

Vulnerability Assessment Toolkit

A Toolkit for Project Teams

Draft Date: April 14, 2018

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Credits

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Overview

Objective of This Document

This guide presents a methodology to assess natural hazard risks and their impacts on assets in your community, then identify and prioritize responsive strategies to help reduce this risk. This process can be used to meet many requirements and goals, such as Local Hazard Mitigation Plans, Climate Adaptation Plans, or other resilience planning processes. This document captures lessons learned from years of working with jurisdictions to assess and mitigate hazards including earthquakes, fire, landslide, and sea level rise. The main objectives of the document are:

- Present a holistic concept that ties together natural hazard mitigation, climate adaptation, sustainability, and equity under the umbrella of “resilience-building,” and why this adaptable and flexible approach can result in better outcomes.
- Share a road-tested process, complete with tools and resources, that can help assess risk to natural hazards.
- Highlight best practices for identifying and implementing impactful mitigation and adaptation activities that are responsive to your unique risk profile.
- Identify different avenues and tools to codify risk reduction measures – land use planning, code adoption, smart, safe growth practices – that can build resilience to natural hazards.
- Provide the building blocks for how to build a case – politically, socially, environmentally, and economically - for taking action to reduce the risk from natural hazards.

Scope of this Document

This document outlines a process for assessing risk and developing strategies for managing that risk. Risk is defined as exposure to a natural hazard, either now or predicted for the future, which can negatively impact the built environment and cause consequences to residents that significantly interrupt their daily lives, resulting in a much reduced quality of life. Understanding how specific hazards affect specific assets or asset classes, and identifying potential consequences of the effects of hazards on assets, is key to reducing risk.

For the purposes of this document, the effects of climate change are considered natural hazard; while climate change due to increased greenhouse gas emissions is caused by human behavior, the *impacts* of climate change can cause or exacerbate natural hazards.

At the most basic level, the process of building resilience to hazards before a disaster consists of the following five phases:



While this document will touch on all of the phases, the emphasis in this guide is on the risk assessment and strategy selection and development phases: the technical meat to figure out what to do and how to do it. This part of the process is typically conducted by jurisdiction staff, with or without the assistance of a consultant. However, this process can also be done by another entity such as a regional agency, a nonprofit, or an educational institution, as long as the entity engages the proper stakeholders who will be facilitating implementation.

Intended Audience

This guide is primarily intended to be used by a project team working on a vulnerability assessment project. The assumption is that this project team will be led by local jurisdiction staff, and thus this guide is written for this audience. The assumption that the project team will be led by local jurisdictions is primarily because jurisdictions typically have the best capacity to gather information on their assets and also have the power to promote policy and partnerships that help implement resilience-building strategies. However, many other entities may also find the ideas helpful, such as consultants, nonprofits, regional governmental entities, collaboratives or consortiums focused on resilience issues, campuses, special districts, or utilities.

Why We Developed This Document

Expanding the Natural Hazard Mitigation Process to Encompass a Wider Resilience Frame

This guide was designed to lead jurisdictions through an inclusive and flexible natural hazard and assets risk assessment process that leads to robust, actionable strategies for reducing risk and increasing a community's resilience. It is our belief that the risk assessment process is a fundamental tool for creating the deep understanding, capacity and buy-in that leads to meaningful resilience-building actions within a community in response to natural hazards like earthquakes, wildfires, flooding, and climate hazards.

The basis of the process outlined here is based in the Local Hazard Mitigation Plan process. For many local jurisdictions, one of the most common avenues for planning for a more resilient future in the face of natural hazards is a FEMA Local Hazard Mitigation Plan (LHMP). While there are many benefits that come from creating a LHMP, such as eligibility for FEMA mitigation grants and, in California, a waiver of the local match for post-disaster assistance, the resilience landscape has changed significantly over the past few years and jurisdictions are expected to consider many different elements that fall under the umbrella of natural hazards resilience, including climate change adaptation.

As new thinking about current and future risks has emerged, countless guidance documents have been developed that outline specific processes to meet specific outcomes, either regulatory or voluntary. However, we noticed very significant overlaps in every process and, in response, developed an overarching process that would meet the requirements of the LHMP process but be flexible and comprehensive enough to provide significant benefit above and beyond the requirements of the LHMP. This guide expands the traditional LHMP risk assessment process to incorporate a number of other different hazard assessment considerations and can easily be used to meet requirements for other resilience plans, such as climate adaptation plans.

This guide pulls best practices from many different documents providing guidance on hazard mitigation, climate adaptation, and safety element risk assessment and strategy development processes, including General Plan Guidance, ICELI's Climate Adaptation Guidance, Rockefeller 100RC guidance, and many FEMA Local Hazard Mitigation Plan guidance documents. In this guide, we have tried to get at the heart of what makes this process successful, meaning that it leads to actual implementation of strategies and actions that reduce risk from hazards. We have pulled out the most relevant questions to ask about the process to achieve maximum stakeholder buy-in and increased capacity amongst city staff, as well as how to infuse resilience thinking into daily decision-making. While other guides may not be identical to the concepts and processes laid out here, they are largely compatible.

Once you understand some key concepts, you can easily incorporate elements from whatever guidance resonates most with your team or meets your particular requirements. The outcome matters more than the exact process. A successful resilience-building process results in action that protects assets; all of the elements in this process are designed to support action.

Identifying Triggers

Everyone who picks up this document will have a unique "trigger" for moving through this process as well as a unique "lens" that will help scope and frame the work. A trigger is something that spurs this work to happen; this could be an external trigger like a regulatory requirement or an internal trigger such as a strong internal champion. The trigger provides the motivation to do resilience-building work. A lens is the

perspective through which the assessment is done; for a Local Hazard Mitigation Plan the lens would be natural hazard risk reduction, but for other jurisdictions the lens may be more narrowly focused on climate change adaptation, or may be focused through the lens of a particular asset type, like transportation infrastructure. Projects may have multiple lenses or secondary lenses, like social equity, environmental sustainability, or housing affordability. This document is primarily written with the trigger of the Local Hazard Mitigation Plan and the lens of natural hazards, but our hope is that, by understanding how malleable this process really is, users will be able to apply this process to any type of risk assessment, no matter the trigger or the lens. Below are some of the most common triggers for undergoing a risk assessment.

Risk

Jurisdictions may be triggered by existing risk in their community, either known threats or existing hazards that are either severe enough to have significant consequences or are anticipated to become more severe and create worsening consequences. Sometimes resilience-building is triggered by a disaster with undesirable consequences, either a local disaster or a high profile disaster elsewhere, that wakes up jurisdictions and causes them to realize that they must take action to mitigate or reduce the risk.

Regulatory Requirements

In California, planning for resilience is not just good practice to ensure a more secure long-term future; it is also a part of the regulatory landscape. Your entry point to resilience-building may be triggered by regulations, which include specific requirements about what your assessment should include. Below is some legislation in California which may trigger resilience planning processes in your community:

- AB 2140 (Hancock) – AB 2140 states that any jurisdiction that has a local hazard mitigation plan as part of the safety element of its general plan that includes 1) an initial earthquake performance evaluation of public facilities that provide essential services, shelter, and critical government functions; 2) an inventory of private facilities that are potentially hazardous, including, but not limited to, multiunit, soft story, concrete tilt-up, and concrete frame buildings; and 3) a plan to reduce the potential risk from private and governmental facilities in the event of a disaster; may be eligible for a state share of local post-disaster costs that exceeds 75%. Currently, the California Disaster Assistance Act limits the state share for no more than 75% of eligible state costs. Cities with LHMPs in place that meet the above requirements waives this maximum and can significantly help ease the local government cost sharing burden.
- SB 379 (Jackson) – SB 379 requires that, upon the next revision of a local hazard mitigation plan on or after January 1, 2017, or on a new LHMP on or before January 1, 2022, the safety element of the general plan should be reviewed and updated as necessary to address climate adaptation and resiliency strategies applicable to that city or county. The updates would include a set of goals, policies, and objectives based on a vulnerability assessment, identifying the risks that climate change poses to the jurisdiction and the geographic areas at risk from climate change impacts. Jurisdictions with a current LHMP that is linked to the safety element (per AB 2140) will likely not have much difficulty meeting the requirements of SB 379, especially with the climate-related guidance put forth in this document.
- SB 246 (Wieckowski) – This bill establishes a state-led Climate Adaptation and Resiliency Program to coordinate local and regional efforts with state climate adaptation strategies and a clearinghouse for climate adaptation information to be made available to local governments. This effort will build upon the information laid out here and provide more resources to jurisdictions to coordinate and align climate and resilience-building strategies.

Local or National Trends

A high visibility thought leader, either locally or elsewhere, can help trigger others to conduct resilience planning. This can be especially true when it comes to climate adaptation, as there is a general understanding of the regional nature of sea level rise and other climate hazards. It is advantageous for cities to work together to assess risk and create solutions. Working with neighbors may also be advantageous for securing funding, as funders are often looking to make a greater impact with their investments. Sometimes, high profile cities elsewhere in the country can also trigger local action as cities look to keep up with national best practices.

Incentivizing Business and Investment

Going through a visible, public process to assess your risks and be responsive to them is a clear signal to the business community that you are invested in the long-term resilience and viability of your city. Especially if you utilize a high profile framework or metrics, like Rockefeller's 100 Resilient Cities framework, you can market your city as one committed to protecting assets and expediting recovery, which translates to a good investment for businesses.

Resilience Lenses: Connecting Resilience with Sustainability and Equity

Though your primary lens may be focused on natural hazards or climate change, building communitywide resilience inherently combines aspects of environmental sustainability, economic strength, risk management, emergency preparedness, and strong social communities. True resilience incorporates the ability to withstand multiple types of stressors, and a robust resilience-building process will incorporate multiple lenses that are interconnected to your primary lens. Rockefeller's 100 Resilient Cities categorizes two kinds of stressors: chronic stresses, like housing shortages, an aging or overtaxed public transportation system, or endemic violence; and acute shocks, like earthquakes and floods.¹ These two types of stressors are systemically interrelated and affect each other.

The environmental sustainability lens is tightly interwoven with natural hazards resilience, particularly with the actions that emerge from the assessment: often, actions to increase the sustainability of a community can increase its resilience to disasters. Resilience to disasters can be maximized if environmental sustainability is included as a core value – in many instances, the degradation of the environment can in fact contribute to disaster vulnerability, such as the loss of wetlands increasing vulnerability to hurricanes or sea level rise. Additionally,

¹ ibid

The Four Frames

The Bay Conservation and Development Commission's Adapting to Rising Tides Program uses four frames that define and prioritize sustainability throughout their assessment and planning process for sea level rise hazards:

- **Society and Equity:** Effects on communities and the services on which they rely, with a focus on disproportionate impacts due to existing inequalities.
- **Economy:** Economic values that may be affected such as costs of infrastructure damages or lost revenues during periods of recovery.
- **Environment:** Environmental values that may be affected, such as species biodiversity, and ecosystem functions & services.
- **Governance:** Factors such as organizational structure, jurisdiction & mechanisms of participation that affect vulnerability to impacts.

disasters that destroy or dramatically alter resources render communities unsustainable, since they impact the long-term ability of the community to access and use resources.

