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Standard Guide for Community Resilience Planning for Buildings and Infrastructure¹

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INTRODUCTION

Communities with complex physical, social, and economic systems seek the means to develop effective planning and decision-making processes that increase their resilience to hazards and reduce potential adverse effects. This guide presents a process for communities to develop customized resilience plans for buildings and infrastructure systems that recognize the social, economic, and physical dimensions of a community and encourages the establishment of recovery oriented goals for the performance of buildings and infrastructure systems after a disruptive event.

1. Scope

1.1 This guide sets forth a flexible approach for communities to develop customized, comprehensive resilience plans for buildings and infrastructure systems that include input from relevant stakeholders; consider the social, economic, and physical systems of a community; establish community-scale performance goals that encourage recovery-oriented planning; and recommend processes to implement and maintain community resilience plans over time as community priorities evolve and change.

1.1.1 The social dimensions of a community should drive the requirements of a community's resilience plans and the performance of its physical systems, especially during recovery. The identification of social functions is a fundamental element of developing community resilience plans that accurately reflect priorities for recovery after a hazard event.

1.2 The guide process steps address how to (1) form collaborative planning teams; (2) evaluate the current condition of social and built dimensions of a community; (3) determine community goals and objectives for built systems and hazards; (4) develop plans that address performance gaps and identify solutions; (5) prepare, review and approve final community resilience plans; and (6) implement and maintain resilience plans.

1.3 This guide provides a process that facilitates priority setting and decision making regarding the establishment of community resilience goals and associated solutions. The

process provides a framework for community resilience planning needs and is not intended to be prescriptive.

1.4 *Limitations of Guide*—This guide does not advocate or specify any particular analytical methodology for ascertaining the performance of the built environment. This guide also does not directly address the effects of climate change, although the planning process can incorporate such events and impacts. (For additional information on these processes to address climate resilience planning, refer to Guide E3032.) This guide addresses buildings and infrastructure systems and how they support the social dimensions of communities, and considers how the elements of the built environment support social and economic community functions. The application of this guide is intended to support community resilience planning efforts across a community's interdependent building and infrastructure systems. Applications beyond this scope were not considered in the development of this guide.

1.5 *Units*—The values stated in SI units are to be regarded as the standard. No other units of measurement are included in this standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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2. Referenced Documents

2.1 ASTM Standards:²

- E631** Terminology of Building Constructions
- E2114** Terminology for Sustainability Relative to the Performance of Buildings
- E2348** Guide for Framework for a Consensus-based Environmental Decision-making Process
- E2432** Guide for General Principles of Sustainability Relative to Buildings
- E3032** Guide for Climate Resiliency Planning and Strategy
- E3130** Guide for Developing Cost-Effective Community Resilience Strategies

2.2 Other Standards:

- ASIS ORM 1-2017** Security and Resilience in Organizations and Their Supply Chains—Requirements with Guidance³
- NFPA 1600** Standard on Continuity, Emergency, and Crisis Management⁴

3. Terminology

3.1 Definitions:

3.1.1 *administrative solutions*, *n*—policies, practices, or programs that can be deployed to advance community resilience, acquisition of funding, provide incentives for retrofit and mitigation projects, and improve permitting and other issues that impact recovery time after a hazard event.

3.1.2 *anticipated performance*, *n*—likely level of damage to a cluster or infrastructure system from a hazard event and the expected recovery time before full functionality is restored.

3.1.3 *building*, *n*—individual structure, including equipment and contents, that houses people and supports social institutions.

3.1.3.1 *Discussion*—For definitions of general terms related to buildings, refer to Terminology **E631**.

3.1.4 *built environment*, *n*—all buildings and infrastructure systems within a community or other defined geographic boundary.

3.1.5 *clusters*, *n*—set of buildings and supporting infrastructure systems, not necessarily geographically co-located, that serve a common function such as housing, healthcare, retail, and so forth.

3.1.6 *community*, *n*—place designated by geographical boundaries that functions under the jurisdiction of a governance structure, such as a town, city, or county.

3.1.7 *community resilience*, *n*—ability of a community to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions (refer to Guide **E3130**).

3.1.8 *construction solutions*, *n*—projects or actions involving physical improvements to building or infrastructure systems

or new capital projects that lead to improved resilience through enhanced robustness, redundancies, or retrofits.

3.1.9 *dependency*, *n*—reliance of physical or social systems on other physical or social systems to function or provide services.

3.1.9.1 *Discussion*—A dependency is considered a unidirectional relationship between two systems where the operation of one affects the other. An interdependency is a bidirectional relationship between two systems where the operations of both affects the other (**1**).⁵

3.1.10 *function*, *n*—role or purpose of a particular social institution (for example, education, finance, healthcare) or physical system (for example, electric power, potable water, transportation) to provide a service within a community.

3.1.11 *functionality*, *n*—capability of serving an intended function.

3.1.11.1 *Discussion*—The relationship between function and functionality relates to the level of service or capacity of a system to provide its intended service. For a water system, for example, the function of a water system in a community is to provide clean, potable water quality and pressure for a range of community purposes. The functionality of a water system describes various levels of capacity of the system to provide those services. An operational level of functionality will provide sufficient water quality and pressure for all community functions, while a minimal level of functionality may provide lower pressure to some locations and require boil water orders because of uncertainty in water quality.

3.1.12 *goal*, *n*—broad, general statements that indicate a statement of purpose to be achieved or accomplished (**2**).

3.1.13 *hazard*, *n*—potential threat or an incident, natural or human caused, that warrants action to protect life, property, the environment, public health, or safety and minimize disruptions of government, social, or economic activities (**3**).

3.1.14 *hazard event*, *n*—occurrence of a hazard.

3.1.15 *indicators*, *n*—quantitative or qualitative data indirectly measuring or describing the inherent characteristics of a community that establish the relative position of that community, cluster, or infrastructure system and, when measured over time, can point out the direction of change (**4-6**).

