Resilience Planning:

Tools and Resources for Communities

ENVIRONMENTAL FINANCE CENTER
AT SACRAMENTO STATE

November 2020

Acknowledgements

This research was funded by the US Environmental Protection Agency (EPA) through the Region 9 Environmental Finance Center (EFC) at California State University, Sacramento (Sacramento State) and by the Office of Water Programs (OWP) at Sacramento State.

About the EFC at Sacramento State

The EFC at Sacramento State is operated by OWP. The EFC serves state and local governments, tribal communities, and the private sector in the areas of financial planning and asset management. Focusing on communities within the US EPA Region 9 that include California, Arizona, Nevada, and Hawaii, the EFC increases capacity of local communities to fund environmental and public health services and adapt to future needs as regulations, technology, and resources change. The EFC is part of the nationwide Environmental Finance Center Network that provides expertise in technical assistance and training for local communities across the country to solve environmental challenges.

ENVIRONMENTAL FINANCE CENTER
AT SACRAMENTO STATE

EPA Region 9 EFC
OWP at Sacramento State
Modoc Hall, 6000 J St
Sacramento, CA 95819
efc@csus.edu
(916) 278-6142

Table of Contents

1.0 Introduction

For centuries, cities and communities have built infrastructure and developed plans to deal with disaster threats. Whether natural disasters such as hurricanes, floods, and wildfire, or man-made disasters such as economic recessions and infrastructure failures, societies make significant investments to limit how often such disasters occur and reduce the likely impacts.

In recent decades, the term "resilience" has emerged as a way to capture how cities and communities can prepare for disasters, which helps reduce the vulnerability and risk associated with natural and man-made hazards. Resilience planning is a process that communities can undertake to identify potential hazards and threats, and then establish adaptation, mitigation, and recovery plans. The goal is to reduce likely impacts and ensure that key infrastructure systems continue operating, or quickly begin providing services again. The need has grown more acute as scientific studies detail with greater specificity how extreme weather events will grow in severity and frequency in coming decades with climate change.

As part of its work to support communities in EPA Region 9, the EFC at Sacramento State compiled a list of existing resources and toolkits to assist local agencies and communities in resilience planning.

2.0 What is Resilience Planning?

Resilience planning is a planning process. It includes many types of activities, which generally seek to promote 2 goals: 1) actions that ensure communities have access to critical lifeline needs, services, and capital in the period following a disaster; and 2) actions that reduce risk from natural and human-driven hazards over the long-term, reducing the likelihood that communities suffer from multiple disasters over time that compound. The first set of potential actions relate to emergency response and disaster recovery, while the second set of actions recognize that short-term response and recovery measures may not always be sufficient following a disaster to ensure that communities recover and prosper.

While resilience planning does promote health and well-being during disasters, it does not mean that the status quo is adequate and should be maintained. Economic impacts from recent natural disasters are growing (Botzen et al. 2019). Current patterns of land use, which can situate homes and businesses in areas of high risk, may not be sustainable (Smith 2020). More fundamental changes, such as improving access to capital and resources and reallocating rights and power may be necessary to ensure that communities (especially low-income and marginalized communities) can adapt to changing conditions.

Many types of investments and policy actions can promote the goals of resilience planning. These include building new infrastructure, developing emergency response plans, and engaging residents and businesses in preparedness planning.

Recent legislative efforts by both the federal government and states have drawn on principles of resilience planning for improving community infrastructure. For instance, America's Water Infrastructure Act (AWIA) of 2018 and, in California, the Safe and Affordable Funding for Equity and Resilience Program (SAFER), weave resilience concepts into justifications for policies and investments. The resilience-planning processes described in this technical memo can be used as a guide to promote community-based resilience planning and identify infrastructure needs.

In the sections below, the technical memo covers basic definitions related to resiliency, steps in the resilience planning process, and ways to engage stakeholders and experts. The memo also includes attachments that provide a compiled list of existing toolkits for resilience planning and an example of a resilience-planning process for a hypothetical metropolitan flood risk management case.