Equity is also a critical secondary lens of resilience. The most vulnerable populations are often most impacted by natural disasters and are the least likely to be able to effectively prepare for, respond to, and recover from disasters. They often live in the most vulnerable housing, due to age, condition, and location. They are often more dependent on city services to meet their daily needs, which may be significantly compromised by natural hazards. They are less likely to have insurance, to have control over the safety and adaptive capacity of their homes, and, if impacted, typically do not have adequate financial resources to bounce back. After a disaster event, vulnerable populations may have less access to recovery resources, either because of language barriers, less capacity to know how to engage with government and ask for resources, or intentional or inadvertent discrimination. Resilience-building processes and actions need to account for the needs of the most vulnerable residents. A community cannot be resilient without consideration of all residents, and equity in resilience is of the utmost importance.

Why Focus on Natural Hazards?

Just like sustainability a decade ago, the term resilience has been embraced by many to encompass a new way of thinking about how we think about our built environment. Human settlements exist in relationship to the natural world, and our built environment has always been vulnerable to the forces of nature. Sometimes these natural disasters occur suddenly, causing significant damage in a short period of time, such as in an earthquake, hurricane, or storm-related flooding. Other times nature's impacts on the built environment builds slowly and incrementally, such as in the case of climate-change induced sea level rise. Because of the cyclical or unpredictable nature of many natural disasters, in the past many decisions about the built environment, such as land use and past building codes, may not have been developed with adequate consideration of potential hazards. In many cases, such as with earthquakes with a long return period or with sea level rise, our knowledge of hazard risk is highly uncertain.

The impacts of natural disasters without proper pre-disaster mitigation can be devastating to residents through loss of housing, jobs, access to services like healthcare and education, and loss of municipal services like water, energy, wastewater treatment, and fuel. Disasters can also have significant impacts on local culture, recreation, businesses and the economy, and local revenue generation for the jurisdiction.

Using collective lessons learned, and resulting best practices, however, states, regions, and jurisdictions now have more information and tools to include natural hazards considerations in regulating and planning for the built environment. Many considerations already go into local decision-making, such as the needs of residents, revenue generation for the jurisdiction, or reduction of greenhouse gas emissions; considerations for the impacts of natural hazards, now and in the future, should be given equal weight.

Planning for resilience to natural hazards involves some basic steps: understanding past, current, and future disaster risks and understanding how these risks interact with critical components of the built environment; understanding the consequences of potential damage to the built environment due to natural hazards; and identifying and implementing strategies to either reduce the hazard, reduce exposure to the hazard, reduce the damage that the hazard can inflict, or minimize the consequences of damage. In the hazard mitigation world, this is commonly done through a Local Hazard Mitigation Plan, and the strategies are referred to as mitigation actions. In the climate adaptation world, this is commonly done through a Climate Adaptation Plan, and the strategies are referred to as adaptation actions. However, in this guide, the general process – whether for traditional natural hazards like earthquakes or fire or for climate-induced changes such as sea level rise or extreme heat – will be referred to as one process that can be approached

from different angles and through different lenses. Generically, this encompasses assessing risk and implementing resilience-building strategies.

Incorporating Hazards into Local Planning and Decision-Making

Traditionally, hazard mitigation and climate adaptation actions have been relegated to their respective plans and seen as stand-alone actions, separate from everyday local planning and decision-making. However, this guide advocates for hazard and climate-related considerations to be infused in the daily thinking and planning of a wide variety of city departments, incorporated throughout a wide variety of documents that guide and regulate the city's functions, and be seen as a critical component of the success or failure of a city's ability to grow and provide for its residents in a way that contributes to a high quality of life. All decisions that guide city growth, or regulate the current built environment, should include consideration of current and projected hazards and their consequences.

Resilience and hazards-related considerations should be incorporated into many different city documents and departments, not just relegated to special interest efforts. Information about current and future hazards should be taken into consideration whenever decisions are made about land use, buildings, infrastructure, and city services. Traditionally, the hazard assessment and strategy development process outlined in this guide is done for a Local Hazard Mitigation Plan, Safety Element, or Climate Adaptation Plan. Jurisdictions may be triggered to do an assessment by regulation or incentive (see section XX, regulatory context). However, the process here can be done with many different goals and outcomes and incorporated into many different decision-making processes, independent of the traditional "home" for hazards assessment. This can help ensure that a wider variety of stakeholders are involved and invested, leading to better implementation.

The following table illustrates some places where hazards considerations could be incorporated into city planning documents and processes.

Table 1: How Hazards can be incorporated into Various City Documents

*Adapted from **Integrating the Local Natural Hazard Mitigation Plan into a Community's Comprehensive Plan**, FEMA*

Local Plan or Document	How you can incorporate hazards
General Plan	
Land Use Element	<ul style="list-style-type: none"> – Consider hazards exposure as part of planning future land uses and include policies to control development in high hazard areas, as appropriate
Circulation Element	<ul style="list-style-type: none"> – Ensure that transportation infrastructure is in sufficient condition to withstand design forces – Use transportation policies to guide growth to lower hazard locations – Ensure redundancy in the transportation network (modes, routes) if critical infrastructure nodes may be damaged by hazards
Housing Element	<ul style="list-style-type: none"> – Analyze the exposure and vulnerability of existing housing and adopt retrofit policies if appropriate – Consider how to balance demand for housing, especially affordable housing, with pressure to build in high hazard areas

Conservation Element	<ul style="list-style-type: none"> – Protect natural features that can help mitigate flood and sea level rise, like floodplains, wetlands, marshes, and dunes – Limit development in flood-prone areas like floodplains, wetlands, and marshes – Preserve vegetation on steep slopes to manage landslide risk
Open Space Element	<ul style="list-style-type: none"> – Utilize conservation and recreation areas to protect high-hazard areas and limit other, higher density land uses
Safety Element	<ul style="list-style-type: none"> – Incorporate all findings of hazard assessment into the safety element, or use the safety element as your Local Hazard Mitigation Plan and/or Climate Adaptation Plan. The safety element should differ very little, if at all, from your LHMP
Zoning Ordinance	<ul style="list-style-type: none"> – Limit the density of development in high hazard areas, prohibit development or require land to be placed in conservation uses in these areas, or change density in high hazard areas of existing development – Include special considerations for high hazard areas, such as additional mitigation guidelines, through the use of new zoning or zoning overlays
Land Use Designations	<ul style="list-style-type: none"> – Designate high hazard areas as conservation areas, or include special development considerations
Subdivision Regulations	<ul style="list-style-type: none"> – Control the location of new roads, residential lots, and public facilities to account for hazard risks – Include regulations and requirements to preserve environmental features and natural stormwater functions
Capital Improvements Plan	<ul style="list-style-type: none"> – Limit investments that will be vulnerable through exposure to hazard areas and increase vulnerability of the community as a whole – Include expenditures for hazard mitigation projects
Building Codes	<ul style="list-style-type: none"> – Include local building code amendments that account for increased hazard exposure and create higher levels of performance during disasters
Specific Plans	<ul style="list-style-type: none"> – Ensure that investments in redevelopment areas do not perpetuate vulnerability – Incorporate hazard-resilient features like green infrastructure or flood control features – Ensure that redevelopment is built to more hazard-resistant standards if area is a high hazard area
Stormwater Management Plans	<ul style="list-style-type: none"> – Incorporate natural stormwater retention and detention features to limit flooding due to stormwater – Develop new stormwater features to account for sea level rise and temporary storm surges
Emergency Management or Operations Plan	<ul style="list-style-type: none"> – Ensure that emergency management plans use similar assumptions as in mitigation assessments about hazard exposure and asset vulnerability
Post-Disaster Redevelopment Plan	<ul style="list-style-type: none"> – Develop redevelopment plans that coordinate with anticipated consequences of disasters as identified in a hazard assessment and account for mitigation measures implemented
Local Hazard Mitigation Plan	<ul style="list-style-type: none"> – Meet FEMA requirements and become eligible for funding by incorporating your hazard assessment in a Local Hazard Mitigation Plan

Climate Adaptation Plan	– Ensure that assessments about future risks due to climate change are incorporated into other risk assessments and all plans and decisions about existing and future development
Climate Action Plan	– Understand the life cycle of climate change – reduce greenhouse gas emissions while planning for inevitable changes through climate adaptation actions
Sustainability Plan	– Strategies that reduce use of resources like energy and water can also help support mitigation to disasters. Tie sustainability strategies to hazard mitigation and climate adaptation strategies to ensure consistency

Resources

Local Hazard Mitigation Plans

- ✓ Local Mitigation Planning Handbook. FEMA
- ✓ State Mitigation Plan Review Guide. FEMA

Climate Adaptation Plans

- ✓ California Adaptation Planning Guide: Planning for Adaptive Communities. CalOES, CNRA
- ✓ Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments. ICLEI

Aligning planning processes

- ✓ Hazard Mitigation: Integrating Best Practices into Planning. APA
- ✓ State of California General Plan Guidelines. Governor's Office of Planning and Research
- ✓ Integrating Hazard Mitigation and Climate Adaptation Planning: Case Studies and Lessons Learned. ICLEI
- ✓ Plan Integration: Linking Local Planning Efforts. FEMA
- ✓ Integrating the Local Natural Hazard Mitigation Plan into a Community's Comprehensive Plan: A Guidebook for Local Governments. FEMA
- ✓ Integrating Hazard Mitigation Into Local Planning: Case Studies and Tools for Community Officials. FEMA, 2013

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The Process: Assessing Hazards and Assets and Developing Responsive Strategies

Much of the technical work necessary to understand your hazards and make decisions about your community in the context of hazards is done through a seven-step process that helps you assess your hazards, gather critical information about your community assets, and develop the right ways to respond to the unique picture that your hazards and assets present. This process is the core of this document: this is what guides how a community decides to respond to their own unique hazards given myriad factors at play in their local context. Each of these steps is described in much greater detail later in this guide, but an overview of each step is below.

Phase I. Identify and Assess Hazards and Assets



Phase II. Develop and Implement Strategies

Phase 1: Identify and Assess Hazards and Assets

The assessment process presented in Phase 1 is broken into the following steps:

- ✓ **Step 1: Lay the Groundwork**
- ✓ **Step 2: Describe Hazards**
- ✓ **Step 3: Determine your Assessment Methods and Select Assets**
- ✓ **Step 4: Conduct the Assessment**

An in-depth risk assessment can provide a comprehensive understanding of vulnerabilities and consequences within a community, and can lead to the development and implementation of more appropriate and achievable mitigation and adaptation actions. The outcomes of the assessment can also help guide long-range planning and future land use decisions, spur important partnerships with utilities and the business community, and provide additional incentive to help protect vulnerable communities, small businesses, or unique community features such as historic structures or critical park and recreational facilities.

This process is designed to not just be followed in a stepwise manner, but to introduce a process of inquiry that leads to the most useful outcome. The assessment process will be informed by the lens through which you are approaching it, what your priorities and goals are, and who your primary stakeholders are. Since these factors will influence the decisions you make about which hazards you assess, which assets you focus on, and what type of vulnerability information you will be looking at, we've designed this process to help you

inquire and identify your priorities prior to starting your assessment. Assessments that lead to the most impactful outcomes, and lead to on-the-ground action, start with asking the right questions.

You may be doing an assessment to fulfill particular requirements (for example for your Local Hazard Mitigation Plan or SB 379 compliance), or you may not need to meet any requirements with your assessment. This process has been designed to help you fulfill requirements for both LHMP approval as well as SB 379 compliance (see table on next page). This assessment process closely follows FEMA's Local Mitigation Planning Handbook. However, we have broadened Step 2 from solely identifying community assets to taking the time to determine the overall assessment approach including how you will gather the information about risk. This is intended help shape your assessment according to your preferred lens for a more locally meaningful and actionable assessment.