3.1.15.1 *Discussion*—Indicators are composed of measurable attributes of a community, cluster, or infrastructure system (**7**).

3.1.16 *infrastructure system*, *n*—physical networks, systems, and structures that make up transportation, energy, communications, water and wastewater, and other systems that support the functionality of community social institutions.

3.1.17 *objective*, *n*—specific, measurable statements of the goal that can be used to measure progress; can be described quantitatively (**2**).

3.1.18 *social dimensions*, *n*—needs of individuals and social institutions, including those representing government, business

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from ASIS International, 1625 Pine St., Alexandria, VA 22314, www.asisonline.org.

⁴ Available from the Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471, www.nfpa.org.

⁵ The boldface numbers in parentheses refer to a list of references at the end of this standard.

and industry, finance, health, education, community service, and those representing particular religious and cultural beliefs and the media.

3.1.19 *social institutions, n*—public or private organizations that provide services or resources that support the social dimensions of community members.

3.1.20 *stakeholders, n*—all parties that have an interest or concern in an operation, enterprise, or undertaking.

3.1.21 *stressor, n*—condition, event, or trend that can exacerbate hazards (8).

3.1.22 *time to recovery of function, n*—measure of how long it takes before a cluster or infrastructure system is functioning after damage or a disruption in services, or both.

3.1.22.1 *Discussion*—Time to recovery of function can be measured at various functional levels, such as minimal, functional, and operational. Also referred to as “time to recovery” or “functional recovery.”

3.1.23 *vulnerable population, n*—individual, group, or community whose circumstances create barriers to obtaining or understanding information or the ability to react as the general population including, but not limited to, age; physical, mental, emotional, or cognitive status; culture; ethnicity; religion; language; citizenship; geography; or socioeconomic status (9).

3.1.24 *underserved communities, n*—populations sharing a particular characteristic, as well as geographic communities, that have been systematically denied a full opportunity to participate in aspects of economic, social, and civic life (10).

3.2 Acronyms:

3.2.1 *CPT*—Collaborative planning team

3.2.2 *CRO*—Chief resilience officer

3.2.3 *FEMA*—Federal Emergency Management Agency

3.2.4 *GIS*—Geographic information system

3.2.5 *HIRA*—Hazard identification and risk assessment

3.2.6 *NIST*—National Institute of Standards and Technology

3.2.7 *THIRA*—Threat and Hazard Identification and Risk Assessment

4. Summary of Guide

4.1 This guide comprises a six-step process to establish a community resilience plan for buildings and infrastructure systems that is intended to be implemented by community officials.

4.2 The six steps in the process are: (1) form a collaborative planning team; (2) understand the situation; (3) determine goals and objectives; (4) develop the plan; (5) prepare, review, and approve the plan; and (6) implement and maintain the plan. The six steps are based upon the approach presented in Ref (11).

4.3 With the use of this guide, it is intended that a community will develop and maintain a resilience plan that will inform future community planning and investment actions for the built environment or incorporate the concepts in existing and related community plans. The process by which the resilience plan is developed and maintained is equally as

important as the plan itself. Engagement with stakeholders and officials is necessary to ensure there are resources and community support to implement the actions described in the resilience plan.

5. Significance and Use

5.1 This guide is intended for use by communities, which may include towns, incorporated cities, counties, or similar entities with the authority to convene and implement resilience planning. The process described in this guide may have applications to a broader set of users, such as those described in Guide E3032.

5.2 This guide is intended to be applied at a community or regional geographical and administrative scale. Smaller geographic and administrative scales, such as neighborhood scales, may also use this guide; however, there may be limitations in the range of solutions (see Step 4B) that are available due to statutory, regulatory, financial, or administrative constraints caused by limitations in governance bodies.

5.3 This guide provides an analytical framework for establishing desired versus current anticipated performance in terms of time to recovery of function for clusters and infrastructure systems. The output of this analytical framework provides an objective basis for establishing priorities among proposed strategies and solutions to help meet community resilience goals.

5.4 The planning and analytical process can be applied to any hazard, though the focus is on natural hazards. Steps 1 and 2 (form a collaborative planning team and understand the situation) do not require the use of hazard information and provide useful information for communities that can be incorporated into a resilience plan. The activities described in Steps 3 and 4 (determine goals and objectives, and develop the plan) require technical information about hazards and an assessment of their impact on community systems.

5.5 This guide provides a planning process that emphasizes disaster recovery outcomes. However, all phases of preparedness, including prevention, protection, mitigation, response, and recovery, are important to the successful achievement of disaster recovery objectives. The analytical outputs of this guide should inform all phases of preparedness and provide an objective approach to prioritize pre-event mitigation action.

5.6 The steps of this guide, presented in Section 6, are best initiated in the order provided. However, with the exception of the formation of a collaborative planning team in Step 1 and implementation and reporting Steps 5 and 6, it is feasible to complete Steps 2 to 4 in a non-consecutive order. Depending on a community’s specific needs, timeline, resources, or technical capabilities, Steps 2 to 4 may occur in a different order than described in this guide. In Section 6, supplemental information that elaborates on how to implement each step and collaborative planning team flexibilities is provided in a discussion note following each step.

NOTE 1—The collaborative planning team provides the foundation for stakeholder engagement and input in subsequent steps, even if later steps are completed in a different order than what is described in this guide.

Ideally, each step should be at least initiated to describe how the plan will eventually address all elements of resilience planning.

5.7 Resilience plans developed with the support of this guide should be compatible with, inform, and augment other hazard mitigation planning and comprehensive planning processes. It is compatible with the National Preparedness Goal, the National Infrastructure Protection Plan, and the National Disaster Recovery Framework, and should inform and be consistent with other state and local plans and priorities. In practice, this includes general plans, capital improvement programs, hazard mitigation, emergency response, recovery, economic development, and transportation plans.