3.0 Understanding Terminology

The National Research Council National Academies defines resilience as the "capability to anticipate, prepare for, respond to and recover from significant multi-hazard threats with minimum damage to social well-being, the economy, and the environment" (NRC 2010). In both practice and literature, definitions of resilience vary. Engineering resilience captures methods to assess risk through quantitative criteria, evaluating how quickly a system is likely to bounce back or recover to its original state once an event has occurred. Tradeoffs may exist in maximizing reliability and minimizing vulnerability (Hashimoto et al. 1982). Flood protection by a dam or levee may reduce flood risk, but could enable development in higher-risk zones. Ecological resilience, on the other hand, recognizes that systems may or may not return to a previous equilibrium state or prosperity level following a large disruption. Ecological resilience captures the magnitude of disturbance a system can absorb before there is a change in structure or controls governing the system (Holling 1973; Walker et al. 1969). Multiple states of equilibrium exist in ecological resilience with a disturbance of a certain threshold causing a system phase change that is not easily reversible. Pairing ecological resilience and engineering resilience can provide a more holistic view of how ecological and social systems behave, where they are vulnerable, and their long-term system health (Holling 1996).

Before engaging in a resilience planning process, it is helpful to understand key terms. These terms are defined in Table 1 and described in more detail as part of resilience planning. A more extensive glossary is included in Appendix A.

Table 1. Core Terms for Resilience Planning

Term	Definition
Asset	A physical item with value, or something intangible, such as reputation
Hazard/Threat	An object, situation, or event that may cause injury, illness, or death to people or damage to assets
Impact	Adverse consequences caused by a hazard or threat
Risk	Likelihood of a hazard or threat occurring and the magnitude of the impact
Vulnerability	Degree of susceptibility to adverse effects of hazards and threats
Recovery	Actions taken following an event to address impacts
Adaptation	Actions taken to adjust to conditions so that risk to assets is reduced
Mitigation	Actions taken to prevent or reduce the likelihood or magnitude of a hazard and consequently, the risk associated with a hazard

Assets are tangible or intangible items and concepts with value. Evaluating assets is critical for a risk assessment process. It involves identifying and listing assets of interest and their unique characteristics. The monetary or quantifiable value of an asset is of particular interest. It is usually easier to apply monetary value to a tangible asset like buildings, equipment, and infrastructure. So-called "soft" assets such as reputation, customer base, trust, and intellectual property could be considered intangible and are inherently more difficult to define and value. Resilience literature frequently acknowledges the distinction between tangible and intangible assets, but typically works with tangible assets because of the ease in approximating values.

An asset inventory is a database of all assets and important characteristics that are used for resilience planning. When creating an asset inventory, it should be as detailed as possible, including the value, age, condition, material, location, and other attributes. Location in particular helps identify risk for a given asset from one or more hazards. These attributes not only inform the value and eventual replacement costs of assets, but also help flesh out vulnerabilities that are dependent on an asset's exposure, adaptive capacity, and sensitivity to impacts.

Hazard and *threat* are used to denote a condition or event that has the potential to cause harm or other adverse effects to assets. *Hazard* is usually used in a safety context to denote conditions that can result in accidents, whereas *threat* is usually used in a security context to denote potential malevolent acts. A hazard can be defined as "a naturally occurring or human-induced process or event with the potential to create loss, i.e., a general source of danger" (Smith 2013). Often, hazard and threat are used interchangeably. Examples of hazards and threats are shown in Table 2.

Resilience planning requires a community to identify one or more hazards that could disrupt life and create hardship. Hazards of greatest concern will be unique to individual communities/utilities. Many factors will influence the types of hazards considered during the resilience planning process. For example, wildfire will be a top priority for a rural community in a heavily forested area, while a community protected by levees may be more concerned with flooding. Stakeholders throughout each community should be engaged, as different socioeconomic or demographic groups can place value on tangible items or intangible concepts in varied ways, but they are all important in considering prosperity.