This process can also be adapted to different degrees of depth in your assessment. You may wish to do a high level assessment of all your hazards, as for a LHMP, or you may wish to do a more in-depth assessment on a specific hazard, for example if you are concerned about sea level rise in a particular area. At a most basic level, assessing exposure of assets to a hazard presents a geographic understanding of risk. On a more in-depth level, identifying specific assets and diving deep into their vulnerabilities can help create significant investment in specific and detailed responsive strategies to reduce risk in a meaningful way.

At the end of the assessment you will have the following outcomes:

- ✓ Goals to guide the risk assessment and development of mitigation and adaptation actions
- ✓ A preliminary list of key project team members, advisory body members, and key stakeholders to contribute to the assessment and implementation process
- ✓ Prioritized hazards, hazard scenarios, and maps to be used in your assessment
- ✓ An inventory of assets, by asset class and specific assets, to be used in your assessment
- ✓ Exposure analysis – maps and data describing which assets are exposed to which hazards
- ✓ Assessment information about vulnerability and consequences
- ✓ Vulnerability problem statements
- ✓ **Fulfillment of Element B1 in FEMA's Local Mitigation Plan Review Tool Checklist**
- ✓ **Fulfillment of Element B2 in FEMA's Local Mitigation Plan Review Tool Checklist**
- ✓ **Fulfillment of Element B3 in FEMA's Local Mitigation Plan Review Tool Checklist**
- ✓ **Fulfillment of Element B4 in FEMA's Local Mitigation Plan Review Tool Checklist**
- ✓ **Fulfillment of Element C3 in FEMA's Local Mitigation Plan Review Tool Checklist**

Phase 2: Develop and Evaluate Strategies

Phase 2 is broken into four steps:

- ✓ **Step 5: Summarize Vulnerability**
- ✓ **Step 6: Identify Strategies**
- ✓ **Step 7: Evaluate Strategies**
- ✓ **Step 8: Develop Implementation Plans**

Assessing hazards and assets and summarizing your findings into problem statements leads to the most important component of risk reduction and resilience-building: identifying responsive mitigation and adaptation strategies and actions and setting up implementation of these actions. Mitigation and adaptation strategies should be directly responsive to the hazards and vulnerabilities you uncovered in your assessment step and be designed to resolve real-world, meaningful problems in your community. At the end of this step, you should have a short list of prioritized, implementable strategies that tie back to your

goals, problem statements, and other planned local actions; concrete plans for implementing strategies through local action; narrative and cases for decision-makers and funders to support implementation and local action; and buy-in from key stakeholders and your community to aid in supporting implementation.

This is a good time to revisit your resilience goals that you used to guide your assessment. Your assessment may have uncovered new information or highlighted new priorities, and you may want to update goals to reflect new findings. If your goals were based on existing community goals and not hazards-specific, this may also be a good time to develop new, hazards-based goals. Goals are important because they can inform which strategies and actions your community values and should prioritize, and can also indicate which strategies already have community support and may be easier to implement.

Strategies should also respond directly to the problems you identified in your assessment and summarize into problem statements. In your problem statements, you should have identified your community's most pressing hazards problems, informed by goals, hazard risks, the vulnerability of assets or asset classes, and the consequences and impacts of damage or failure of key assets or asset classes. Strategy selection is the time to identify and evaluate the most appropriate solutions to the problems your community faces, using criteria such as responsiveness, cost benefit, ease of implementation, and impact.

At the end of this phase you will have the following outcomes:

- ✓ Draft list of appropriate strategies to address your hazard problem statements
- ✓ Basic information on each strategy to assist in evaluating and prioritizing strategies
- ✓ **Fulfillment of Element C4 in FEMA's Local Mitigation Plan Review Tool Checklist**
- ✓ **Fulfillment of Element C5 in FEMA's Local Mitigation Plan Review Tool Checklist**
- ✓ **Fulfillment of Element C6 in FEMA's Local Mitigation Plan Review Tool Checklist**

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Step 1: Laying the Groundwork



Key Steps:

- ✓ Decide how to approach the project and what objectives you will be meeting through your process
- ✓ Identify and establish project goals
- ✓ Establish a multidisciplinary project team, advisory body, and stakeholder group

Establish a Project Team, Advisory Body, and Stakeholder Group

Traditionally, hazard mitigation has been grouped with disaster preparedness and response and often housed in response-based departments like fire or police. However, to get the best outcome for the community as a whole, the resilience-building process should be multi-disciplinary, spanning city departments, across different levels of authority (i.e., staff, management, executive staff, and elected officials), and involve many non-governmental stakeholders, such as community-based organizations, asset owners and managers, regulators, business interests, community members, and local institutions. Engaging a wide variety of participants at multiple scales has many short and long-term benefits. Working together on a resilience assessment can help develop strong inter-organizational relationships that form a foundation for collaborative problem-solving. Multidisciplinary teams also help build capacity of the project team and other stakeholders in shared assessment and decision-making skills.

It is important to understand the role that a consultant can and cannot fill in a resilience assessment – while a consultant may be able to provide specific technical or organizational expertise at certain points in the project, unless project team members are heavily involved in the process, and especially with key stakeholders, the project team may not build the degree of experience, trust, and partnership with stakeholders that could provide benefits for future work, like funding and implementing strategies.

Successful implementation of strategies relies heavily on the engagement of stakeholders who can help or hinder implementation, and capacity-building throughout the process that empowers stakeholders to make decisions and take actions that support the overall desired outcome. Local staff will need to build coalitions of stakeholders at different levels and with different capacities who all buy into the end result. Additionally, both the internal team and external stakeholders should represent a broad power base and include leaders who are empowered to make decisions and make actions happen. Engaging a wide variety of stakeholders also ensures that all necessary expertise, values, and viewpoints are heard at all stages of assessment and implementation. You will generally have three types of involved stakeholders:

- **Internal project team.** The internal project team should be led by a project manager and involve staff from relevant city departments. This staff will be doing the technical work behind the assessment as well as coordinating other stakeholders and engaging with their managers, executive staff, and elected officials to ensure that the process is moving along smoothly.

- **Advisory Body.** This body should be comprised of key stakeholders such as tangential city staff not part of the core project team, non-governmental and community-based organizations, community members, private entities and groups or organizations representing the private sector/economic development/business community. The advisory body provides credibility and subject-matter expertise, can assist with public and political support, and can support the project team with volunteer time or funding.
- **Stakeholders.** These are community members who will need to be apprised of decisions as they are made, such as elected officials who may be approving or adopting the project and/or supporting implementation, city or town managers who may have holistic knowledge that can help ensure success in budgeting and implementing, and Planning Commission members who can approve or disapprove projects.

Community engagement, starting at the beginning of the project and utilized throughout the project at key points, has many benefits and many ways in which it helps contribute to successful implementation. From the outset, engagement can help critical stakeholders self-identify themselves as stakeholders and buy into the process and outcomes. Engaging throughout the project can help build alliances and constituencies, uniting stakeholders with similar interests and goals and facilitating and building capacity for implementation. Additionally, engaging elected officials and other key political players can help build political support for action, limiting potential roadblocks to implementation and policy adoption.

The process outlined here depends on a core planning team to guide the work, but the assessment and strategies should be reflective of the interests of any stakeholder who will ultimately be responsible for owning or implementing the action strategies.

We have provided a worksheet to help your internal team identify potential advisory body and external stakeholder members. Once you have convened your initial team, it is suggested to work through this worksheet as a group, using the suggested departments and agencies as a starting point. It would be helpful in this exercise to establish guidelines or criteria for identifying participants. Some suggested criteria include:

- The stakeholder owns an asset that we care about
- The stakeholder has the authority to regulate, make policy, or make decisions about an asset or asset class we care about
- The stakeholder will be affected by the assessment or potential strategies
- The stakeholder has the potential to either help or hinder the political process of assessing hazards and implementing strategies
- The stakeholder has specialized expertise that will help the city with technical questions
- The stakeholder may be able to provide funding or otherwise assist in implementing strategies
- The stakeholder represents typically underrepresented community members
- The stakeholder may be able to make critical connections to other relevant topic areas and/or projects that the project team may not be aware of

It's also extremely critical to involve stakeholders outside your city, especially those who have the power to influence decisions, who can provide funding or implementation assistance, or who will need to be the actual implementers of certain strategies (like other agencies who own critical assets). Resilience-building work can easily run into road blocks, especially for politically charged hazards like climate change-induced sea level rise. These road blocks may be related to agreements about the best course of action, in which case it's important to gain consensus amongst diverse stakeholders; may be due to lack of initiative or lack of staff capacity due to other, more pressing demands; or may be due to lack of control over implementation, as is the case when action needs to be done by private asset owners or when the

regulatory context makes implementation difficult or complex. These challenges can be lessened, sometimes significantly, if key stakeholders are identified early on and incorporated into the assessment and strategy development process at key points.

Scope and Organize the Project

Many people, especially those triggered to do hazard assessments through an unknown process, like a climate adaptation plan or LHMP, walk through the steps with the goal of meeting requirements, not the intention to catalyze local change and implementation-building. While there is nothing inherently wrong with meeting requirements, with a little extra understanding and effort, the time and energy invested into an assessment and strategy development process can yield far greater results than if it is done just to check off boxes.

A good place to start in developing a more holistic project is to simply ask a few questions before you begin that help you start with a meaningful outcome in mind: implementation of resilience-related actions. Identifying your triggers, lenses, and desired outcomes will help deliver a more robust assessment, implementable strategies, and internal capacity to help drive implementation of strategies. The triggers behind the process, and the lens through which resilience is defined, will determine which stakeholders should be at the table. Asking the right questions before going through the assessment steps will produce a radically better process and ensure that transparency and sustainability are considered throughout.

The following are some questions that can help you identify why you are going through this process to develop a more resilient community:

- What has triggered this process to begin? Is it an individual, or a regulation, or general pressure from the community, an agency, or neighboring jurisdictions?
- Who cares about this process and why? What are the motivations behind who cares and why they care?
- What is the “lens” through which you’re viewing this process? Is this rooted in climate change, sustainability, equity, etc? Are there multiple lenses?
- How will you measure a successful process?
- Is this project a stand-alone project or will you be conducting multiple small assessments with different stakeholders as part of a larger project?