6. Procedure

6.1 *Step 1: Form a Collaborative Planning Team (CPT):*

6.1.1 The CPT provides the leadership, community engagement, and facilitation of planning activities in a resilience planning process. The motivation for the formation of a CPT, along with its scope, authority, and relationship to other community planning processes and government agencies, should be provided or adopted by a local governing body. The development of a chartering document for the CPT would provide terms of reference as the CPT conducts its planning and outreach activities. Other motivations for the formation of a CPT and its scope may be informed by sector-based initiatives or from the efforts of community-based non-governmental organizations and local residents.

NOTE 2—Individuals experienced with participating on mitigation or damage assessment teams that have experience and skills assessing hazard effects on the capabilities and capacity of physical systems may be useful to include on the CPT.

6.1.2 *Step 1A: Identify a Resilience Leader*—A chair of the CPT shall be designated to identify and recruit members, facilitate the engagement process, provide leadership and continuity to the community resilience planning and implementation process, and present final recommendations or decisions for approval.

NOTE 3—The CPT chair provides a single point of contact for decision makers and inquiries throughout the community resilience planning and implementation process. There should be identification of a dedicated community official who can lead the process and provide continuity, elevate the importance of resilience, convene stakeholders, communicate effectively, and engage public support. The chair may be a chief resilience officer (CRO), emergency management professional, community planner, or other official. There may also be other champions that emerge during the process that the chair can collaborate with to increase the effectiveness of resilience planning. Communities may choose to identify different governance structures for their specific circumstances and objectives, for example, establishing co-chairs instead of a single chairperson.

6.1.3 *Step 1B: Identify Team Members and Their Roles and Responsibilities*—The CPT shall have members representing government, private sector, non-profit, or other community segments that provide or represent services, equities, and interests of the community's physical, social, and economic systems. The CPT members shall reflect the needs and perspectives of all residents of the community, particularly vulnerable populations or members of underserved communities.

NOTE 4—Collectively, the membership of the CPT should have knowledge of community plans and goals, buildings and infrastructure systems,

and social functions, and engage various stakeholder groups they represent. The composition of the collaborative planning team will vary between communities reflecting the diversity of interests, cultures, economies, and the environment. The team composition may also vary over time. Recruitment for the planning team should include a diversity of community stakeholders and perspectives with representatives from the appropriate public, non-profit, and private domains. However, CPT membership should be kept to a size that is reasonable for regular meetings and making decisions. There is no best model for the composition or specific functions of the CPT. The composition of a CPT and the timeline of the CPT's activities should be community- and context-specific. Other considerations for the formation of a CPT and its associated decision-making processes are discussed in Guide E2348, NFPA 1600, and ASIS ORM 1-2017. Organizations may include local government offices (for example, emergency management, public works, buildings and permitting, public health, and land use and zoning departments), owners and operators of major community infrastructure systems, local business and industry representatives, and non-profit and social organizations (for example, faith-based, education, health, and vulnerable populations). Infrastructure systems are often owned and operated by entities outside of the community (for example, electricity provided by a regional utility; communication; and transportation at regional, state, and national levels). Given this distribution of how infrastructure systems are provided, consider regional, state, federal government, and national organization representative participation on the CPT as needed.

6.1.4 *Step 1C: Establish the Scope of the Planning Effort*—The CPT shall decide on the scope of the effort by considering what community social and economic functions are supported by different elements of the built environment, while also considering the associated organizations and institutions that support those functions. This scoping activity may include a focus on specific physical and built systems that the CPT is capable of addressing.

NOTE 5—Considerations for scoping the planning effort may be related to addressing prevailing hazards or stressors in the community, selecting a subset of the built environment that the planning team can influence, or concurrent community planning efforts that may be complementary to the CPT's efforts (for example, economic development planning, hazard mitigation planning). Consulting prior reports that characterize community systems and involving stakeholders in system characterization is a useful step to inform the scope of the planning effort. Integrated resilience assessment tools, such as FEMA's Resilience Analysis and Planning tool, provide nationally available resilience planning data that can inform the scope of the planning effort (12). The CPT should consider the range of possible construction and administrative solutions that may be available, which can inform the scope of the planning effort. At this stage, the CPT should also define the scope of the community and the potential constraints on action. This includes both geographic boundaries, resource, and administrative constraints. Defining and describing a community's boundaries can be useful in several ways:

To identify significant parts of the community not previously considered during the formation of the CPT;

To help define the parameters for planning and resource allocation;

To help focus on physical, social, and economic connections to the region; and

To help identify the authorities and limitations of the community. All communities face challenges with prioritizing resource allocation, but some resilience challenges require long-term solutions and funding. The CPT may opt initially to prioritize short-term challenges and solutions given resource limitations and the authority given to the CPT. Early success will give additional credibility to the planning process when seeking resources and support from outside the community.

6.1.5 *Step 1D: Identify and Engage Key Public and Private Stakeholders*—The CPT shall identify the necessary stakeholders to engage in the planning process to understand issues,

priorities, uses of the built environment, and identify where conflicts for resilience plans may occur.

NOTE 6—Community engagement early in the planning process serves to document the community’s priorities and inform stakeholders about the resilience planning process and seek their support. Outreach and engagement efforts should be timed and located for their intended audience, while serving the strategic vision of the planning team. For example, the planning team may need to engage stakeholders with domain expertise and community-specific interests—such as key industry and business leaders—based on their availability; other neighborhood interests because of geography may require multiple, smaller, more focused outreach events. The CPT should ensure early engagement with stakeholders that are responsible for the creation and maintenance of other plans that are complementary to, or are in conflict with, the proposed resilience plan. Some engagement may include messaging that communicates the mission and status of the community resilience plan through data and resource sharing sites (for example, webpage with links), news media, and brochures placed in purposely targeted venues. As part of engaging a range of stakeholders, the CPT may wish to develop an awareness and engagement plan to ensure that stakeholders representing all aspects of the community, particularly vulnerable populations, are notified and included in the resilience planning process. This would ensure adequate communication with, and engagement of, the whole community and identify where certain stakeholders may require targeted outreach and accommodations (for example, childcare, transportation reimbursement, and compensation for their time) to garner their participation in the planning process. Community engagement is essential to developing a robust and widely accepted resilience program and motivating members and organizations to act. Engagement activities help develop broad-based community ownership, connect community members, develop trust, form partnerships, solicit input or feedback on aspects of the community resilience program, and gain involvement in community resilience improvement activities. Principles for effective awareness and engagement and tips for identifying target audiences can be found in Ref (13).