Table 2. Hazard and Threat Examples

Natural Hazards	Technological Hazards	Human Caused Threats
Wildfire	Dam failure	Active shooter
Pandemic	Hazardous materials spill	Cyber attack
Flood	Industrial accident	Workplace violence
Drought	Mine accident	Chemical/Biological attack
Extreme heat	Pipe explosion	Explosives attack
High wind	Train derailment	Nuclear terrorism
Landslide	Radiological release	Radiological attack
Tornado	Urban conflagration	-
Tsunami	Utility disruption	-
Winter storm	-	-
Coastal Erosion	-	-

Adapted from USDHS 2013.

Each hazard has associated impacts on 1 or more assets. With top hazards identified, the next step is to determine and evaluate impacts. The bulleted list below presents examples of impacts that can occur from a hazard or threat (adopted from Risk Assessment:

- Loss of life
- Financial loss
- Fines and penalties
- Property damage
- Environmental contamination
- Business interruption
- Loss of customers
- Loss of confidence
- Lawsuits

With the exception of loss of life, impacts are often quantified by estimating an associated dollar value. This is helpful because monetary valuation can help standardize the value of potential impacts across many different types of goods and services. For example, the impact of property damage from coastal erosion can be measured by the value of properties and internal belongings in the affected area. That value can be compared to the cost of replacing above-ground utility lines in an area prone to landslides to evaluate the relative magnitudes of impact. Monetary valuation can serve as a useful tool to compare the magnitude of 2 unrelated impacts. Even though the valuation could be the same for these 2 cases, environmental or social vulnerability assessments may yield different planning measures and actions. Monetary valuation also describes benefits (in the form of potential savings) when conducting

costs-benefit analysis (i.e., when comparing the cost of resilience planning to the benefits).

Using economic value to estimate impacts, however, can be biased. Insufficient data can yield inaccurate or inappropriate monetary valuations. In addition, if the adaptive actions focus on reducing overall economic damages without considering differential impacts across communities, it can leave out areas of underinvestment within low-income or marginalized communities. For instance, a disaster event could disproportionately affect communities without resources to recover. While the total monetary damage may be moderate, its relative effect on certain populations is large.

An alternative approach involving a broader set of economic and sociodemographic indicators is useful when assessing potential impacts of a disaster across communities of different races, ethnicities, incomes, and locations (Blaikie et al., 1994; Cutter, Mitchell, and Scott, 2000). *Vulnerability* is a key component of analyzing total resilience. Vulnerability is broadly defined as the degree of susceptibility to adverse effects of hazards and threats. Exposure to hazards and threats and the ability of different populations to adapt both contribute to vulnerability assessments. Vulnerability of sociodemographic groups vary in space and time, underscoring the need for appropriate data to assess, plan, and act. As noted above, human vulnerability factors include wealth, gender, race, and class. Other factors integrate social sciences and can require a deeper knowledge of the community resilience in question. These social vulnerabilities are more difficult to quantify and can have contributing factors that include the influence of sociopolitical organizations, family structure, social service dependencies, and special needs populations (Cutter et al. 2003; Heinz Center 2002). Cutter and Finch (2008) stress the importance of developing emergency plans based on how vulnerable populations are exposed to hazards.

In resilience planning, *risk* is a measure of the likelihood of a hazard occurring and the degree of impact the hazard may have. Risk is calculated by multiplying the probability of a hazard occurring by the magnitude of the hazard's impact (either economic or a combination of impact indicators that are not all monetized). A numerical assessment of risk can then be used to rank all hazards from highest to lowest.

Action plans establish policies and funding priorities, which a community pursues to reduce exposure to the existing or emerging hazards. Action planning has particularly increased given the predicted increases in extreme weather from climate change, which will expose communities and infrastructure to more frequent and intense events. Climate change has brought about a renewed focus on adaptation planning.

especially how communities respond to and plan for sea level rise, flooding, wildfire, and hurricanes.

Adaptation refers to actions taken that adjust to current or expected future conditions for the purposes of reducing impacts to assets, lowering the overall risk. One way to reduce impacts is to reduce the vulnerability of assets. For example, to deal with the likely effects of climate change on water supply and quality, communities may choose to undertake adaptation actions such as:

- Building new infrastructure to capture water or reduce floods associated with a likely shift in peak streamflow from spring to winter due to earlier snowmelt.
- Investing in drinking water system demand reductions to accommodate water supply shortages due to drought.
- Investing in water treatment systems to deal with water quality degradation due to higher water temperatures.

