integration is weak, with  $R^2 = 0.0193$ . This value indicates little correspondence between local visual access  
335 and the global integration pattern within the analysed spatial system.

336 In the controlled alternative configuration, the same relationship is stronger, with  $R^2 = 0.9103$ . The alternative

retains the building perimeter and overall courtyard system while modifying the internal arrangement described in Section 3.3. The comparison therefore indicates a marked change in configurational intelligibility under the tested geometry.

This result is restricted to the relationship between the two depthmapX metrics. It does not demonstrate improved navigation by users, nor does it establish greater thermal comfort or reduced climate risk. The alternative configuration is therefore interpreted as a controlled configurational test rather than as a validated redesign proposal.

Figure 6 compares the scatterplots for the baseline and controlled alternative configurations. Panel (a) reports the baseline relationship between Connectivity and Visual Integration ( $R^2 = 0.0193$ ), while panel (b) reports the relationship for the controlled alternative configuration ( $R^2 = 0.9103$ ).

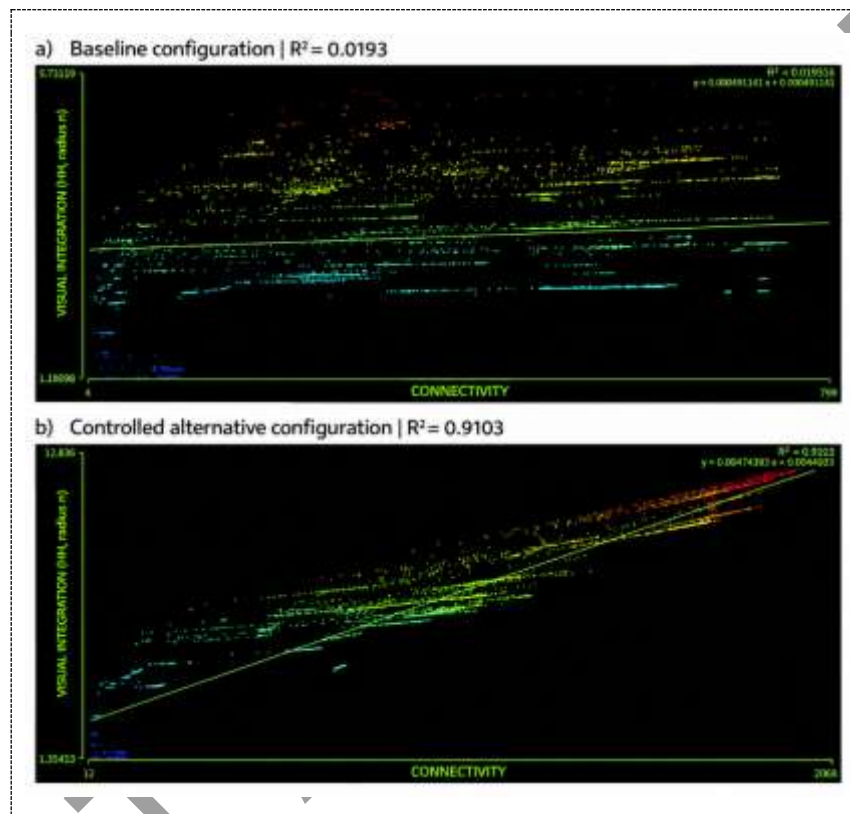


Figure 6. Scatterplots of Visual Integration (HH, radius n) versus Connectivity for the baseline configuration and the controlled alternative configuration.

## 5. Discussion

### 5.1. Integrated interpretation and methodological contribution

The case-study results indicate that the proposed workflow can serve as an early-stage decision-support procedure linking climate-risk diagnosis with feasible adaptation choices. Its contribution lies in the traceable relationship between baseline conditions and simulated scenarios rather than in the absolute values of individual indicators. Vulnerability drivers are connected to recorded input changes, while class-based changes are interpreted at the package level. This structure suits contexts where technical information is incomplete and further engineering verification is required.

The comparison between Profile 1 and Profile 2 shows how different feasibility conditions can lead to distinct adaptation pathways under the same climatic context. Profile 1 relies on a constrained package, whereas Profile 2 allows a broader range of building and site interventions. The comparison supports separate profiling when building portions differ in construction conditions and intervention constraints. It also reinforces the need to interpret class changes as responses to complete scenarios rather than as effects of individual measures.