6.1.6 If the CPT identifies plan conflicts that cannot be resolved, the CPT should consider discussion-based exercises. The Homeland Security Exercise and Evaluation Program provides resources that can aid in the design, development, and implementation of this effort (14).

6.2 Step 2: Understand the Situation: *hards/sist/729d4526-3*

6.2.1 *Step 2A: Assess Existing Community Plans*—The CPT shall collect and review existing community plans and relevant regional, state, and federal plans to review their scope, goals, objectives, timeframe for implementation, and actions that affect the built environment and resilience of the community.

NOTE 7—Existing planning documents are a rich source of information about the community’s priorities, emerging or long-term community issues, existing condition of buildings and infrastructure systems, and plans for future development. It is useful for the CPT to examine the plans to understand where they may be in alignment or conflict with one another and consider these factors when setting goals in subsequent steps. When reviewing plans, consider the relevance of the plan to enhance resilience within the jurisdiction. It can be helpful to standardize the process used to review the policies within plans using a tool such as the Plan Integration for Resilience Scorecard (15). In this tool, each plan is reviewed for applicable policies to the resilience planning process based on a “three-point” test including: evaluating the policy’s potential to affect (reduce or increase) vulnerability to acute hazards or stressors; evaluating whether the policy includes at least one mappable, place-specific term; and assessing if there is an associated policy tool (a form of government intervention to achieve specific objective or outcome).

6.2.1.1 While existing planning documents provide a helpful baseline for the CPT, the analysis that led to the plan content may not be available when conducting this resilience planning activity. The CPT should consider what level of plan

adoption has been achieved thus far, or the result of assessments or exercises, to ensure the actions and outcomes described in prior plans effectively address the CPT’s resilience planning objectives.

6.2.1.2 If available, a community’s Crisis Management Plan (see NFPA 1600 Standard) addresses events where the hazard has exceeded the design basis assumed in other plans. Data developed for drills, exercises, and testing that support the preparation of a Crisis Management Plan can inform the scope of the CPT’s resilience planning effort and the desired performance goals of the community resilience plan (see Step 3B).

6.2.2 *Step 2B: Characterize Community Members and Their Needs*—The CPT, in consultation with community members, shall characterize the community’s social and physical needs, including addressing the needs of vulnerable populations and underserved communities.

NOTE 8—Community members and their needs should be identified through broader engagement activities undertaken in Step 1, which may include engagement efforts beyond the scope of the CPT. Additional engagement guidance is provided in Ref (16). Indicators are a data-driven approach to characterize the community, its population, and their present and future needs. This approach includes collecting information on population demographics and locations, economic indicators, social vulnerabilities, and social capital. Demographic information can include age, health, education, income, employment, housing status, language, cultural background, and information about vulnerable populations. Short- and long-term needs, including those caused by potential population changes, should be considered.

6.2.3 *Step 2C: Characterize the Community’s Social Functions and Dependencies*—The CPT, in consultation with community members, shall identify the social institutions that meet community member needs and dependencies among and within social institutions.

NOTE 9—Common community social institutions include government services, housing, health care, retail and manufacturing, education, financial services, media, faith-based services, and cultural services. An example of this association is represented in Annex A1. Information gathered should include their functions, the particular needs they meet, their dependence on buildings and infrastructure systems to deliver services, any gaps in institutional and organizational capacity that could be improved by changes to the built environment, and the potential impacts that building and infrastructure system disruptions could have on service delivery. Additional guidance is provided in Ref (17). Given that social institutions are linked in many ways, a disruption in the built environment that affects one social institution may have cascading effects on other institutions and systems. Therefore, planners should identify dependencies among and within social institutions when identifying what functions are most critical during recovery. These dependencies may include, for example, how community social institutions rely on continuously functioning childcare and school services. The CPT may wish to describe the status of social functions of the community with the use of social and economic indicators. Social and economic indicators can help community decision makers understand the implications of community decisions for planning, siting, design, construction, operation, protection, maintenance, repair, and restoration of the built environment. Social- and economic-based resilience indicators can be quantitative or descriptive. Refer to Annex A1 for common social dimensions and associated social institutions.

6.2.4 *Step 2D: Characterize the Built Environment:*

6.2.4.1 The CPT shall identify and characterize elements of the built environment.

NOTE 10—Elements of a community’s built environment may include buildings (including individual buildings and clusters), transportation

facilities (for example, roads, tunnels, rail, airports, maritime ports, and terminals or stations), energy systems (for example, electric power and fuel systems), communication systems (for example, internet, phone, cellular infrastructure, and emergency communication systems), potable water and wastewater facilities (for example, reservoirs, pumping stations, transmission network, water treatment plants, and stormwater systems), and the dependencies between these various systems. Characterizing systems of the built environment includes identifying key attributes and dependencies for existing buildings and infrastructure systems within the community. Data and information needed to characterize the current condition of the built environment may include the owner; location(s); current use; age; construction types; zoning; maintenance and upgrades; description of current continuity measures for individual building and infrastructure systems; and applicable codes, standards, and regulations both at the time of design and for current practice. Information about dependencies and the effectiveness of existing controls between systems will contribute to understanding how the built environment is expected to perform if one of the systems stops providing services. Building and public works departments and utilities may have much of the needed information available through their geographic information system (GIS) applications or other databases. GIS-based maps can help communities understand whether their buildings or infrastructure systems are located in higher-risk areas. For instance, many communities were established before flood zones were mapped and, consequently, have buildings and infrastructure systems subject to flood damage. Other communities have buildings and infrastructure systems located near seismic faults and may not perform well if a significant seismic event occurs. Alternatively, a period of rapid growth may have exceeded the infrastructure system capacity or may have lacked adequate adoption or enforcement of local codes and regulations.