Mitigation involves attempting to prevent or reduce the likelihood or magnitude of the hazard and consequently, the risk associated with a hazard. Mitigation actions could also reduce the scale of adaptation actions required because of a lowered risk. Some mitigation actions addressing climate change include:

- Adopting energy efficient transportation that reduces greenhouse gas emissions
- Electrifying industrial processes to reduce pollutants from factors
- Capturing and sequestering carbon dioxide in underground storage

Within resilience planning for natural hazards, mitigation actions typically focus on reducing human emissions of greenhouse gases, a fundamental driver behind the magnitude and frequency of hazardous events due to climate change.

Classifying an action that a community may outline within a plan as either adaptation or mitigation is not always clear. It depends on how a hazard or threat has been defined. Traditionally, mitigation actions have included both adaptation measures and mitigation measures, while climate change literature has differentiated them. An illustrative example is FEMA's Flood Mitigation Assistance and the Costal Resilience program which encourages communities to earn discounts on flood insurance premiums by taking actions that can reduce the risk of a flooding event, such as building setbacks with open-space and natural areas, creating coastal erosion open space, restoring and protecting dunes by planting native grasses, or building wetlands to slow down and store flood waters.

Within FEMA's working definition of mitigation, "sustained actions taken to reduce or eliminate long-term risk to life and property from hazards" (FEMA 2013), this program is an example of risk mitigation—communities are taking steps to reduce the socioeconomic impacts on assets of flooding events. While the Coastal Resilience program is classified as risk mitigation, some of the actions could be considered as adaptation for practitioners of climate change resilience. Protecting and in some cases augmenting the natural shoreline is an adjustment action that would reduce the risk to assets and could be considered an adaptation measure. Overall, this document focuses on adaptation planning as a response to increasing risk from climate change. Mitigation is considered as a decrease in hazard magnitude and/or likelihood and adaptation is viewed as an adjustment made to decrease a hazard's impact to assets by decreasing vulnerability.

Exposure of communities varies widely, but incorporating this variation into emergency plans is important to improve emergency management (Cutter and Finch 2007).

4.0 The Resilience Planning Process

Generally, a multi-step procedure comprises a resilience-planning process. The EFC has organized these procedures into 2 major components. The first component is assessing risks, the second focuses on addressing risks through developing action plans. Figure 1 shows the sequence for the steps involved.

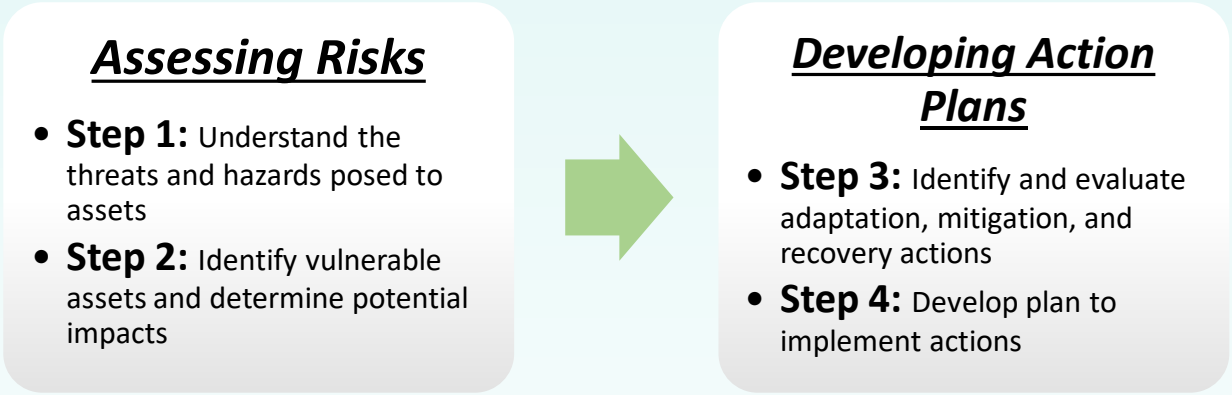

Figure 1. Steps for Resilience Planning

The bulleted list below presents different types of assessments that can be conducted for Steps 1 and 2, along with planning activities and documentation for Steps 3 and 4 of the resilience-planning process. For an example that illustrates the concepts presented herein, please see Appendix C: "Risk Assessment and Adaptation Planning." This list was adapted from the US Climate Resilience Toolkit.