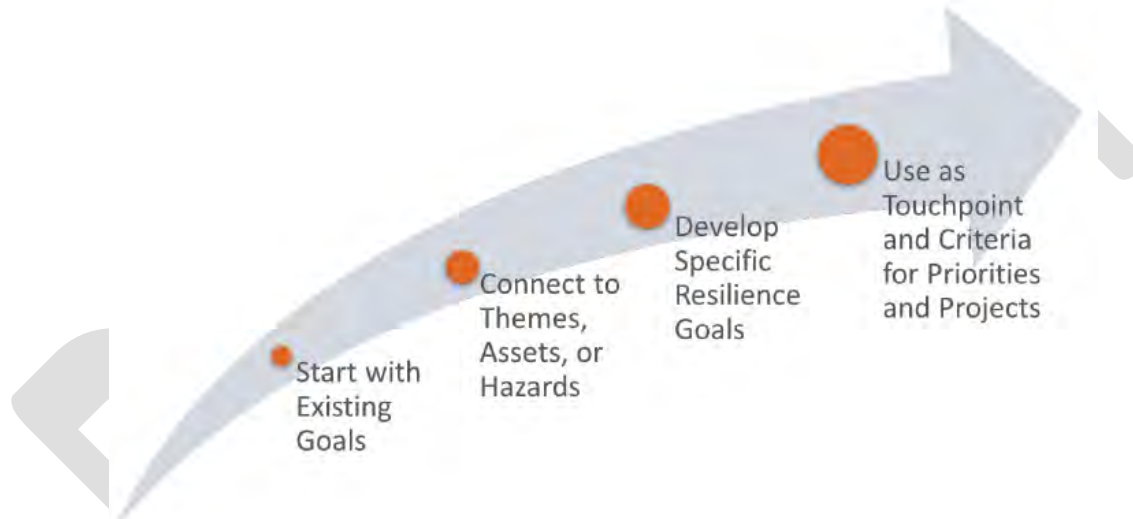
The answers to these questions can help you identify and agree upon the scope of the project, including the geographical area you will assess, your priorities and draft goals that will help shape the extent of the project, and your desired outcomes.

Establish Resilience Goals

Using goals to guide the risk assessment process can help explain what the community wants to achieve through the process. They are usually broad policy-type statements that represent a vision for reducing or avoiding losses from hazards. Goals will be heavily reflective of the “lens,” or “trigger,” that is guiding the assessment, and will also ideally reflect the perspectives and needs of the stakeholders involved. Identifying goals or visions can also help determine the scope and breadth of the assessment process, establishing a common “lens” and clarifying priorities, as well as guide the prioritization, selection, and implementation of resilience actions. While an assessment can be done without identifying goals, establishing a common vision for the outcome can:

- Build transparency into the process at the outset so that all participants and others with an interest in the process know what will be included and what will likely be a priority.
- Engage the project team early in deciding what shared outcomes they will work cooperatively to achieve, and provide an opportunity for them to ask their stakeholders for input and feedback on the project direction.
- Provide a foundation upon which future project decisions can be made and help in evaluating how well mitigation actions will help meet established community values and expectations.

The risk assessment process can be a critical tool for advancing existing community goals and may provide an opportunity to establish new goals focused on resilience. Leveraging existing community goals can help rally a broader base of support amongst stakeholders who have already bought into existing goals or priorities and who understand that resilience assessment and action can advance these goals. For example, community goals to increase quality of life or maintain affordability can be achieved, in part, by protecting housing from earthquakes and flooding, or by keeping small businesses intact after a natural disaster. New goals may also emerge that focus on specific vulnerabilities present in your jurisdiction and identified through your risk assessment, such as a large elderly population that should be considered prior to a hazard event and will likely need extra support after a disaster.



Selecting community goals early in the planning process helps scope the assessment and prioritize which community assets should be analyzed. Later in the assessment process, community goals help guide development of locally meaningful mitigation and adaptation actions. To develop locally relevant goals, start with existing community goals that can be found in General Plans, Specific Plans, Climate Mitigation Plans, Climate Adaptation Plans, Sustainability Plans, Local Hazard Mitigation Plans, or other local planning documents. Use these goals to help determine what assets, and what degree of detail for each asset, is needed to conduct a meaningful risk assessment. Be aware that the process of scoping and conducting a risk assessment may also reveal additional goals. Through a better understanding of your community's specific hazard and vulnerability profile, you may uncover issues that are not fully addressed in existing community goals.

There are many ways of identifying priorities and establishing goals. Start with what the community values, and then identify key elements that support those values. Goals may be driven by:

- Identifying physical areas to protect (i.e., new development along the shoreline)
- Asset classes to protect (i.e., hospitals)
- Social values (i.e., protecting parks because beauty and recreation are highly held values)
- Economic values (i.e., protecting major economic drivers like large businesses or business parks)
- Character, history, sense of place (i.e., protecting historic structures or neighborhoods)
- Preserve functions/activities (i.e., preserving the function of an airport or seaport)
- Protect specific communities (i.e., vulnerable populations)

Goals that guide resilience assessments should focus on the performance of assets, reduction of impacts from hazards, and expediting and protecting residents during recovery, not on emergency response.

Example: County of Santa Cruz LHMP Goals

General Plan Guiding Principles

The overall goals and guiding principles for the Land Use Element of the General Plan, which needed to be considered in our Local Hazard Mitigation Plan, are as follows:

- Population and Residential Growth Goals: To provide an organized and functional balance of urban, rural, and agricultural land use that maintains environmental quality, enhances economic vitality, protects the public health, safety and welfare, and preserves the quality of life in the unincorporated areas of the county.
- Rural Residential Siting and Density: To achieve patterns of rural residential development that are compatible with the physical limitations of the land, the natural and cultural resources of the County, the availability of public services, and protection of the natural environment.
- Village, Town, Community and Specific Plans: To continue using village, town, community and specific plans to provide a planning framework to guide future public and private improvements in town centers and other concentrated urban and rural areas, to provide a higher level of planning detail and involvement.

LHMP Goals

- To protect human life, private property and the environment.
- To minimize public expenses by preventing inappropriate use and development or location of public facilities and infrastructures in those areas, which by virtue of natural dynamic processes or proximity to other activities, present a potential threat to the public health, safety and general welfare.

Outputs

- ✓ Goals to guide the risk assessment and development of mitigation and adaptation actions
- ✓ A preliminary list of key project team members, advisory body members, and key stakeholders to contribute to the assessment and implementation process
- ✓ **Fulfillment of Element C3 in FEMA's Local Mitigation Plan Review Tool Checklist**

Tools + Worksheets to Support This Step

- ✓ **Identifying your Project Team, Advisory Body, and Key Stakeholders for Resilience-Building Worksheet**

This worksheet can be used by the project lead, along with whoever is initiating and driving the project, to identify key internal project team members. It can also be used by the project team, once convened, to identify key advisory body members and external stakeholders, and why they are important to include.

Resources

- ✓ [**ART Engagement Exercise: Functions & Values Mapping**](#)
This exercise, provided by our partners at Bay Conservation and Development Commission, can be used by your planning team early on to establish the team's priorities and goals through geographically identifying key functions and values that are critical for the economy, public health and safety, community, and environment in your project area. While this exercise, like all ART materials, are geared towards climate adaptation, the concepts can be used for any assessment to any hazard.
- ✓ [**ART Supply Good Planning Guide: Stakeholder Engagement**](#)
*Use this guide to develop an approach for engaging stakeholders as part of a working group to ensure that the necessary expertise, values, and viewpoints are included in all stages of your assessment and implementation process to build resilience. While this guide, like all ART materials, are geared towards **climate adaptation, the concepts can be used for any assessment to any hazard.***
- ✓ [**ART Supply Good Planning Guide: Transparent Decision-Making**](#)
This guide provides guidance for using transparent decision-making in a risk assessment and implementation process that makes sure that all aspects of sustainability are considered, that the process and outcomes are well-communicated, balanced throughout the process, and build a strong and actionable case for adaptation. While this guide, like all ART materials, are geared towards climate adaptation, the concepts can be used for any assessment to any hazard.

Identifying your Project Team, Advisory Body, and Key Stakeholders for Resilience-Building

Purpose

Identify who should participate in your project that will lead to an actionable outcome that aligns with your goals and facilitates relationship and capacity building. The stakeholders identified should also represent a variety of voices from those that may be impacted by the project, can help fund or implement the project, or have the authority to make decisions about the project area.

The worksheet identifies three types of project participants: the core internal project team, who leads the project, an advisory body comprised of key stakeholders who will actively participate in the project, and a larger stakeholder group who will need to be apprised of decisions as they are made.

Approach

Prior to kicking off the project, the project lead should work through this worksheet in conjunction with their manager, or another city authority who will be overseeing or approving the project. The worksheet can be used to establish the internal project team first, and the rest can be worked through by the whole team once it has been convened.

Outcomes

1. An initial, comprehensive list of key project participants. This list is adaptable and may change over the course of the project as more information is gathered, but should represent the best understanding of who will be affected by, or have opinions about, the project.
2. An understanding of potential road blocks or allies within the community who can either slow down or enhance the development of the assessment and/or the implementation of resilience strategies.
3. An initial group-building exercise to bring the project team together and begin working as a team.

Agency or Entity	Contact	Reason for including this stakeholder
Internal Project Team		
Comprehensive Planning		
Land Use		
Transportation		
Public Facilities		
Local Emergency Planning		
Advisory Body		
<i>Local Agencies</i>		
Building Code Enforcement		
Emergency Management		
Fire Departments/Districts		
Floodplain Administration		
Geographic Information Systems		
Parks and Recreation		
Public Information Office		
Public Works		
Natural and Cultural Resources		
Stormwater Management		
Transportation (roads/bridges)		
Finance		
Economic Development		
Housing		
Health and Social Services		
<i>Special Districts and Authorities</i>		
Utility Districts		
Parks Districts		

Public and private schools		
Public and private hospitals		
Non-Governmental Organizations		
Community-based organizations		
Private sector businesses, economic development entities, or business groups		
Private utilities		
Public-private partnerships or collaboratives		
Faith-based organizations		
State and Federal Partners		
State Office of Emergency Services		
Federal Emergency Management Agency		
Stakeholders		
City Council/Board of Commissioners		
Planning Commission		
Planning/Community Development		
General Public		
Other local, regional, or state elected officials		

Adapted from FEMA Worksheet 2.1, Mitigation Planning Team Worksheet

Step 2: Describe Hazards



Key Steps:

- ✓ Identify and describe current sudden shocks and slow-moving hazards in your community
- ✓ Identify and describe how both sudden shock and slow-moving hazards may change in the future, as well as new hazards that may appear and/or become exacerbated in the future
- ✓ Document past disasters
- ✓ Determine which hazards will impact your community the most, now and in the future
- ✓ Develop hazard impact statements that summarize the hazards in your community

Before you develop your risk assessment, you must identify and describe the hazards that are present within your community. An important part of this step is identifying which hazards pose the greatest threat to your community, either through the extent of the hazard, the severity of the hazard, or the consequences of the hazard.

Different communities are at risk from different hazards, resulting in unique risk profiles or fingerprints. One community may be located in a very high fire hazard severity zone, while another may have low wildfire risk but large flooding exposure. Fortunately, there are a number of resources that Bay Area communities can use to map and describe the natural hazards that will affect them. For example, in California the State Hazard Mitigation Plan and MyPlan website describes all of the natural hazards that can impact the State of California. Resources such as these should be used in combination with local data and knowledge, such as local liquefaction assessments and knowledge of past disasters, to characterize the hazards your community may face.

The following describes a stepwise process that will help you describe your hazards as part of your risk assessment



Identify past hazard patterns

Patterns of past disasters can help your community understand where disasters may reoccur and can help to estimate the likelihood of a disaster in the future. This is especially true for disasters such as earthquakes or flooding. Understanding past disasters can also help you estimate the magnitude and scale of impact if the disaster reoccurs.

Your state OES and FEMA should be able to provide you with a list of all state and federally declared disasters. You will also need to include information about local disasters that may not have been state or federally declared. When describing past disasters, include as much information as possible, including the extent and severity of the disaster as well as the impacts (i.e. “this portion of the city has had repeated flooding even in moderate rain events,” or “a fire in 2012 destroyed a transmission line interrupting power to 3,000 residents for 36 hours”).