6.2.4.2 The CPT shall identify clusters that provide community functions and services and assign each to one of four functional categories: critical facilities, emergency housing, housing/neighborhoods, and community recovery. In Fig. 1, an example of the relationship between functional categories and the clusters of which they are composed is provided.

NOTE 11—Clusters may include buildings that are geographically distributed throughout a community but provide a common function. (Example clusters and associated community functions are described in Annex A2.) Buildings can be characterized individually or as elements of clusters. When identifying clusters, the CPT should consider dependencies between the functions of buildings and supporting infrastructure systems. These may be dependencies internal to a building, such as water system pipes and pumping systems, or external dependencies, such as flows of material, energy, or personnel. The functional categories, critical facilities,

emergency housing, housing/neighborhoods, and community recovery, are the first level of organization used in the tables shown in Annex A2 and Annex A3 to catalog the return to function times needed to support community resilience stated in terms of days, weeks, and months. These time periods can be paired with different levels of functionality, which can be described as: (1) minimal levels of function to initiate recovery activities, (2) levels of function that are needed to resume operations at a reduced level, and (3) operational levels of function that represent normal levels of service (11). This is described in further detail in Step 3B. In Fig. 1, a visual representation of the relationship between time to recovery of function and levels of functionality for clusters is provided. The CPT may wish to use alternate taxonomies that link clusters to community function, such as those found in Refs (18-21).

6.2.5 Step 2E: Link Social Dimensions to the Built Environment:

6.2.5.1 For each cluster and infrastructure system, the CPT shall identify the relationship between the functions and services provided by the social institutions and the clusters on which they rely.

NOTE 12—In Table A2.1, the linkage of services provided by each social institution and clusters for each functional category is shown. This should be an iterative process in which each cluster is organized under a functional category that has a common return to function goal. During Step 2E, the CPT may wish to identify indicators that help describe the relationship of buildings and infrastructure systems to community functions. Identifying these indicators may help the CPT address long-term community goals, allow monitoring of progress, identify community-scale vulnerabilities and strengths, communicate effectively with stakeholders, and support monitoring of progress.

6.2.5.2 For each social function, specific buildings and systems should be identified and catalogued for future use in Step 3 (specifying desired performance and determining the anticipated performance).

6.3 Step 3: Determine Goals and Objectives:

6.3.1 Step 3A: Establish Long-Term Community Goals—The CPT, in consultation with community members, shall identify long-term community goals to guide the community resilience planning and implementation process.

NOTE 13—Long-term community goals guide the resilience planning, prioritization, resource allocations, and implementation process. The goals are statements that indicate the purpose of the planning effort as outcomes

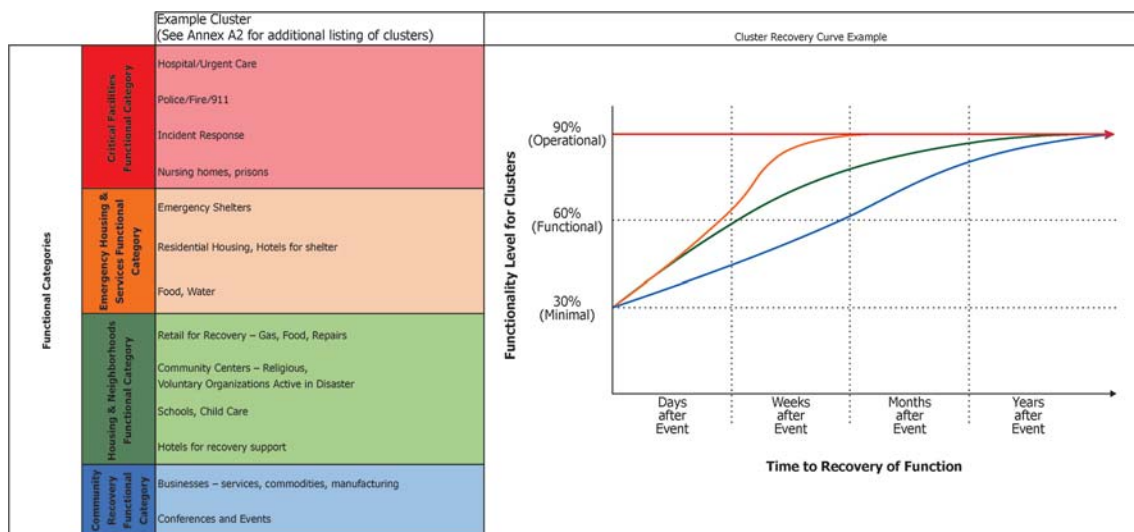


FIG. 1 Functional Categories and Clusters Relationship Example

to improve the community. Objectives, on the other hand, are quantifiable, specific measurable statements of the goal that can be used to measure progress. (See *goal* and *objective* definitions in Section 3.) Examples of these types of goal statements include: (1) improve performance of an infrastructure system to improve community resilience and functions, (2) improve or add redundancy to a transportation route to reduce travel impacts on residents and supply impacts on businesses, and (3) revitalize an existing area through improvements that benefit the community. An example of an objective statement is “80 % of small businesses have reopened within one week of a design-level flood, wind, or earthquake event.” Long-term goals and associated objectives can be accompanied by a set of indicators to allow monitoring of progress. Community resilience goals should be informed by assessments of the existing built environment and social and economic needs of the community. The indicators described before can serve as the basis for such an assessment. This assessment may include reviewing prior planning documents to identify goals and associated actions and geographic locations that the community has identified or implemented toward supporting specific goals. Methods for identifying goals and associated actions across plans can be found in Ref (14). Resilience goals should be incorporated into all community planning documents (for example, comprehensive or general plan, economic development plan, and hazard mitigation plan). In addition to consulting existing community plans, goals may be identified through a visioning process. The development of a shared community vision requires input from the entire community; the process and resulting vision should inspire individuals, families, businesses, and organizations to see themselves included in the vision. Developing a shared vision is a long-term process, so the community should develop the best vision possible given its current situation, needs, constraints, and resources. The vision may need periodic updates to make sure that it represents the community’s current conditions. The visioning process highlights opportunities for anticipating risk; minimizing impact; and fostering survival, adaptation, evolution, and growth. The visioning process is an opportunity to address and capture equity, economic, environmental, cultural, and other community values. See Ref (13) for information on visioning.