The depthmapX component extends the workflow from measure selection to spatial localisation. The zone-based analysis distinguishes stronger and weaker positions within the visibility network and informs the

placement of visual risk communication and the identification of candidate locations for cool refuge areas. The intelligibility test adds a controlled comparison between the baseline and controlled alternative configurations. The increase in  $R^2$  indicates a stronger relationship between Connectivity and Visual Integration for the tested geometry. It does not demonstrate improved user navigation or reduced climate risk. The alternative therefore does not represent a validated redesign proposal. Graphic representation contributes to the integration by making the analytical sequence traceable. Bat-ADAPT outputs can be represented through comparative schemes, while depthmapX outputs can be translated into zoning and location-oriented diagrams. Representation thus acts as an interface between diagnostic evidence and design decisions. It makes assumptions and input changes visible and creates an audit trail from diagnosis to the spatial application of selected measures.

## 5.2. Methodological limitations and external validation needs

Several methodological limitations must be acknowledged. Bat-ADAPT produces class-based and thresholded outputs, so incremental changes may remain invisible unless a class boundary is crossed. The platform's underlying calculation logic and class boundaries are not available to users. The results should therefore be interpreted through controlled baseline–scenario comparisons rather than as calibrated physical risk estimates. The assessment combines documented information with conservative baseline assumptions and is based on a single case study. Some hazard families are also not quantified within the Europe model, which restricts the range of hazards that can be examined through the same diagnostic procedure. The spatial component has separate limitations. Visual Integration and Connectivity describe configurational properties and do not measure microclimatic or hydrological performance. The High, Medium and Low classes used in the zone-based analysis represent a relative intra-site hierarchy rather than transferable thresholds. The intelligibility test assesses the relationship between Connectivity and Visual Integration under the baseline and controlled alternative configurations. The change in  $R^2$  therefore provides configurational evidence and does not validate user behaviour or demonstrate climate-risk reduction. In addition, the workflow does not determine intervention dimensions or verify technical performance. Structural feasibility and drainage capacity require dedicated assessment. Thermal conditions and costs require separate verification. External validation should address both the diagnostic and spatial components. Bat-ADAPT outputs should be compared with evidence from technical surveys and specialist simulations. The placement of visual risk communication and candidate locations for cool refuge areas should be examined through user-based assessment and operational testing. Replication across additional building assets is also needed to test whether the workflow remains consistent under different construction conditions and climate-risk contexts. These steps would clarify its transferability and define the conditions under which the proposed workflow can support subsequent design stages.

## 6. Conclusions

This paper developed and applied a lightweight, indicator-based workflow for early-stage climate-adaptation decisions in mixed-use building assets. The method combines Bat-ADAPT for class-based diagnosis and adaptation simulation with depthmapX for the selective localisation of measures that depend on spatial configuration. Its contribution lies in connecting climate-risk priorities with feasible adaptation packages while preserving a traceable link between diagnostic evidence and design decisions. The Cascina Fossata application illustrates the rationale for treating building portions with different construction conditions as separate assessment profiles. Under the same climatic exposure, Profile 1 and Profile 2 produced distinct vulnerability conditions and adaptation pathways. The resulting class changes were observed at the package level and should not be attributed to individual measures. The depthmapX analysis added configurational evidence for placing visual risk communication and identifying candidate locations for cool refuge areas. It did not extend the assessment to thermal or hydrological performance. The spatial results should therefore not be interpreted as evidence of climate-risk reduction. The case study indicates that the workflow can provide a structured basis for early-stage adaptation decisions when technical information is incomplete. Its outputs remain dependent on class-based assessment and case-specific assumptions. The spatial component remains limited to configurational evidence. Technical validation and replication across additional cases are therefore required before broader transferability can be established.

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## 8. Authors Contributions

Conceptualization and methodology, S.C. and M.V.; investigation and case-study data, S.C., M.V. and L.M.S.; Bat-ADAPT analysis and adaptation scenarios, S.C.; spatial analysis framework, M.V.; depthmapX modelling and visualization, L.M.S. under M.V. supervision; writing—original draft, S.C.; writing—review and editing, S.C., M.V. and M.M.B.; supervision, M.V. and M.M.B. All authors approved the manuscript.