4.1 Assessing Risk

Risk assessment is an iterative process that requires a detailed asset inventory and a list of hazards. The objectives of conducting a risk assessment are two-fold:

- **Step 1:** Assess threats or hazards to a population, economy, or environmental system. The assessment should first describe the location, extent, previous occurrences, and probability of the hazards (natural, technological, or human caused) faced by the community. The probability of hazards occurring can be separated as highly likely—occurs at intervals of 1–10 years; likely—occurs at intervals of 10 to 50 years; and somewhat likely—occurs at intervals greater than every 50 years. Some hazard profiling simply evaluates likelihood of event occurrence on an annual basis into high probability (75–100 percent), medium probability (50–75 percent) or low probability (0–50 percent). There are much

more complicated methods for developing event probabilities not reviewed in this document. The assessment should then identify community assets at risk from listed hazards, referred to as a "hazard-asset pair." Assets can include people, the economy, built environment (infrastructure, critical facilities, and cultural resources), and natural environment (wetlands, vegetation, and critical habitats).

- **Step 2:** Conduct a vulnerability and impact assessment, which evaluates the susceptibility of assets to hazards and threats. This creates an understanding of where asset vulnerabilities lie and which hazards or threats pose the greatest risk for assets of interest. The magnitude and type of impact for each combination of a hazard and an asset must be identified. The magnitude of impact is dependent on vulnerabilities of an asset. For instance, in considering the potential impacts of extreme rainfall events on substations within electric grid infrastructure, substations could be subject to inundation by flooding, explosions, or outages from associated wind damages. The magnitude of these various hazards would depend on the location of a substation, its size, the extent of backup systems, and proximity to flood-prone areas. These characteristics of a substation all contribute to its vulnerability, which can differ across different substations.

  Assets with high exposure will have a greater vulnerability, and ultimately, larger magnitude impacts. Ranking hazards and estimated impacts for assets of interest on a simple quantitative scale (1–5) is an easy way to compile a score that evaluates the relative assets at risk, with rankings based on expert judgement of the infrastructure system.

  Each organization or community can use a rating system with magnitudes that are applicable and relevant. The result of these activities is a list (table) of assets affected by the chosen hazard and the magnitude of the impact.

4.2 Developing Action Plans

Action plans help chart strategies and policies that will increase resilience and reduce long-term risks. They should outline responsibilities and roles, listing what will be done and in what order. Action plans can include identification and evaluation of adaptation, mitigation, and recovery strategies after which implementation measures are developed to set plans in motion.

- **Step 3:** Identify and evaluate potential actions to deal with hazards. Actions should be considered that help adapt, mitigate, or recover from the effects of a hazard. Strategies can be drafted to help identify and evaluate potential actions. Strategies can be based on vulnerability and impact assessments. Strategies

should include first identifying the Step objectives, which are to develop adaptation, mitigation, and/or recovery actions for each hazard/asset/impact item identified in the risk assessment (Steps 1 and 2). An objective statement for each hazard/asset/impact item should be developed. Then, for each objective, determine the type(s) of actions (i.e., mitigation, adaptation, or recovery) that would be appropriate, followed by specific actions for each category. Specific actions can be drawn from existing emergency response or other plans within a community, or taken from plans developed by other communities. Appendix B provides several resources for identifying actions (see description of the resource in Section 6.0 of this report). Tabulation of the hazard/asset/impact item and the relevant actions, grouped by action category, can help organize and communicate ideas. For each potential action, detailed needs must be identified along with ideas on how such needs can be addressed or obtained. With these needs considered, advantages and disadvantages, or benefits and limitations, can be added to the table for each potential action to further retain and evaluate potential actions. Table 1 shows an example of how potential actions can be documented for evaluation.