6.3.2 Step 3B: Determine Desired Performance Goals for Buildings and Infrastructure Systems—The CPT, in consultation with community members, shall specify the desired performance goals for clusters and infrastructure systems in terms of time to recovery of function for specified restoration levels of functionality.

NOTE 14—A desired performance goal refers to an acceptable level of damage associated with a particular hazard or multiple-hazard event and a corresponding time to restore functionality of a cluster or infrastructure system. Restoration levels refer to the functionality of a cluster or infrastructure system that has been partially or fully restored. When setting resilience goals, restoration levels (for example, minimal, 30 %; operational, 60 %; and functional, 90 %) are linked to time to recovery of function and are categorized as short term (days), intermediate (weeks), and long term (months-years). In Annex A3, example templates are provided for completing this activity. In Fig. 1, examples of the type of functionality restoration curves and associated time to recovery that would be expected for the functional categories presented in Steps 2D and 2E are provided. Determining the desired time to recover functionality helps to prioritize repair and reconstruction efforts. Additionally, desired performance goals should consider the role of a facility or system within local, regional, and, possibly, national contexts. For instance, if a production plant in a community is the national supplier for a particular product, the economic impact of the plant’s reduced function may extend well beyond the community. Desired performance goals developed by community members, with the support of the CPT, can promote community buy-in to the resilience planning efforts. These goals can serve multiple purposes after the resilience planning concludes, including prioritizing resource allocation, specifying restoration priorities, and supporting outreach programs.

6.3.3 Step 3C: Define Community Hazards and Levels—The CPT shall identify the community’s prevailing hazards and define a level of hazard intensity for routine, design, and extreme events.

NOTE 15—Natural hazards that communities commonly face include wind events (for example, severe storms, hurricanes, and tornados), earthquakes and other geological phenomena (for example, tsunamis, liquefaction, and landslides), flooding (for example, riverine, coastal inundation, and flash flooding), fire (for example, urban and wildland), snow, rain, and ice. Longer-term stressors, such as sea level rise and drought, effects should also be considered. Communities may also need to address technological or human-caused hazards (for example, chemical contamination, cyber-attack, and associated impacts to infrastructure systems). The CPT should look to the jurisdiction’s THIRA or HIRA for a comprehensive list of applicable hazards and cascading effects (for example, hurricanes, flooding, and landslides). The CPT may wish to consider how prior or expected future hazard exposure or specific community system vulnerability could result in significant impacts or longer-term consequences. This can inform the selection of types and levels of hazards used in this planning process. The design hazard level is a reference that is used in codes and standards for buildings, bridges, and other physical infrastructure systems. Design-level events specified in codes and standards generally provide information for a single hazard, and the CPT may need to consider how multiple hazards can concurrently be experienced (for example, hurricane riverine flooding, coastal inundation, and winds). To support community resilience, clusters and infrastructure systems should remain sufficiently functional to support the response and recovery of the community as defined by the performance goals. Achievement of desired performance levels may require assessment that reveal the need for additional design criteria beyond those in codes and standards, especially for buildings and infrastructure systems that support housing and neighborhoods. At a routine hazard level, resilient buildings and infrastructure systems should remain functional and not experience any significant damage that would disrupt social functions in the community. The extreme hazard level exceeds the design level for the built environment and has a lower probability of occurrence than the design level. Critical facilities and infrastructure systems should remain partially functional at this level with the ability to restore functionality when needed to support the response and recovery of the community as defined by the performance levels. Other buildings and infrastructure systems should perform at a level that protects the life safety of occupants, though they may need to be rescued. See Ref (11) for more information. In addition to considering hazards that result in acute shocks to community systems and associated buildings and infrastructure systems, the CPT should consider how stressors may affect the level of hazard that may be experienced by a community and its systems. Stressors generally are experienced over longer time periods than acute hazard shocks and can affect how certain systems function under hazard loading, under normal circumstances, or may result in differential levels of performance/function for certain populations or locations in a community (for example, bridge functionality may not translate to transportation functionality if certain populations do not have access to private vehicles because of social or economic stressors).

6.3.4 Step 3D: Determine Anticipated Performance of Buildings and Infrastructure Systems to Support Social Functions for Hazard Events—The CPT shall determine the anticipated performance of clusters and infrastructure systems, including: (1) the estimated level of damage that occurs for the hazard event (performance level) and (2) the corresponding recovery time to restore functionality.

NOTE 16—The anticipated performance of a cluster and infrastructure system is the estimated time necessary to restore functionality of the existing clusters and infrastructure system based upon their current condition for a selected hazard level. Current engineering practice for determining the performance of buildings and infrastructure systems under specific hazard levels is often based on subject-matter expert elicitation to estimate impacts and consequences, prior hazard experience,

system- or building-specific modeling, and hazard-based loss modeling. This guide does not advocate or establish requirements for any specific analytical methodology. The anticipated time to recovery depends on other factors beyond the design requirement of the system, such as administrative or emergency response considerations that affect how quickly a community can restore the function of its clusters and infrastructure systems. The templates provided in [Annex A3](#) are used to complete Step 3B and should be updated to complete this step, clearly catalog the results, and demonstrate dependencies between clusters.

6.3.5 Step 3E: Summarize the Results—The CPT shall use information collected in prior Steps 3B, 3C, and 3D for clusters and infrastructure systems for each hazard event under consideration. Each hazard event and hazard level under consideration shall be included in a summary table which considers the aggregate performance goals and anticipated performance. The CPT shall use this summary to identify time to recovery of function gaps between specified desired performance and anticipated performance.