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## 10. Appendix

Table S1. Key Bat-ADAPT input assumptions, diagnostic components and simulated modifications for Profile 1 and Profile 2

| Field / diagnostic context                                                                                                                                                                                                                               | Profile 1 – reused historic courtyard building                                                                                    | Profile 2 – new multi-storey construction                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Input category: General modelling setting<br>Bat-ADAPT field / diagnostic item: Geographic perimeter<br>Hazard relevance: All hazards<br>Provenance / assumption status: Methodological setting: Europe perimeter selected for assets outside France.    | Baseline: Europe<br>Final scenario modification: Not modified                                                                     | Baseline: Europe<br>Final scenario modification: Not modified                                                                |
| Input category: General modelling setting<br>Bat-ADAPT field / diagnostic item: Time horizon<br>Hazard relevance: All hazards<br>Provenance / assumption status: Methodological setting: 2050 used for comparison.                                       | Baseline: 2050<br>Final scenario modification: Not modified                                                                       | Baseline: 2050<br>Final scenario modification: Not modified                                                                  |
| Input category: General modelling setting<br>Bat-ADAPT field / diagnostic item: Climate scenario / assumption<br>Hazard relevance: All hazards<br>Provenance / assumption status: Methodological assumption: business-as-usual applied to both profiles. | Baseline: Business-as-usual<br>Final scenario modification: Not modified                                                          | Baseline: Business-as-usual<br>Final scenario modification: Not modified                                                     |
| Input category: Asset structuring<br>Bat-ADAPT field / diagnostic item: Asset modelling approach<br>Hazard relevance: All hazards<br>Provenance / assumption status: Methodological choice: separate profiles used to avoid averaging effects.           | Baseline: Separate asset profile representing the reused historic courtyard building<br>Final scenario modification: Not modified | Baseline: Separate asset profile representing the new multi-storey construction<br>Final scenario modification: Not modified |

| Field / diagnostic context                                                                                                                                                                                                                                                                                                                      | Profile 1 – reused historic courtyard building                                                                                                                                                 | Profile 2 – new multi-storey construction                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Input category: Site conditions<br/>Bat-ADAPT field / diagnostic item: Plot-level and outdoor-space characteristics<br/>Hazard relevance: Heat; Rainfall &amp; Floods<br/>Provenance / assumption status: Shared-input assumption for the general site context; profile-specific outdoor-space quantities follow the assessment records.</p> | <p>Baseline: Common site context; profile-specific outdoor-space quantities reported in dedicated fields<br/>Final scenario modification: Modified through selected outdoor-space measures</p> | <p>Baseline: Common site context; profile-specific outdoor-space quantities reported in dedicated fields<br/>Final scenario modification: Modified through selected outdoor-space measures</p> |
| <p>Input category: Building type / age<br/>Bat-ADAPT field / diagnostic item: Building portion<br/>Hazard relevance: All hazards<br/>Provenance / assumption status: Documented information: case-study building type.</p>                                                                                                                      | <p>Baseline: Reused historic courtyard building<br/>Final scenario modification: Not modified</p>                                                                                              | <p>Baseline: New multi-storey construction<br/>Final scenario modification: Not modified</p>                                                                                                   |
| <p>Input category: Feasibility envelope<br/>Bat-ADAPT field / diagnostic item: Retrofit / intervention constraints<br/>Hazard relevance: All hazards<br/>Provenance / assumption status: Interpretive assumption: based on construction type and retrofit feasibility.</p>                                                                      | <p>Baseline: Constrained retrofit context; reversible measures with limited physical impact preferred<br/>Final scenario modification: Not modified</p>                                        | <p>Baseline: Greater design and technological flexibility; roof and envelope measures more feasible<br/>Final scenario modification: Not modified</p>                                          |
| <p>Input category: Main functions<br/>Bat-ADAPT field / diagnostic item: Use profile<br/>Hazard relevance: Heat; Rainfall &amp; Floods<br/>Provenance / assumption status: Documented information: case-study programme; the same use profile was applied to both profiles.</p>                                                                 | <p>Baseline: Mixed-use asset including residential and hospitality functions, with neighbourhood-oriented services<br/>Final scenario modification: Not modified</p>                           | <p>Baseline: Mixed-use asset including residential and hospitality functions, with neighbourhood-oriented services<br/>Final scenario modification: Not modified</p>                           |
| <p>Input category: Heat vulnerability<br/>Bat-ADAPT field / diagnostic item: External solar protection<br/>Hazard relevance: Heat<br/>Provenance / assumption status: Conservative baseline assumption: scenario values from the final adaptation record.</p>                                                                                   | <p>Baseline: Partial external solar protection<br/>Final scenario modification: Partial → Complete</p>                                                                                         | <p>Baseline: Partial external solar protection<br/>Final scenario modification: Partial → Complete</p>                                                                                         |