If you are meeting LHMP requirements, you must also list National Flood Insurance Program (NFIP) insured structures in your community that have suffered repetitive damaged due to flooding (see box to the right)². To obtain this list, you will need to go through the following steps:

1. Obtain a sample request letter from your local NFIP Bureau & Statistical Agent
2. Adapt the sample letter with your jurisdiction’s information, letterhead, and signature from your department head
3. Mail the completed letter to your NFIP Bureau & Statistical Agent
4. The Bureau will send you a list of repetitive loss properties including property address, claim amounts, and date of claim for your jurisdiction
5. Use this information to map repetitive loss properties in relation to the floodplain and to aggregate loss information for your plan (though individual addresses and claim amounts for a specific property are private information, so do not include this in your plan)

Repetitive and Severe Loss Properties

Repetitive and severe loss properties not only put a cost burden on the National Flood Insurance Program, they indicate areas where flooding is repetitive and severe. These properties could help pinpoint areas for changed land use or zoning to avoid similar losses in the future.

Repetitive loss property: an NFIP insured structure that has had at least two paid flood losses of more than \$1,000 each in any ten-year period since 1978.

Severe repetitive loss property: any NFIP insured single or multifamily residential properties that:

1. Have incurred flood-related damage for which 4 or more separate claims payments have been made, with the amount of each claim exceeding \$5,000 and the cumulative amount exceeding \$20,000; or
2. For which at least 2 separate claims payments have been made under such coverage, with the cumulative amount exceeding the market value of the building.
3. In both instances, at least two of the claims must be within 10 years of each other (claims made within 10 days of each other count as one claim).

² Sources: NFIP Flood Insurance Manual, FEMA. Revised October, 2012
44 CFR §79.2(g)

Describe and map current risks

Current hazards may be indicated by hazard map layers depicting current flooding, wildfire risk areas, landslide risk areas, or earthquake ground shaking or liquefaction risk. These maps depict risk by compiling currently known information about hazard patterns and sources and usually include a level of probability for the risk. These layers are often based on past risk patterns or vulnerability factors such as loose soils (liquefaction), steep slopes (landslide), proximity to known faults (ground shaking), or areas with known fire fuels (fire). These maps represent hazards that could occur today, and an approximation of the potential degree of severity.

Explore the current hazards that are of greatest concern by downloading any available hazards data and by reviewing local hazard maps your city, county, or district may keep. Using these resources, develop local-scale maps of your community, including the location, expected frequency, and severity of the hazard, such as the strength (magnitude) of an earthquake or the geographic extent or duration of flooding.

Describe and map projected future hazards

Past and current disasters may not accurately predict how disasters will impact your community in the future. Changes to land use and increases in population can significantly change the location, frequency, severity, and consequences of a disaster. Additionally, a changing climate could intensify or exacerbate disasters in areas already at risk, expand hazards into areas where they have not occurred in the past, or create new risks that your community may be unfamiliar with. For example, as the climate changes and sea level rises, flooding will become more frequent or severe and some areas that currently experience temporary flooding may become permanently inundated.

Develop hazard impact statements

In addition to mapping your hazards to explore how they will affect your community spatially, written descriptions that describe the extent, probability, and expected severity of the hazard. This can help succinctly summarize hot spots or areas with multiple hazards that should receive special attention in assessment or strategy development. These descriptions are often called hazard impact statements.

As an example, your hazard statement might read: "The western portion of the city has very high liquefaction susceptibility while the remainder of the city has low likelihood of liquefaction. Liquefaction may occur in earthquakes with very high levels of shaking, including one from the Hayward fault, which runs adjacent to the city and has a high probability of occurring in the next thirty years."

The following paragraphs describe some of the most common impacts from specific hazard types. This language may trigger you to think about if these impacts will occur in your community, and if so, where they will occur, on what timeline, and to what degree.

Current and Future Flooding

Flooding

Flooding in riverine and coastal systems can disrupt access to transportation and transit systems, power and other utilities, goods and services, jobs, and emergency response and recovery resources.

Shoreline erosion and overtopping

High water levels can cause changes in tidal and wave energy, leading to increased shoreline erosion and the potential for shoreline protection, such as levees, berms and revetments to be damaged or fail. There is also the

potential that as sea levels rise, shoreline protection will be overtopped during storm events when there are extreme tides levels and wind-driven waves, flooding inland areas that are currently protected.

Other potential consequences of inundation, shoreline erosion and overtopping include:

- Damage to shoreline protection structures creating the need for more frequent replacement, repair and/or maintenance
- Disproportionate burdens on community members with certain characteristics (e.g., low income renters and homeowners) caused by repair, retrofits or relocation, and higher insurance, goods, and services costs
- Loss of tidal wetlands that cannot keep up or migrate inland and reduced ecosystem service benefits (water quality, habitat, flood risk reduction)

More frequent, extensive, longer-duration flooding in the future

Higher sea levels especially during storm can lead to more frequent flooding in coastal flood-prone areas, including tidal creeks and flood channels, and flooding of larger areas for longer periods of time. Along with many other potential impacts this may result in the increased mobilization of pollutants if contaminated lands such as closed landfills are subjected to prolonged inundation.

Other potential consequences of flooding include:

- Increased cost to repair and maintain flood protection channels and storm drains that are overwhelmed during flood events
- Overwhelmed wastewater and stormwater treatment systems harming water quality, and environmental and public health
- Changes to sediment transport and deposition that affect the ability of tidal wetlands to keep up with sea level rise
- Lost wages and lower productivity during recovery, and disproportionate burden on individuals, households and neighborhoods with certain characteristics (e.g., income, housing tenure, age, ethnicity).

Elevated groundwater and increased salinity intrusion

As the sea level rises, groundwater levels and salinity intrusion will increase, affecting water supplies along the shoreline, damaging below or at-grade infrastructure, requiring additional pumping and costly maintenance and repairs of stormwater and flood control facilities, and increasing the risk of earthquake-induced liquefaction.

Other potential consequences of elevated groundwater and increased salinity intrusion include:

- Damage to below grade living spaces, finished basements, and below-grade electrical or mechanical equipment
- Mobilization of contaminants at contaminated sites, including those that have already been remediated or closed.
- Saltwater intrusion into fresh water coastal aquifer supplies

Permanent inundation due to sea level rise

Sea level rise will cause areas not currently exposed to the tide to be inundated, resulting in the need to either protect or move people and infrastructure, and the loss of trails, beaches, vistas, and other shoreline recreation areas.

Earthquake Impacts

Ground shaking

Ground shaking occurs in all earthquakes. In large magnitude earthquakes, a larger area of ground shakes, and it shakes harder and longer, than in small magnitude earthquakes. Ground shaking may cause wood-frame buildings to shift off of their foundations if not bolted. Shaking may damage older, non-retrofitted air control and terminal facilities at the airport, and will likely break underground pipes and damage overhead power lines. Ground cracks may appear, causing damage to airport runways, roads, or buried utilities.

Liquefaction

Saturated soils that are loose or sandy will exhibit the characteristics of a liquid when shaken long and hard enough. Liquefaction may result in ground sinking or pulling apart, ground displacement, or ground failure such as lateral spreads and sand boils, or sand “volcanoes.” Liquefaction is a significant threat for underground pipelines, airport runways, and road or highway surfaces, as it causes buckling of these features due to ground shifting. Liquefaction may also cause building damage due to foundation movement or cracking when the underlying soils shift, or when there is a loss of bearing capacity for foundation elements. Liquefaction can cause levee damage and failure, increasing the risk of flooding in low-lying areas.

Earthquake induced landslide

Ground shaking can lead to ground failure on slopes, triggering earthquake-induced landslides. Typically an earthquake-induced landslide occurs when seismic energy at the top of a slope gets concentrated and breaks off shallow portions of rock. Landslides tend to occur in weak soil and rock on sloping terrain. In the Loma Prieta earthquake, earthquake-induced landslides disrupted traffic for a month along Highway 17 in the Santa Cruz Mountains.

Fire Following Earthquake

Earthquakes are often responsible for igniting fires that can contribute to a considerable share of overall damage. Fires can start from a variety of sources: appliances with natural gas pilot lights may tip, damaged electrical equipment may spark, and gas line connections may break. Where building damage or collapse “seed” fires can impact undamaged neighboring structures. Areas of liquefaction are more vulnerable to fire because of the greater potential for underground gas mains to break due to the ground displacements, and because the water lines in the area may also be damaged – preventing the ability to fight a fire with regular water resources. Areas that are largely wood frame or shingle roof may be less prone to earthquake damage, but are a heightened risk for the spread of fires. There is added concern in areas with hazardous materials with the potential for explosion, or with the potential to produce toxic smoke. Industrial facilities and labs are a high concern because of the hazardous and flammable materials they store at their facilities.

Tsunamis & Seiches

Large underwater displacements from major underwater earthquake fault ruptures or landslides can lead to ocean waves called “tsunamis.” Since tsunamis have high velocities, the damage from a particular level of inundation is far greater than in a normal flood event. Similarly, water sloshing in lakes during an earthquake, called “seiche,” is also capable of producing damage. Tsunami waves generated at far-off sites can travel across the ocean and can reach the California coast with several hours of warning time, while local tsunamis generated from offshore strike-slip faults would reach the coast with little warning time.

Prioritize the hazards that are most important to your community

For your risk assessment, you will want to prioritize the hazards that could have the most impact on your community. This can help guide you to which assets will need the most robust assessment (based on exposure to prioritized hazards), can help you understand the overlap between high priority hazards and vulnerable populations, or can help you engage certain stakeholders. You can qualitatively estimate which hazards will have the most impact by considering the extent of exposure (this can be measured by the number of people exposed, number of buildings exposed, or the value of assets exposed), the potential impacts of a hazard, and the likelihood of the hazard occurring. FEMA provides a worksheet for summarizing and prioritizing hazards in their *Local Mitigation Planning Handbook* (**Worksheet 5.1**, Hazards Summary Worksheet).

Once you have prioritized hazards it is a good time to consider if you need to refine or reprioritized the goals you previously outlined. In addition, now that you know where hazards may affect your community you can use that information to guide the remainder of the risk assessment, including which assets should be considered and what information needs to be gathered.

Outputs

- ✓ Prioritized hazards, hazard scenarios, and maps to be used in the risk assessment
- ✓ **Fulfillment of Element B1 in FEMA's Local Mitigation Plan Review Tool Checklist**
- ✓ **Fulfillment of Element B2 in FEMA's Local Mitigation Plan Review Tool Checklist**
- ✓ **Fulfillment of Element B4 in FEMA's Local Mitigation Plan Review Tool Checklist**

Tools + Worksheets to Support This Step

- ✓ [FEMA Worksheet 5.1 Hazards Summary Worksheet](#)
Use this worksheet, or adapt to meet your own needs, to summarize hazard information and prioritize hazards based on the geographic area affected, the maximum probable magnitude or strength of the hazard, and the probability of the hazard in the future to produce an overall significance rating.