NOTE 17—Completing the performance tables for all hazard events and levels becomes a defining element of the resilience plan even if detailed information related to all steps are not completed and the included information is based on informed judgment. It can serve as a summary and a link to other community plans. Sufficiently completing the performance tables provides a baseline for future testing or exercises, and a basis for data collection to verify levels of performance in future hazard events. [Annex A4](#) provides a template for completing this step.

6.4 Step 4: Develop the Plan:

6.4.1 Step 4A: Evaluate the Gaps between the Desired Performance Goals and Anticipated Performance—Using the summary table completed in Step 3E, the CPT shall evaluate the gaps between desired and anticipated performance for the built environment.

NOTE 18—The gap between desired and anticipated performance informs where key vulnerabilities may exist for various hazard events and levels, and forms the basis for solution identification for the resilience plan. The CPT should prioritize the gaps identified in terms of their relative importance toward advancing the community’s previously articulated resilience goals (see Steps 2A and 3A). As part of this prioritization effort, the CPT should consider if there are existing plans or projects that address the identified gaps. Because of the linkage defined in Table A2.1, specific buildings and systems can be identified as the key contributors to the anticipated performance levels and candidates for mitigation to achieve the desired performance.

6.4.2 Step 4B: Identify Solutions to Address Gaps Including Both Administrative and Construction Options—The CPT shall identify potential administrative and construction solutions and the required resources to implement the solutions that address the gaps between desired and anticipated performance of systems.

NOTE 19—Potential solutions to address the gaps can be physical upgrades through construction and retrofitting or administrative and policy actions. Construction solutions can be very expensive and often require governmental support to supplement the capability of individual buildings and infrastructure system owners. Administrative solutions often have relatively lower initial cost and can generate high value in the long term as new and retrofit projects are influenced by administrative changes. Examples of construction and retrofitting solutions are often hazard-specific and can include improving flood control structures, elevating homes, or retrofitting buildings to resist seismic loading. These may be temporary to sustain functionality until the repairs can be completed. Examples of administrative or policy actions include adopting the latest edition of model building codes and standards, adopting land use planning and zoning regulations that avoid development in high-risk zones,

acquiring external funding resources to implement solutions, or designating leadership for managing and maintaining community-wide resilience initiatives. Previously defined or selected indicators can help inform the identification of community-relevant solutions.

6.4.3 Step 4C: Prioritize Solutions and Develop an Implementation Strategy—The CPT, in consultation with community members, shall prioritize potential solutions and develop an implementation strategy.

NOTE 20—Building upon the prioritization of gaps in Step 4A, prioritization of solutions for inclusion in an implementation strategy will need to be reconciled with community goals and budgetary, statutory, or regulatory constraints. Engaging a diverse audience and all sectors of the community is critical to prioritization and implementation planning. Without sound engagement, there is a real risk that the actions will not encompass the whole community and participation will be profoundly limited, impacting the scope and success of the plan and the overall community resilience effort. Resources, including available time, financial resources, and equipment that are required to complete actions, are critical to implementation. The availability of these resources, and the availability and requirements of external funding resources, will inform prioritization. Identifying financial and technical assistance resources can help constrain options. For example, repairing a bridge requires access to specialized machinery. Without these resources or adequate funding to hire a contractor, the action is nearly impossible, a factor affecting how it should be prioritized. An overview of many of the types of resources in the community and where to go to find more information about them is provided in [Annex A5](#) and [Ref \(13\)](#). Economic decision support approaches are useful to determine whether a project makes economic sense in terms of costs and benefits (22). Guidance for evaluating the costs and benefits for community resilience strategies is described in [Guide E3130](#). In addition to identifying resource needs, the potential success of identified solutions relies on other factors influencing the feasibility of an action. Identifying these critical success factors will greatly enhance a community’s ability to implement the plan effectively. Potential challenges and sources of information to identify those challenges are outlined in [Annex A6](#). Such factors include, but are not limited to:

- A community’s political will to tackle a problem or undertake a specific action, especially as they relate to social equity and inclusion issues;
- Cultural considerations that affect acceptance of a given action; and
- Other community considerations that affect the ability or priorities to commit to specific actions (for example, administrative, economic development, equity, and environmental considerations).

6.5 Step 5: Prepare, Review, and Approve the Plan:

6.5.1 Step 5A: Document the Community Plans and Implementation Strategy:

6.5.1.1 The CPT shall develop a summary document (referred to henceforth as the “community resilience plan”) that documents the formation and composition of the CPT (6.1), the assessment of community systems (6.2), the community resilience (buildings and infrastructure system performance) goals (6.3), and the gaps and strategies (6.4). This guide will support community integration of resilience priorities and solutions into other community plans where appropriate.

NOTE 21—Ideally, the elements of the community resilience plan will be integrated in detail into and aligned with other community plans, such as comprehensive plans, hazard mitigation plans, or land use plans. A summary document that informs and leads to the integration of resilience goals across other community plans, departments, and offices can help ensure that the goals and solutions identified by the CPT are easily incorporated and referenced. As part of developing the community resilience plan, the CPT should consider how community planning goals can be supported by the latest building and infrastructure system standards.

6.5.1.2 The community resilience plan should address the significant threats, gaps, and shortfalls identified in Step 2

within the context of the community vision and goals developed in Step 3 and the solutions identified in Step 4.

NOTE 22—The CPT may wish to exercise the plan or plan components (using methods and practices such as those described by the Homeland Security Exercise and Evaluation Program), prior to submitting the plan for approval and community socialization (14). To maximize recovery investment and prevent the need for reconstructions, the resilience plan should emphasize the importance of adhering to community planning goals during recovery. The administrative and construction solutions in the recovery plan should address the spectrum of short- to long-term actions needed for recovery. Short-term recovery actions are generally administrative and may include:

Plans for debris removal and management;

Establishing damage assessment teams to accelerate the process for identification and replacement of lost or damaged assets; and

Create or update continuity of operations plans for government, key businesses, and community services in the immediate aftermath of a crisis.