| Field / diagnostic context                                                                                                                                                                                                                                                                                                                                                                                                        | Profile 1 – reused historic courtyard building                                                                       | Profile 2 – new multi-storey construction                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <p>Input category: Heat vulnerability<br/>Bat-ADAPT field / diagnostic item: Glazing performance<br/>Hazard relevance: Heat<br/>Provenance / assumption status: P1: Conservative baseline assumption. P2: Not documented in available record; no value inferred. P1 scenario value from the final adaptation record.</p>                                                                                                          | <p>Baseline: Double glazing<br/>Final scenario modification: Double → High selectivity</p>                           | <p>Baseline: Not documented in available record; retained without change<br/>Final scenario modification: Not modified</p>      |
| <p>Input category: Heat vulnerability<br/>Bat-ADAPT field / diagnostic item: Impermeable mineral surface colour<br/>Hazard relevance: Heat<br/>Provenance / assumption status: Conservative baseline assumption: scenario values from the final adaptation record.</p>                                                                                                                                                            | <p>Baseline: Dark impermeable mineral surface<br/>Final scenario modification: Dark → Light</p>                      | <p>Baseline: Dark impermeable mineral surface<br/>Final scenario modification: Dark → Light</p>                                 |
| <p>Input category: Heat / “Rainfall &amp; Floods” vulnerability<br/>Bat-ADAPT field / diagnostic item: Impermeable / mineralised surface extent<br/>Hazard relevance: Heat; Rainfall &amp; Floods<br/>Provenance / assumption status: Model-record value: baseline values are present in the assessment record; the external source is not stated in the retained material. Scenario values align with the simulation export.</p> | <p>Baseline: Impermeable surfaces: 3000 m<sup>2</sup><br/>Final scenario modification: 3000 → 2000 m<sup>2</sup></p> | <p>Baseline: Impermeable / mineralised surfaces: 400 m<sup>2</sup><br/>Final scenario modification: 400 → 300 m<sup>2</sup></p> |
| <p>Input category: Heat / “Rainfall &amp; Floods” vulnerability<br/>Bat-ADAPT field / diagnostic item: Risk communication to occupants<br/>Hazard relevance: Heat; Rainfall &amp; Floods<br/>Provenance / assumption status: Conservative baseline assumption: scenario values from the final adaptation record.</p>                                                                                                              | <p>Baseline: No visual risk communication<br/>Final scenario modification: No → Visual communications</p>            | <p>Baseline: No visual risk communication<br/>Final scenario modification: No → Visual communications</p>                       |