Resources

- ✓ [ABAG Risk Landscapes document](#)
ABAG has developed a comprehensive document that describes the hazards the region faces as well as key asset classes and how they are vulnerable to hazards. If you are in the Bay Area, you can utilize the language in Risk Landscapes to provide regional context to your hazard descriptions. However, jurisdictions will still need to describe localized hazards. If you are not in the Bay Area, you may still find useful generalized language or concepts about hazards and asset classes.
- ✓ [California State Hazard Mitigation Plan](#)
The California State Hazard Mitigation Plan offers a statewide perspective on hazards and asset classes at the state scale. This document may be helpful if you are outside of the Bay Area and need generalized language to describe hazards. However, jurisdictions will still need to describe localized hazards. If you are not in California, you may still find useful generalized language or concepts about hazards and asset classes.
- ✓ [ABAG Open Data webpage](#)
ABAG has gathered 40+ data layers from various partners that illustrate many of the hazards the Bay Area faces. These data layers can be downloaded from the website for use in identifying which hazards are applicable in your community. Some of the data is collected and generated by ABAG; however, most of the data is generated by other agencies and curated here. In some instances, these data sets are unchanged from their original source; in other cases, ABAG has translated the data for use by cities and counties.
- ✓ [CALEMA's MyPlan website](#)
This website, developed and hosted by the California Office of Emergency Services, is an online mapping tool designed to explore hazards in your area. This can be done by entering a location into the map and exploring which hazards are nearby. This tool can be used to develop exposure maps for generalized areas. This tool can be particularly helpful outside of the Bay Area where ABAG has not collected hazard layers via the Open Data website.
- ✓ [ART Supply How-to Guide: Communicating About Climate Impacts](#)
This resource can help your team develop hazard impact statements that communicate the impacts being addressed in your project to your advisory body and other stakeholders. While this guide, like all ART materials, are geared towards climate adaptation, the concepts can be used for any assessment to any hazard.

Step 3: Determine Your Assessment Methods and Select Assets



Key Steps:

- ✓ Determine your approach to understanding exposure, vulnerability and consequences
- ✓ Select the assets you will analyze and consider if they will be assessed as a group or individually

Hazards become meaningful only when they interact with assets within your community, including people, structures, facilities, and services. In this step you will get prepared to conduct the assessment by identifying the community assets to include and determining the assessment method you will use for your risk assessment. The method you choose for assessment helps you decide what information you need to determine the ability of the assets you're including to withstand the hazards as well as the consequences to the community if assets are damaged in a disaster.

Determine your approach

Before you conduct your risk assessment you need to decide how much information you are going to collect, both on your hazards and on individual assets, representative assets, and asset classes to be included in your assessment. The depth and scope of a risk assessment can vary significantly, and will depend on your community goals, the availability of data and information, resources to conduct the assessment, and individual interests of the jurisdiction and its residents.

The simplest assessment includes an exposure analysis, which simply maps hazards on top of locations of key assets, to identify the assets likely to experience a hazard. This approach is most appropriate if there are a large number of assets, for example single-family residences, or for privately-owned facilities with limited available information (e.g., power substations).

However, more detailed information on assets can help you better understand the unique vulnerabilities and consequences for key assets and provides a better platform for identifying mitigation and adaptation strategies to address hazards. Because it is important to understand what will happen to assets and the people and services that rely on them if they are exposed to a hazard, it is strongly recommended to go beyond the exposure analysis and collect vulnerability information on assets. This can be achieved through answering a series of assessment questions about the asset.

Risk assessments can be expanded or focused based on three different elements:

1. The number of asset classes you include in your assessment and the number of representative assets or individual assets you assess within each class. At a minimum, you should assess your emergency response facilities and strongly consider assessing your public buildings. A more comprehensive assessment may include residential units, infrastructure systems, and/or recreational spaces.

2. Whether your assessment will evaluate assets as a class, as representative assets, or as individual assets. The most comprehensive approach would be to evaluate all assets individually, but this will likely require more resources than are available. This process can be simplified by choosing a representative asset to assess that may be similar to many others, house important services, or serve a large number of residents. If assessing a representative asset is not possible, asset classes can be assessed with far fewer resources, but can still provide information useful for your community.
3. The amount of information you are able to collect on each asset. At a minimum, you need the location and use for each asset that you include in your assessment, but more information can make your assessment much more meaningful. Including more information about how the asset is vulnerable to a hazard, or what the consequences are if it is damaged can transform the assessment into something that tells a story and sets up targeted, meaningful actions.

There are many factors that go into answering the questions implied in the three elements above. The most basic limiting factor is the amount of time and resources you have, or can make available, for the assessment. Data can also be a critical factor, especially data at the right scale. If you are unable to get meaningful data on hazards or assets at the scale you need to do a meaningful assessment, or the amount of resources it would take to get meaningful data is too great, your assessment will be scoped very differently than if you have ready access to robust, accurate, and plentiful data. Another significant factor in scoping your assessment is connected to your desired outcomes and goals – what do you hope an assessment will get you? If your goals are very complex or specific, you may need a more detailed or focused assessment, but if you are using this assessment as an exploratory first step, a high-level assessment may provide all the information you need to move forward.

Diving in Deeper: Profile Sheets and Assessment Questions

To go beyond an exposure analysis, you'll be looking at asset classes, representative assets, and individual assets. As you go deeper into your assessment, you'll be able to get more detailed information about vulnerabilities. Assessing an asset class as a whole allows you to identify broad vulnerability factors that tell a high-level story about the scale and nature of the asset classes' vulnerabilities, as well as about the consequences of failure of the asset class as a system. It can be helpful to organize findings for an asset class as a whole through basic types of vulnerabilities and consequence lenses. ART has developed templates for asset class profile sheets that can help you identify the level of detail achievable through assessment of asset classes.

For individual and representative assets, we have compiled a list of assessment questions that can help simplify and facilitate the collection of information, both qualitative and quantitative, about asset conditions and characteristics that can either increase or reduce vulnerability and consequences for individual or representative assets. The assessment questions here seek to uncover physical, governance, and functional factors that may indicate increased vulnerability, as well as who and what are dependent upon the asset to determine potential consequences of failure. There is a similar set of assessment questions for asset classes.

The questions in these guides are based on the Adapting to Rising Tides (ART) Program's robust list of assessment questions that provide a framework for collecting the data and information that lead directly to the identification of vulnerabilities and consequences. The ART assessment questions, which have been applied and refined based on a number of on-the-ground assessments, can be used for a wide variety of sectors at the individual, representative or asset class scale. Answers to the questions help build an understanding of the underlying causes and components of vulnerability and the potential consequences of those vulnerabilities on society and equity, environment and economy. You can also adapt these questions based on your needs, goals, hazards, and access to information.

A reduced list of assessment questions based on the full list of ART assessment questions is included in this guide. These represent the short-list of questions that if answered, will provide a fairly detailed understanding of vulnerability and consequences. The full set of questions is available here: http://resilience.abag.ca.gov/wp-content/documents/mitigation_adaptation/ART%20Assessment%20Questions%20Supplement%20V1.xlsx.

Select your assets

In deciding which assets to include in your assessment, you will need to determine if you will be assessing individual assets, representative assets for an asset class, or the asset class as a whole. For example, a community can choose to evaluate transportation infrastructure as an asset class or can assess individual transportation assets, such as bus yards, train stations, bridges, etc. You can begin by first identifying which asset classes are applicable and important to your assessment, and then decide if you need to do a deeper analysis for each asset class. Some questions that may help you identify important assets include:

- What critical assets are present in your community?
- What assets would have significant consequences if they were damaged?
- How do your goals relate to specific assets or asset classes?
- What assets are important to your stakeholders?

In general, we group assets into the following classes:

- People
- Buildings (publicly-owned or privately owned, you may also want to break out different building types like commercial, industrial, or residential)
- Critical Response Facilities
- Community Services
- Utilities Infrastructure
- Transportation Infrastructure
- Communication Infrastructure
- Recreation, Open Space, and Working Lands
- Natural Resources
- Hazardous Materials Sites and Contaminated Lands

More detail about each asset class, including the specific assets included and where to find information on them, is included in the **Identifying Community Assets Worksheet**.

Scope Matters

The type of assets to be included in your assessment should be broad enough to ensure that the consequences of hazards on people where they live, work, access key services and conduct other day-to-day activities will be fully considered. Focusing on a single asset class can provide a deep understanding of vulnerability and can lead to implementation of specific actions, but may overlook vulnerabilities due to physical or organizational relationships among assets or agencies. For example, publicly-owned buildings and critical response facilities rely on a variety of other assets to maintain function such as power, road access, and wastewater services. Starting with a broader assessment and focusing in on individual assets as necessary based on your community goals, hazards identified and the potential consequences of the hazards is a good balance between broad and detailed approaches.

Risk assessments that include multiple asset classes can reveal how seemingly dissimilar assets, such as nursing homes, single access roadways, trails used by those with limited mobility, and tidal marshes that support threatened or endangered species, have similar vulnerabilities due to their unique function. Multi-class assessments can also identify complexities in regulatory and other decision-making processes that cut across asset categories; for example, actions to address the vulnerability of a roadway that crosses a tidal creek can have similar regulatory challenges as improving the utility or rail crossings.

If you are completing an assessment for a LHMP in California, AB 2140 (2006) requires that safety elements contain an earthquake performance evaluation of public facilities that provide essential services, shelter, and critical government functions, as well as an inventory of private facilities that are potentially hazardous, including, but not limited to, multi-unit, soft story, concrete tilt-up, and concrete frame buildings. To meet these requirements, be sure that you prioritize assessment of these asset classes. To comply with AB 2140 requires not just an exposure analysis, but an assessment of the actual characteristics of the buildings within that asset class.

Scale Matters

Once you have identified critical asset classes for your assessment, you should determine if the class contains assets that should be evaluated individually. Some assets should be evaluated individually while others can be evaluated as a class. Scaling down to individual assets can help identify specific vulnerabilities that are often caused by particular physical and functional characteristics. An assessment of individual assets can identify specific components, critical functions, or management challenges that will increase vulnerability.

Individual assessments should be conducted for unique, critically important or high consequences assets. Individual assessments do require a greater level of effort and more detailed information than may be available. Asset class assessments should be conducted when there are many similar assets and can be supplemented by evaluating representative assets (see sidebar) that will provide similar benefits as assessing individual assets. The **Risk Assessment Scoping Worksheet** (attached) provides guidance for selecting asset categories and for determining if they are best assessed individually or as a group.

What if You're Not Sure?

It can be confusing to know what assets you should assess at what scale. You may need to do an exploratory assessment of an asset class to gain some basic information about the class to determine if there's a need to explore individual assets, or representative

Representative vs. Individual Asset Assessments

Representative Assets

Answering the assessment questions for representative assets works well for asset categories that have numerous, similar assets. For example, contaminated sites may be very similar in their vulnerability to specific hazards, therefore rather than assessing each site individually, answering the questions for a few examples that represent a cross-section of the types of contaminated sites can reveal the range of vulnerabilities and consequences that are likely.

Individual assets

Unique assets for which the findings from the assessment questions are unlikely to be similar between assets need to be assessed individually. Examples of these types of assets include wastewater treatment plants. Additionally, if there are only a small number of assets in the asset class the assessment questions can be answered for each.

assets, more closely. This can be because of physical vulnerabilities, like greater or more urgent exposure to hazards than anticipated, or because you uncover some complex governance issues, like ownership or regulations, that require more attention. You may also start down an assessment path and find that it's not uncovering any meaningful information, for example if many individual assets are similar and show similar vulnerabilities, it may not make sense to do an assessment of each individual asset but instead use one assessment as a representative for that type of asset.