Table 3. Example of How to Identify and Evaluate Potential Adaptation, Mitigation, and Recovery Actions

Hazard-Asset-Impact	Action Type	Potential Action	Needs	Resources	Limitations
<List from Risk Assessment Steps 1 and 2>	<Mitigation, Adaptation, or Recovery>	<Identify from existing community plans or other resources>[1]	<List what is required to implement the potential action>	<List resources available to address or acquire each need>	<List limitations of potential action>

[1] *See Appendix B for tools and resources to help in identifying actions.*

- **Step 4:** Develop a plan to implement the selected actions. Organize actions into a cohesive plan that focuses on responding to disaster in the short-term while incorporating long-term plans. Assign responsibilities and roles, allocate funds, generate a timeline, update older plans, etc. Table 4 summarizes the various types of plans that are common, and details for each are discussed below.

    - *Adaptation plans* will detail how a community threated by a new or changing hazard is adjusting to decrease the magnitude of impacts. If a community has adopted a Local Hazard Mitigation Plan according to the federal Disaster Mitigation Act of 2000, it could help identify adaptation strategies to respond to natural or human-caused hazards.

- *Mitigation plans* provide a roadmap to reduce the severity of hazards. An example of a large-scale mitigation plan would be the widespread adoption of electric vehicles in order to reduce greenhouse gas emissions contributing to climate change. In traditional hazard mitigation planning, a utility flood plan would include bolting down chemical tanks, elevating wellheads and other equipment, or installing backup generators (Goldbloom-Helzner and McFeely 2015). Note that these actions would be considered adaptation planning in the context of the climate change definition.

- Lastly, *recovery plans* address future conditions in the near-, mid-, or long-term that will help a community return to equilibrium after an event. Recovery planning items that need to be in place before an event occurs can include decision-making matrices, housing strategies, and an agreed-upon plan to ensure essential community systems are restored quickly (Schwab 2014).

Table 4. Types of Action Plans

Action Plans	Definition
Adaptation Plans	Describe actions that reduce impacts of new or changing hazards.
Mitigation Plans	Describe actions that lessen the severity or frequency of identified hazards.
Recovery Plans	Describe actions that address conditions in the immediate, intermediate, and long terms after a hazard has occurred.

5.0 Engaging Stakeholders and Experts

A critical task in resilience planning is community outreach. After identifying hazards and vulnerable assets, communities should engage residents and work with them to adopt practices that support broader goals in the community and specific actions that improve long-term resilience. For instance, in areas of wildfire risk, municipal departments that prepare for emergencies and enforce building codes can work with residents to take preparatory actions that reduce the risk of wildfires destroying personal properties, such as vegetative safe zones around homes, or clearing roofs of leaf and tree needle materials. Other actions include identifying evacuation routes and vulnerable residents, such as elderly or hospital populations that would need special assistance during a disaster.

This process of outreach is generally known as stakeholder engagement. Stakeholders include residents, local business owners, non-profits and companies, local politicians and elected officials, non-profit groups and community-based organizations, and any others who may have contributions to, or be affected by, a resilience planning effort. Through engagement, stakeholders with different perspectives have an opportunity to take ownership of a process, providing input that would otherwise not influence plans.

Engaging stakeholders can make the evaluation process more balanced. For example, data related to specific hazards may become more accurate, and new channels of communication related to resilience building blocks (i.e., action plans and risk assessments) may open up. Plans may also better capture unique cultural considerations of particular sociodemographic groups, or redistributed planned investments differently.

In stakeholder outreach, it is important to distinguish between internal and external stakeholders. Internal stakeholders are decision-makers involved in resilience planning. External stakeholders, the community-at-large and organizations whose support is required to move resilience operations forward (e.g., non-profits and local businesses), can provide perspectives to inform strategic decisions and build closer communication ties. External stakeholders help internal stakeholders understand the particular needs and values of the community.

Many successful grant-awarded resilience plans involve collaborations of government and non-profit organizations in delivering services; including stakeholder engagement can be a draw for grant funding or loans, and may even be required for it. Experts, such

as consultants and university staff, provide guidance on the process. They can help develop timelines, protocols, supply chain needs, and best management practices, among many other details related to assessing risk and developing action plans. Internal stakeholders can be local and state government employees, elected officials, or emergency response officials. FEMA recommends stakeholder engagement as an ongoing activity throughout risk assessments and during the planning process (2019).