| Field / diagnostic context                                                                                                                                                                                                                                                                                                                     | Profile 1 – reused historic courtyard building                                                                                                                                   | Profile 2 – new multi-storey construction                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input category: Heat vulnerability / preparedness<br>Bat-ADAPT field / diagnostic item: Refuge areas<br>Hazard relevance: Heat<br>Provenance / assumption status: Conservative baseline assumption: scenario values from the final adaptation record.                                                                                          | Baseline: No cool refuge area<br>Final scenario modification: No → Cool refuge area                                                                                              | Baseline: No cool refuge area<br>Final scenario modification: No → Cool refuge area                                                                             |
| Input category: “Rainfall & Floods” vulnerability<br>Bat-ADAPT field / diagnostic item: Basement-related sensitivity<br>Hazard relevance: Rainfall & Floods<br>Provenance / assumption status: Bat-ADAPT diagnostic output: interpreted from the vulnerability decomposition.                                                                  | Baseline: Basement-related vulnerability considered relevant in the diagnostic decomposition<br>Final scenario modification: Addressed through relocation of sensitive equipment | Baseline: Basement-related vulnerability considered relevant in the diagnostic decomposition<br>Final scenario modification: Not modified in the final scenario |
| Input category: “Rainfall & Floods” vulnerability / operational continuity<br>Bat-ADAPT field / diagnostic item: Sensitive equipment in basement<br>Hazard relevance: Rainfall & Floods<br>Provenance / assumption status: P1: Model-record value from the final adaptation record. P2: Not documented in available record; no value inferred. | Baseline: Yes - sensitive equipment in basement<br>Final scenario modification: Yes → No                                                                                         | Baseline: Not documented in available record; retained without change<br>Final scenario modification: Not modified                                              |
| Input category: Heat / “Rainfall & Floods” vulnerability<br>Bat-ADAPT field / diagnostic item: Roof type<br>Hazard relevance: Heat; Rainfall & Floods<br>Provenance / assumption status: P1: Not documented in available record; no value inferred. P2: Model-record value from the final adaptation record.                                   | Baseline: Not documented in available record; retained without change<br>Final scenario modification: Not modified                                                               | Baseline: Dark roof<br>Final scenario modification: Dark → Dark + green roof                                                                                    |
| Input category: Heat / “Rainfall & Floods” vulnerability<br>Bat-ADAPT field / diagnostic item: Green roof vegetation strata<br>Hazard relevance: Heat; Rainfall & Floods<br>Provenance / assumption status: P2: Model-record value from the final adaptation record. P1: not applicable as a scenario lever.                                   | Baseline: Not applicable / not modified<br>Final scenario modification: Not modified                                                                                             | Baseline: No vegetation stratum<br>Final scenario modification: No vegetation stratum → 1 stratum                                                               |

| Field / diagnostic context                                                                                                                                                                                                                                                               | Profile 1 – reused historic courtyard building                                                                                                                                                             | Profile 2 – new multi-storey construction                                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input category: Heat vulnerability<br>Bat-ADAPT field / diagnostic item: Cooling component<br>Hazard relevance: Heat<br>Provenance / assumption status: Bat-ADAPT diagnostic output: not used as a scenario lever.                                                                       | Baseline: Cooling-related sensitivity considered in the diagnostic decomposition<br>Final scenario modification: Not modified as a scenario lever                                                          | Baseline: Cooling-related sensitivity assessed as medium in the diagnostic decomposition<br>Final scenario modification: Not modified as a scenario lever                                                                        |
| Input category: Heat / “Rainfall & Floods” vulnerability<br>Bat-ADAPT field / diagnostic item: Use / occupancy-related component<br>Hazard relevance: Heat; Rainfall & Floods<br>Provenance / assumption status: Bat-ADAPT diagnostic output: not used as a scenario lever.              | Baseline: Use-related sensitivity contributes to vulnerability for Heat and “Rainfall & Floods”<br>Final scenario modification: Not modified as a scenario lever                                           | Baseline: Use-related sensitivity contributes to vulnerability for Heat and “Rainfall & Floods”<br>Final scenario modification: Not modified as a scenario lever                                                                 |
| Input category: “Rainfall & Floods” vulnerability<br>Bat-ADAPT field / diagnostic item: Ground-floor component<br>Hazard relevance: Rainfall & Floods<br>Provenance / assumption status: Bat-ADAPT diagnostic output: not used as a scenario lever.                                      | Baseline: Ground-floor-related sensitivity relevant in the diagnostic decomposition<br>Final scenario modification: Not modified as a scenario lever                                                       | Baseline: Ground floor less sensitive than Profile 1<br>Final scenario modification: Not modified as a scenario lever                                                                                                            |
| Input category: Heat / “Rainfall & Floods” vulnerability<br>Bat-ADAPT field / diagnostic item: Outdoor-space component<br>Hazard relevance: Heat; Rainfall & Floods<br>Provenance / assumption status: Shared-input assumption: combined with simulated outdoor-space adaptation fields. | Baseline: Shared outdoor-space context; mineralised surfaces and permeability relevant<br>Final scenario modification: Modified through albedo and de-sealing measures; refuge-area designation also added | Baseline: Shared outdoor-space context; mineralised surfaces and permeability relevant<br>Final scenario modification: Modified through albedo and surface-reduction measures; green roof and refuge-area designation also added |
| Input category: Baseline diagnosis output<br>Bat-ADAPT field / diagnostic item: Heat exposure<br>Hazard relevance: Heat<br>Provenance / assumption status: Bat-ADAPT output: baseline diagnosis.                                                                                         | Baseline: Very high<br>Final scenario modification: Exposure unchanged                                                                                                                                     | Baseline: Very high<br>Final scenario modification: Exposure unchanged                                                                                                                                                           |