When you plan your assessment methods, be sure to leave some room for adjustments as findings emerge. You may start to see a storyline emerge, and it makes sense to tell the story of risk through a certain lens, such as within a specific geographic area, or a critical asset class. Don't worry if you're still uncertain about exactly what assets you will assess – your community's storyline will come out, and it's your job to listen to it and guide your assessment to help it be told.

With an understanding of your hazards and the assets you would like to assess, you can map out your approach to your risk assessment using the **Risk Assessment Scoping Worksheet** before you begin to work through your assessment.

Asset Interdependencies

An ABAG study released in 2015 ([Cascading Failures: Earthquake Threats to Transportation and Utilities](#)) explored the concept of interdependencies in utility systems. The study found strong dependencies on the fuel and electric power systems and regional and local roads, meaning that if these systems failed in a disaster, many other systems, like water, wastewater, and telecom, would have difficulty or be unable to function. Failures due to these dependencies would likely lead to significant and widespread consequences. Considering the dependencies and interdependencies of asset classes can help determine priorities in assessing asset vulnerabilities.

Outputs

- ✓ Assessment methodology and approach
- ✓ Asset classes and specific assets to be assessed

Tools + Worksheets to Support This Step

- ✓ **Community Asset Identification Worksheet**
Use this worksheet with your project team to develop a general sense of the types of assets your community has and where you might find data on these assets. This worksheet can help guide your risk assessment scope and allow you to focus your resources in areas with the most impact, as well as identify data gaps.
- ✓ **Risk Assessment Scoping Worksheet**
Use this scoping worksheet to help you plan the assessment your community will undertake. To help decide which assets to evaluate and if they will be evaluated as individual assets, as an entire asset class, or if representative assets will be selected, consider both your community's goals and if data and information is readily available to begin answering the assessment questions.

Resources

- ✓ [ART Scope and Scale Issue Paper](#)
This issue paper provides additional thinking about two fundamental questions about the appropriate scope and scale of resilience assessments: how does scope and scale affect assessment and planning outcomes? And how can planning for hazards identify and communicate issues that cut across different asset and geographic scales? If you are still unsure of how to scope your assessment after reading this chapter, this paper may give you more food for thought. While this paper, like all ART materials, are geared towards climate adaptation, the concepts can be used for any assessment to any hazard.

Community Asset Data Identification Worksheet

Purpose

Having a general sense of the types of assets you have in your community can help to guide your risk assessment and allow you to focus your resources in areas with the most impact. Gathering information on your assets now can also help you identify where data gaps exist.

Approach

Work through this worksheet with your project team, or have a team member tasked with data collection to work through the worksheet and review with the team. For the asset class column, check off the boxes of the asset classes and sub-classes that you'd like to include in your assessment. In the Data Sources column, check off sources that are applicable to your community that might contain the data you need to accurately assess the asset classes you checked off.

Outcomes

After working through this worksheet and reviewing with your team, you will have an idea of the scope of your assessment (which asset classes you think you will include) as well as where to find the data and if data gaps exist. In some cases, you may not have data for asset classes you'd like to include. If this is the case, you must decide whether or not to include the asset class; if so, what kind of resources will it take to find new sources of data?

Asset Class: People	Data Sources
<input type="checkbox"/> Total population – current and future	<input type="checkbox"/> U.S. Census <input type="checkbox"/> American Community Survey <input type="checkbox"/> Plan Bay Area (ABAG) <input type="checkbox"/> State of the Region (ABAG) <input type="checkbox"/> Priority Development Areas <input type="checkbox"/> Regional Housing Need Allocation (ABAG) <input type="checkbox"/> County Quick Facts <input type="checkbox"/> Local General Plan or Specific Plans <input type="checkbox"/> Local Housing Element <input type="checkbox"/> Local Zoning Code
Population with access or functional needs, including: <ul style="list-style-type: none"> <input type="checkbox"/> Age dependent, children and seniors <input type="checkbox"/> Medically or mobility dependent <input type="checkbox"/> Language constraints <input type="checkbox"/> Low income <input type="checkbox"/> Lack of education <input type="checkbox"/> Culture or ethnicity <input type="checkbox"/> Cost burdened (housing and/or transportation) <input type="checkbox"/> Transit dependent (no car) <input type="checkbox"/> Housing tenure (renters) 	<input type="checkbox"/> U.S. Census <input type="checkbox"/> American Community Survey <input type="checkbox"/> County Health Department Status Reports <input type="checkbox"/> Bay Area Regional Health Inequities Initiative <input type="checkbox"/> East Bay Indicators (East Bay Economic Development Alliance) <input type="checkbox"/> Local General Plan or Specific Plans <input type="checkbox"/> Local studies <input type="checkbox"/> Local Housing Element <input type="checkbox"/> Local Hazard Mitigation Plan <input type="checkbox"/> Nonprofit or Community-Based Organizations

Asset Class: Building Stock	Data Sources
<input type="checkbox"/> Publically-owned buildings	<input type="checkbox"/> County Tax Assessor Parcel Data
Privately-owned buildings: <ul style="list-style-type: none"> <input type="checkbox"/> Residential buildings, e.g., single and multi-family, mobile homes, senior and dependent housing <input type="checkbox"/> Nonresidential buildings, e.g., industrial, commercial or institutional structures 	<input type="checkbox"/> U.S. Census <input type="checkbox"/> American Community Survey <input type="checkbox"/> County Tax Assessor Parcel Data <input type="checkbox"/> Local General Plan or Specific Plans <input type="checkbox"/> Local Housing Element <input type="checkbox"/> Local Zoning Code <input type="checkbox"/> Google Earth/Maps
<input type="checkbox"/> Future buildings, growth areas and infrastructure	<input type="checkbox"/> Plan Bay Area (ABAG) <input type="checkbox"/> Priority Development Areas <input type="checkbox"/> Regional Housing Need Allocation (ABAG) <input type="checkbox"/> Capital Plans <input type="checkbox"/> City and County Budgets <input type="checkbox"/> Local General Plan or Specific Plans <input type="checkbox"/> Local Housing Element <input type="checkbox"/> Local Zoning Code <input type="checkbox"/> Local Growth Boundaries or growth phasing ordinances

Asset: Critical Response Facilities	Data Source:
<input type="checkbox"/> Public health infrastructure, e.g., hospitals and medical facilities	<input type="checkbox"/> County Tax Assessor Parcel Data <input type="checkbox"/> Local Safety Element <input type="checkbox"/> Local Emergency Operations Plans <input type="checkbox"/> Local Area Formation Commission Municipal Service Reviews
<input type="checkbox"/> Police stations	<input type="checkbox"/> County Tax Assessor Parcel Data

<input type="checkbox"/> Fire stations	<input type="checkbox"/> County Tax Assessor Parcel Data
<input type="checkbox"/> Public schools	<input type="checkbox"/> County Tax Assessor Parcel Data

Asset: Community Services	Data Sources
<input type="checkbox"/> Community facilities, e.g., day cares, food banks, senior centers, grocery stores	<input type="checkbox"/> County Tax Assessor Parcel Data <input type="checkbox"/> City licensing and regulating authorities <input type="checkbox"/> Local General and Specific Plans <input type="checkbox"/> Local Zoning <input type="checkbox"/> Google
<input type="checkbox"/> Places of worship	(Same as above)
<input type="checkbox"/> Education and research institutions, e.g., schools, colleges, universities	(Same as above)
<input type="checkbox"/> Waste transfer stations	<input type="checkbox"/> CalRecycle <input type="checkbox"/> County Environmental Health Departments
<input type="checkbox"/> Household hazardous waste collection sites	<input type="checkbox"/> CalRecycle <input type="checkbox"/> County Environmental Health Departments

Asset: Utilities Infrastructure	Data Sources
<input type="checkbox"/> Water systems, including reservoirs and dams	<input type="checkbox"/> Urban Water Management Plans <input type="checkbox"/> Bay Area Integrated Regional Management Plan
<input type="checkbox"/> Wastewater, e.g., industrial and sanitary sewer systems)	<input type="checkbox"/> Urban Water Management Plans <input type="checkbox"/> Bay Area Integrated Regional Management Plan
<input type="checkbox"/> Flood control infrastructure	<input type="checkbox"/> County Tax Assessor Parcel Data <input type="checkbox"/> City/county public works or flood control district <input type="checkbox"/> Local General Plan or Specific Plans <input type="checkbox"/> Google
<input type="checkbox"/> Stormwater (storm drain) system	<input type="checkbox"/> City/county public works <input type="checkbox"/> Special studies within cities and counties <input type="checkbox"/> Local Agency Formation Commission
<input type="checkbox"/> Power utilities, e.g., electricity generation, distribution, transmission systems	<input type="checkbox"/> California Energy Commission <input type="checkbox"/> California Public Utilities Commission <input type="checkbox"/> PG&E
<input type="checkbox"/> Pipelines, e.g., fuel and natural gas	<input type="checkbox"/> National Pipeline Mapping System <input type="checkbox"/> California Energy Commission <input type="checkbox"/> Kinder Morgan
<input type="checkbox"/> Oil refineries	<input type="checkbox"/> EPA <input type="checkbox"/> Air Resources Board <input type="checkbox"/> State Employment Statistics <input type="checkbox"/> County and City General Plans

Asset: Transportation Infrastructure	Data Sources
<input type="checkbox"/> Local streets and roads	<input type="checkbox"/> Metropolitan Transportation Commission 2011TeleAtlas
<input type="checkbox"/> Federal and state highways	<input type="checkbox"/> Metropolitan Transportation Commission 2011TeleAtlas <input type="checkbox"/> CA Department of Transportation
<input type="checkbox"/> Bridges, tubes and tunnels	<input type="checkbox"/> Metropolitan Transportation Commission 2011TeleAtlas <input type="checkbox"/> CA Department of Transportation <input type="checkbox"/> Bay Area Toll Authority
<input type="checkbox"/> Railroads, passenger and freight lines	<input type="checkbox"/> Metropolitan Transportation Commission 2011TeleAtlas <input type="checkbox"/> Capitol Corridor JPA <input type="checkbox"/> Altamont Corridor Express

	<input type="checkbox"/> Caltrain
<input type="checkbox"/> Transit services (bus, BART, light rail)	<input type="checkbox"/> Metropolitan Transportation Commission 2011 TeleAtlas <input type="checkbox"/> Bay Area Rapid Transit
<input type="checkbox"/> Ferry service	<input type="checkbox"/> Golden Gate Bridge Highway and Transportation District <input type="checkbox"/> Water Emergency Transportation Authority
<input type="checkbox"/> Bike/pedestrian routes	<input type="checkbox"/> Local General Plan <input type="checkbox"/> San Francisco Bay Trail
<input type="checkbox"/> Airport	<input type="checkbox"/> Federal Aviation Administration <input type="checkbox"/> Regional Airport Planning Committee
<input type="checkbox"/> Seaports and Marine terminals	

Asset: Communication Infrastructure	Data Sources
<input type="checkbox"/> Land line telephone systems	<input type="checkbox"/> Communication service providers
<input type="checkbox"/> Cable systems	<input type="checkbox"/> Communication service providers
<input type="checkbox"/> Cellular telephone antennae	<input type="checkbox"/> Communication service providers
<input type="checkbox"/> Underground communication conduits	<input type="checkbox"/> Communication service providers

Asset: Recreation, Open Space and Working Lands	Data Sources
<input type="checkbox"/> Park and recreation facilities	<input type="checkbox"/> California Protected Areas Database
<input type="checkbox"/> Designated open space	<input type="checkbox"/> California Protected Areas Database <input type="checkbox"/> Conservation Lands Network Explorer Tool
<input type="checkbox"/> Bike/pedestrian trails	<input type="checkbox"/> San Francisco Bay Trail
<input type="checkbox"/> Natural areas	<input type="checkbox"/> San Francisco Estuary Institute (SFEI) EcoAtlas
<input type="checkbox"/> Agricultural and working lands	<input type="checkbox"/> National Land Cover Database <input type="checkbox"/> County Tax Assessor Parcel Data <input type="checkbox"/> Local General Plan

Asset: Hazardous Materials Sites and Contaminated Lands	Data Sources
<input type="checkbox"/> Hazardous Materials Sites, e.g., RCRA regulated sites, CUPA sites	<input type="checkbox"/> US EPA Envirofacts
<input type="checkbox"/> Landfills (open and closed)	<input type="checkbox"/> US EPA Envirofacts <input type="checkbox"/> State Water Resources Control Board Geotracker
<input type="checkbox"/> Clean up sites, e.g., US EPA or DTSC regulated brownfield, cleanup sites, or landfills	<input type="checkbox"/> US EPA Envirofacts <input type="checkbox"/> State Water Resources Control Board Geotracker

Risk Assessment Scoping Worksheet

Purpose

Use this scoping worksheet to help you plan and scope the risk assessment your community will undertake. Deciding how to scope your risk assessment can be determined by many factors, including regulatory triggers, the interests of stakeholders, community goals, internal capacity, and availability of asset data.