6.0 Tools and Resources

Appendix B summarizes resilience planning resources and toolkits for a variety of sectors, including water (drinking water, wastewater, stormwater, and flood protection), energy, land management and wildfire, solid waste, and transportation. Appendix B is intended to help program managers, directors, utility owners, and other decision-makers evaluate existing tools and identify the most appropriate one(s) for a given phase or step within resilience planning and the relevant sector.

Within the various sectors, tools and resources are categorized into 6 different types of assessments and plans, based on the descriptions and definitions provided in Section 2. Figure 5 shows the different types of resource categories. **Appendix B is available to download**.

Figure 2. The various types of resource categories

7.0 References

Adger, W. Neil. 2006. "Vulnerability." *Global Environmental Change* 16 (3): 268–81. August. https://doi.org/10.1016/j.gloenvcha.2006.02.006.

Annex F: City of Sacramento. *Local Hazard Mitigation Plan Update*; Sacramento County: Sacramento, CA, 2011. September. https://waterresources.saccounty.net/Program%20Documents/HazardMitigationPlan2011/Sacramento%20County%20Annex%20F%20City%20of%20Sacramento.pdf.

Blaikie, Piers, Terry Cannon, Ian Davis, and Ben Wisner. 1994. (Blaikie et al. 1994.) *At Risk: Natural Hazards, People's Vulnerability, and Disasters.* London: Routledge. https://doi.org/10.4324/9780203714775.

Boin, Arjen, ed. 2008. *Crisis Management*. Los Angeles: SAGE Publications.

Botzen W. J. Wouter, Olivier Deschenes, and Mark Sanders. 2019. (Botzen et al 2019.) "The Economic Impacts of Natural Disasters: A Review of Models and Empirical Studies." *Review of Environmental Economics and Policy* 13 (2): 167–88. June 25.

Cutter, Susan L., Bryan J. Boruff, and W. L. Shirley. 2003. (Cutter et al. 2003.) "Social Vulnerability to Environmental Hazards." *Social Science Quarterly* 84 (2): 242–61. May 19. https://doi.org/10.1111/1540-6237.8402002.

Cutter, Susan L., and Christina Finch. 2008. (Cutter and Finch 2008.) "Temporal and Spatial Changes in Social Vulnerability to Natural Hazards." PNAS 105 (7): 2301–06. February 19. https://doi.org/10.1073/pnas.0710375105.

Cutter, Susan L., Jerry T. Mitchell, and Michael S. Scott. 2000. (Cutter et al. 2000.) "Revealing the Vulnerability of People and Places: A Case Study of Georgetown County, South Carolina." *Annals of the Association of American Geographers* 90 (4): 713–37. https://doi.org/10.1111/0004-5608.00219.

Fernandez, Glenn, Yukiko Takeuchi, and Rajib Shaw. 2011. "Chapter 8: From Resilience Mapping to Action Planning." Pp. 149–61 in *Community, Environment and Disaster Risk Management*, vol. 6, edited by Rajib Shaw and Anshu Sharma. Bingley, UK: Emerald Group Publishing Limited.

Folke, Carl. 2006. "Resilience: The Emergence of a Perspective for Social–Ecological Systems Analyses." *Global Environmental Change* 16 (3): 253–67. August. https://doi.org/10.1016/j.gloenvcha.2006.04.002.

Goldbloom-Helzner, David, and Mikko McFeely. 2015. (Goldbloom-Helzner and McFeely 2015.) "Flood Resilience Strategies Protect Utilities in Uncertain Times." *Opflow* 41 (11): 10–13. November. https://doi.org/10.5991/OPF.2015.41.0066.

H. John Heinz III Center for Science, Economics, and the Environment. (Heinz Center 2002.) *Human Links to Coastal Disasters*; Heinz Center: Washington, DC, 2002.

Hashimoto, Tsuyoshi, Jery R. Stedinger, and Daniel P. Loucks. 1982. (Hashimoto et al. 1982.) "Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation." *Water Resources Research* 18 (1): 14–20. February. https://doi.org/10.1029/WR018i001p00014.