| Field / diagnostic context                                                                                                                                                                                                                  | Profile 1 – reused historic courtyard building                       | Profile 2 – new multi-storey construction                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------|
| Input category: Baseline diagnosis output<br>Bat-ADAPT field / diagnostic item: Heat vulnerability<br>Hazard relevance: Heat<br>Provenance / assumption status: Bat-ADAPT output: baseline–scenario comparison.                             | Baseline: High<br>Final scenario modification: High → Medium         | Baseline: Medium<br>Final scenario modification: Medium → Low       |
| Input category: Baseline diagnosis output<br>Bat-ADAPT field / diagnostic item: Heat cross-risk<br>Hazard relevance: Heat<br>Provenance / assumption status: Bat-ADAPT output: baseline–scenario comparison.                                | Baseline: Very high<br>Final scenario modification: Very high → High | Baseline: High<br>Final scenario modification: High → High          |
| Input category: Baseline diagnosis output<br>Bat-ADAPT field / diagnostic item: “Rainfall & Floods” exposure<br>Hazard relevance: Rainfall & Floods<br>Provenance / assumption status: Bat-ADAPT output: baseline diagnosis.                | Baseline: Medium<br>Final scenario modification: Exposure unchanged  | Baseline: Medium<br>Final scenario modification: Exposure unchanged |
| Input category: Baseline diagnosis output<br>Bat-ADAPT field / diagnostic item: “Rainfall & Floods” vulnerability<br>Hazard relevance: Rainfall & Floods<br>Provenance / assumption status: Bat-ADAPT output: baseline–scenario comparison. | Baseline: High<br>Final scenario modification: High → Medium         | Baseline: High<br>Final scenario modification: High → Medium        |
| Input category: Baseline diagnosis output<br>Bat-ADAPT field / diagnostic item: “Rainfall & Floods” cross-risk<br>Hazard relevance: Rainfall & Floods<br>Provenance / assumption status: Bat-ADAPT output: baseline–scenario comparison.    | Baseline: High<br>Final scenario modification: High → Medium         | Baseline: High<br>Final scenario modification: High → Medium        |

| Field / diagnostic context                                                                                                                            | Profile 1 – reused historic courtyard building | Profile 2 – new multi-storey construction |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------------------------|
| Input category: Baseline diagnosis output                                                                                                             | Baseline: 5/5                                  | Baseline: 5/5                             |
| Bat-ADAPT field / diagnostic item: Vulnerability reliability index                                                                                    | Final scenario modification: Not modified      | Final scenario modification: Not modified |
| Hazard relevance: Heat; Rainfall & Floods                                                                                                             |                                                |                                           |
| Provenance / assumption status: Bat-ADAPT output: baseline diagnosis; reliability index used as a quality-control signal, not as external validation. |                                                |                                           |

Note: This table reports the key fields used to reconstruct the baseline–scenario comparison. Where a baseline value was not documented in the available record and was not used as a scenario lever, no value was inferred. Such fields are marked as "Not documented in available record".

Provenance status legend: "Documented information" identifies information supported by the retained case-study sources. "Conservative baseline assumption" identifies a value introduced to complete a required model input when source evidence was incomplete. "Model-record value" identifies a value present in the assessment record whose external source cannot be traced in the retained material. "Not documented in available record" indicates that no baseline value could be reconstructed and no value was inferred. "Methodological setting", "Methodological assumption", "Methodological choice", "Shared-input assumption", and "Interpretive assumption" identify decisions introduced by the study rather than values derived from case-study sources. "Bat-ADAPT output" identifies values generated by the platform.