Longer-term planning looks beyond the initial weeks and months of recovery and helps guide the community to restore the rhythms of its normal activity with an eye toward achieving its future resilient state. Recovery planning tools can be found in Ref (13).

6.5.2 Step 5B: Socialize the Plan with Stakeholders and the Community—The CPT shall conduct outreach and engagement to ensure stakeholders, community officials, and community leaders understand the elements of the plan, the process used to develop the plan, and to obtain additional input and feedback.

NOTE 23—Engagement and outreach may take multiple forms, such as press releases, public presentations and community meetings, social media engagement, and dissemination of public comments received (23). If an awareness and engagement plan is prepared in Step 1D, the CPT should consult it to ensure all stakeholders have an opportunity to engage.

6.5.3 Step 5C: Finalize and Approve the Plan—The CPT shall encourage the adoption of the assembled plan by the appropriate governing body. The appropriate governing body and authority for the CPT to seek or grant approval can be identified in the CPT’s authority, scope, and charter, which are identified in Step 1.

6.6 Step 6: Implement and Maintain the Plan:

6.6.1 Step 6A: Execute Approved Administrative and Construction Solutions—The solutions documented in the commu-

nity resilience plan and integrated in other community plans shall be implemented by the responsible agency or organization with authorities for project implementation once necessary funding and approvals are obtained.

NOTE 24—Implementation and funding options should be coordinated among existing programs and community administrative organizations. Timing and funding of solution implementation are dependent upon community-specific circumstances (for example, funding, existing plans, and previously specified replacement cycles).

6.6.2 Step 6B: Tracking and Review of Plan Implementation—Plan implementation tracking and regular reviews shall be conducted to monitor progress and verify that solutions remain relevant to the community’s resilience issues and priorities.

NOTE 25—Indicators can help track progress and establish a consistent mechanism for reporting results. Publicly posted progress reports ensure transparency and support community engagement.

6.6.3 Step 6C: Modify Short- or Long-Term Implementation Strategy to Achieve Performance Goals as Needed—The CPT shall review the plan on a regular basis and maintain and revise the plan as needed.

NOTE 26—Implementing the plan will be a long-term, ongoing process. The CPT should identify an appropriate interval that is compatible with other community planning efforts to review the resilience plan. The five-year cycle required for renewal of the FEMA Hazard Mitigation Plan may be an appropriate benchmark. This review should include community goals, changes in the built environment, and improvements in the built environment, changing community goals, changing priorities, changes in state and federal programs, and changes in requirements. The CPT should also consider a plan maintenance process for non-recurring events, such as after a hazard event or major changes within the community, or after the community conducts tests or exercises to assess preparedness. The plan maintenance process should be considered iterative and exercises can be used to identify any shortcomings in plan implementation effectiveness.

7. Keywords

7.1 buildings; built environment; collaborative planning; community; economic; hazard mitigation; infrastructure; planning; preparedness; recovery; resilience; social

ANNEXES

(Mandatory Information)

A1. COMMON SOCIAL DIMENSIONS AND ASSOCIATED SOCIAL INSTITUTIONS

A1.1 In **Table A1.1**, an example is provided of common social dimensions and the associated institutions that are identified and associated in Step 2: Understand the Situation.

Additional information on identifying social institutions can be found in NIST Guide Brief 2 and linking social institutions to clusters in NIST Guide Brief 10 (**17, 24**).

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TABLE A1.1 Common Social Dimensions and Associated Institutions

Family and Kinship	Economic	Government	Health
Neighborhood representatives	Chamber of Commerce/large and small retailers	Police and fire/emergency medical services	Public Health Department
Citizens groups	Banking and finance sector	Department of Public Works	Hospitals
Religious institutions	Local major industries	Department of Parks and Recreation	Urgent care/primary care providers
		Senior living centers	Behavioral health care providers
		Aging and people with disabilities services	
		Courts	
Education	Community Service Organizations	Religious and Cultural	Media/Communications
Public schools	Shelters	Local faith-based, cultural, or belief groups	Local news media outlets
Private schools	Food banks/distributors		Social media
Community college/higher education	American Red Cross and other voluntary organizations active in disasters		Post office
Preschools	Recreational/civic clubs or groups		

A2. CHARACTERIZING THE BUILT ENVIRONMENT

A2.1 See [Table A2.1](#) and [Table A2.2](#) for definitions.


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TABLE A2.1 Clusters Definition

Buildings Performance Table	Functional Category	Cluster	Functions and Service Provided	Building	Address
Buildings	Critical Facilities	Critical Medical-Acute Care Hospitals	Acute/urgent care Transportation coordination		
		Emergency Operations Centers	9-1-1 services, dispatch Emergency operations Incident response coordination (for example, utilities, public safety agencies, and so forth)		
		Critical Government-First-Responder Facilities	Transportation, road access, debris removal Communication Internal IT system functionality Fire, emergency services Police, public safety Building safety assessment Response services Documentation and records Trash, debris landfill		
		Non-Ambulatory Facilities—Prisons, Nursing Homes, and so forth	Shelter, food, care, security Special need/consideration residents Adult care, nursing, custodial care		
	Emergency Housing and Services	Emergency Shelters	Temporary housing for public safety Social services—food, water, clothing, and so forth Animal shelters		
		Residential Housing	Shelter in place		
		SFH and Multi-Family	Social services—food, water, clothing, and so forth		
	Housing/Neighborhood	Critical Retail	Food Gas and fuel Banks, credit unions Pharmacy Home repair		
			Religious and Spiritual Centers	Sense of community and help with services needs	
			Residential Housing	Functional living quarters	
SFH and Multi-Family			Access to power, water, food, and so forth		
K-12 Schools		Education Meals Safe environment After school care			
Child Care Centers		Child care			
Hotels and Motels		Housing for recovery support Tourism and business support			