Holling, C. S. 1973. (Holling 1973.) "Resilience and Stability of Ecological Systems." *Annual Review of Ecology and Systematics* 4 (1): 1–23. https://doi.org/10.1146/annurev.es.04.110173.000245.

Holling, C. S. 1996. (Holling 1996.) "Engineering Resilience versus Ecological Resilience." Pp. 31–43 in *Engineering Within Ecological Constraints,* edited by Peter Schulze. Washington, DC: The National Academies Press.

Local Mitigation Planning Handbook (FEMA 2013)*;* FEMA, Washington, DC, 2013. https://www.fema.gov/media-library-data/1590070172371-48e87ca446838ba81afc2aca995940bc/FEMA_Local_Mitigation_Planning_Handbook_508.pdf.

Lower Sacramento/Delta North Regional Flood Management Plan; FloodProtect; Yolo County, CA: 2014. http://www.yolocounty.org/home/showdocument?id=28753.

Lund, Jay R. 2012. "Flood Management in California." *Water* 4 (1): 157–69. https://doi.org/10.3390/w4010157.

"Making Cities Resilient 2030 (MCR2030)," UNDRR website. https://www.unisdr.org/campaign/resilientcities/. Accessed July 7, 2020.

National Research Council. (NRC 2010.) *America's Climate Choices: Adapting to the Impacts of Climate Change*; The National Academies Press: Washington, DC, 2010. https://doi.org/10.17226/12783.

"Open Meeting of the Environmental Financial Advisory Board." 84 C.F.R. 11536; EPA, 2019. March 27.

Schwab, J., ed. (Schwab 2014.) *Planning for Post-Disaster Recovery: Next Generation*; PAS Report 576; American Planning Association (APA), APA Printing Office: Chicago, IL, 2014.

SB 200, 2019–2020 Legislative Session, California State Senate (2019). July 24. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200SB200.

Smit, Barry, and Johanna Wandel. 2006. "Adaptation, Adaptive Capacity and Vulnerability." *Global Environmental Change* 16 (3): 282–92. August. https://doi.org/10.1016/j.gloenvcha.2006.03.008.

Smith, Adam B. 2020. (Smith 2020.) US Billion-Dollar Weather and Climate Disasters, 1980–Present (NCEI Accession 0209268). NOAA NCEI. Dataset. https://doi.org/10.25921/stkw-7w73. Accessed October 1, 2020.

Smith, Keith. 2013. (Smith 2013.) *Environmental Hazards: Assessing Risk and Reducing Disaster.* Abingdon and New York: Routledge. https://doi.org/10.4324/9780203805305.

Stakeholder Engagement Guidance: Preliminary Production Process; Guidance Document 103; FEMA, Washington, DC, 2019. https://www.fema.gov/media-library-data/1578341568251-866521849769f6e92e8bb3101e707b2a/Stakeholder_Engagement_Preliminary_Production_Process_Guidance_Nov_2019.pdf.

Tafoya, Dennis W. 2020. *Crisis, Catastrophe, and Disaster in Organizations: Managing Threats to Operations, Architecture, Brand, and Stakeholders*. Cham, Switzerland: Springer International Publishing. https://doi.org/10.1007/978-3-030-37074-9.

Threat and Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR) Guide: Comprehensive Preparedness Guide (CPG) 201, 3rd Edition; US Department of Homeland Security (USDHS), Washington, DC, 2018. https://www.fema.gov/sites/default/files/2020-07/threat-hazard-identification-risk-assessment-stakeholder-preparedness-review-guide.pdf.

"Transportation," US Climate Resilience Toolkit website, US Global Change Research Program, National Oceanic and Atmospheric Administration (NOAA).

https://toolkit.climate.gov/topics/transportation-and-supply-chain. Accessed December 3, 2020.

Walker, B. H., D. Ludwig, C. S. Holling, and R. M. Peterman. 1969. (Walker et al. 1969.) "Stability of Semi-Arid Savanna Grazing Systems." *Ecology* 69: 473–98. https://doi.org/10.2307/2259679.