Approach

It is recommended to work through this worksheet as a team. Use your community's goals and the results of the **Community Asset Data Identification Worksheet** to help determine the degree of analysis you will perform on each asset type. For each asset type, put a check box in the column of the most in-depth assessment you think you will be able to achieve (or would like to achieve) for that asset type. Also note whether or not assessing that asset will help meet community goals, and whether or not you already have the data you need or if data gaps exist.

Outcomes

Upon completion of this worksheet, you will have a road map forward that will help you plan and execute your risk assessment.

Assets	Exposure Analysis	Assessment Questions			Would assessing this asset help your achieve your community's goals?	Is there sufficient data available to conduct the assessment?
	Individual Asset	Individual Asset	Asset Class	Representative Assets		
Publicly-owned buildings	X					
Critical response facilities	X					
Police						
Fire						
Public schools						
Public health facilities						
Residential buildings						
Non-residential buildings						
People						
Total population						
Population with access or functional needs						
Community services						
Utility infrastructure						
Power						
Water supply						
Wastewater						

Assets	Exposure Analysis	Assessment Questions			Would assessing this asset help your achieve your community's goals?	What information sources are available to help conduct the assessment?
	Individual Asset	Individual Asset	Asset Class	Representative Assets		
Stormwater/Flood control						
Transportation						
Roads						
Rail						
Seaport						
Airport						
Bike/pedestrian routes						
Communication						
Recreation, open space and working lands						
Hazardous materials sites and contaminated lands						

Step 4: Conduct the Assessment



Key Steps:

- ✓ Conduct an exposure analysis using your chosen hazards and assets
- ✓ Gather information on your assets to answer the assessment questions
- ✓ Understand what data you need if you want to conduct further refined evaluations using tools such FEMA's HAZUS-MH model

Exposure analysis

An exposure analysis helps identify which assets will be exposed to a specific hazard and provides a basic understanding of the magnitude of possible damage or loss after a disaster. For example, an exposure analysis can determine how many housing units are likely to be exposed to the highest ground shaking during an earthquake and provide a high-level estimate of the economic impacts and number of residents who could be displaced, or can identify critical facilities exposed to hazards. While an exposure analysis is necessary for your risk assessment it does not capture the nuances of how hazards may affect certain assets; for example, if homes have been retrofitted, or are of newer construction types, they may be able to withstand more ground shaking than older, unretrofitted homes.

To conduct an exposure analysis you will need to combine the location and extent of the hazards with the location of your community assets. This is generally done through GIS mapping using pre-identified hazard scenario map layers and mapped community asset locations. An exposure analysis is a stepwise process (for more detail see **ART How-to Guide: Exposure Analysis**):

1. Add your relevant hazard layers into a new or existing map in ArcGIS. It's helpful to load all of the layers into a single map so that you can turn them on and off as needed. Many hazards are well-mapped and readily available, such as earthquake shaking scenarios, current flood zones, and fire zones. For future hazards, some, such as inundation from higher tides due to sea level rise, may have ready-to-use mapping tools available to evaluate asset exposure. For hazards that are not as well-studied or understood (e.g., salinity intrusion due to sea level rise or precipitation patterns) reliable information may not be readily available.
2. Gather data and map the locations of the community assets included in your assessment. Publicly-available data sources for a range of asset categories are provided in the **Identifying Community Assets Worksheet**. To do this step, you will need to have the location of the assets (latitude and longitude) or a previously made map layer that contains your assets.
3. Compare your assets to the hazard layers. Note which assets are in which hazard zones, the magnitude of the hazard they are exposed to (for example, light, moderate, strong, very strong, violent, or very violent ground shaking) or the probability of the hazard (1% flood hazard zone vs. 0.2% flood hazard zone), and assets that are exposed to multiple hazards.

4. Create maps showing the extent of hazards and the location of assets that intersect with those hazards (see example map on previous page). It is also a good idea to develop summary tables for large asset classes to communicate the different types and levels of hazards exposure (see example on next page).
5. Ask those with local knowledge and experience, such as stakeholders, asset owners, and community members, to review the maps and analysis to help pinpoint locations that do not adequately characterize local conditions and where additional studies, field verification, remapping or reanalysis is needed.

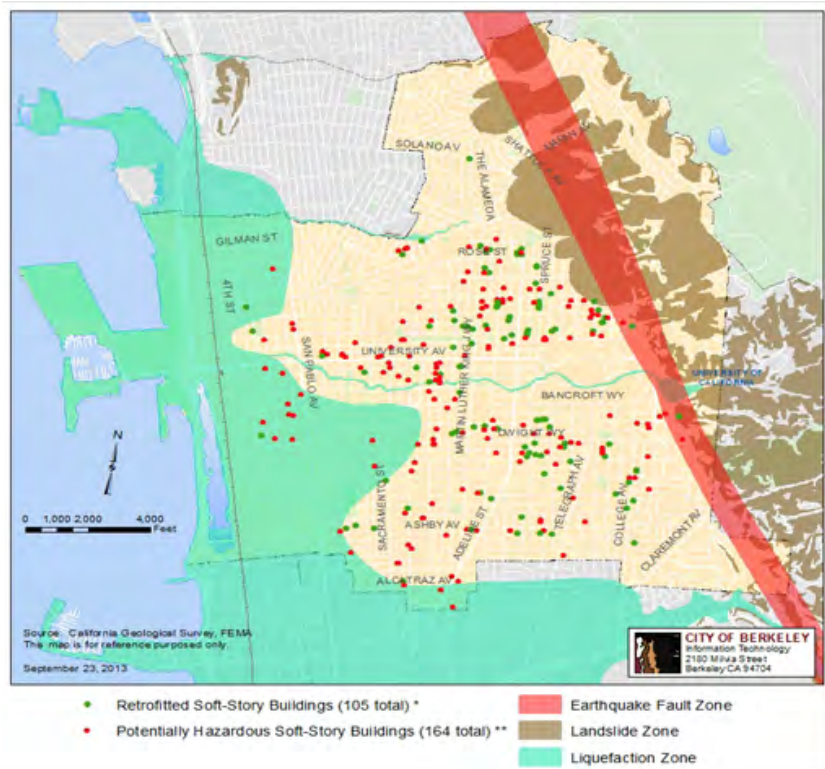


Figure 1: Example exposure map from City of Berkeley Natural Hazard Mitigation Plan (Map 3.8 Retrofitted and Unretrofitted)

Infrastructure Element	Total Length	Length in Hazard Areas		
		Earthquake-Induced Landslide Planning Zone	Fault Rupture Planning Zone	Liquefaction Planning Zone
Curbs	354 miles	44 miles (12%)	31 miles (9%)	93 miles (26%)
Streets	257 miles	42 miles (16%)	26 miles (10%)	68 miles (27%)
Solano Tunnel	0.09 miles	0 miles (0%)	0 miles (0%)	0 miles (0%)

Table 2: Example exposure table from City of Berkeley Natural Hazard Mitigation Plan (Table 3.7 Curbs, Streets, and the Solano Tunnel)

Answering Assessment Questions

Assessment questions help you describe the existing conditions, different types of vulnerabilities, and consequences that may occur if an individual or representative asset is exposed to a specific hazard. We have developed separate assessment questions for individual or representative assets and asset classes, so be sure to use the correct assessment questions worksheet for the scale you’ve decided to assess. However, the process is similar for both worksheets.

The process of answering the assessment questions is best approached in a stepwise manner (for more detail see ART How-to Guide: Assessment Questions):

1. Get familiar with the assessment questions and the types of vulnerability and consequence findings that these questions have revealed (see **Assessment Questions Worksheet**).
2. Develop an approach for answering the questions before diving in. Identify key pieces of information, like sources of data and key stakeholders to talk to such as asset owners, managers, and topic experts. Remember that the assessment questions are a tool to guide the collection of targeted information that can then be summarized in different ways. For each asset class identify whether the assessment questions will be answered for individual assets, the class as a whole, or representative assets. Recognize that it may be necessary to modify the approach for certain assets depending on input from the project team, availability of information, and preliminary findings as the assessment progresses.
3. Gather answers to assessment questions by conducting research to uncover readily available reports, documents, inspection and monitoring reports, and maps. Make a diligent effort to gather as much information as possible before seeking input from asset managers, owners or topic experts, as it is far easier and more efficient for them to help refine answers or provide specific resources to fill information gaps than to answer the entire worksheet. Keep in mind answers are typically a few sentences to a paragraph long. It is okay if the answer uncovers further, specific challenges that need to be further investigated.
4. Ground truth preliminary assessment answers with asset managers, owners, and topic experts. As stated above, it can be beneficial to provide the preliminary assessment answers and sources of information to the asset manager, owner or topic expert before asking for their input. However, be sure to give them enough background on the assessment objectives if they are not already familiar with the risk assessment. Since input on the preliminary assessment answers is partially based on best professional judgment, it is often helpful to ask for assistance in engaging colleagues, co-workers, others in the field, community members and non-profit organizations to gather needed information. Lastly, be sure to ask if there are any additional data or resources available that can help fill in information gaps. If there are none then make sure to note this data need or knowledge gap as an information challenge.

FEMA's Hazus-MH

One assessment tool that can help inform the economic consequences of natural hazards is FEMA's HAZUS-MH software. HAZUS requires user input on structure type and value in order to calculate damages. HAZUS outputs can be used to identify areas where large investments will likely be lost and is used after a disaster to provide damage estimates to FEMA. HAZUS requires detailed and accurate data about individual structure type and value to be useful; therefore it is important to consider when, at what scale, and for which assets Hazus will be informative to your community. The type of data needed to run HAZUS includes:

- ✓ Building Type
- ✓ Replacement cost
- ✓ Content cost (if available)
- ✓ Occupancy class
- ✓ Year built
- ✓ Location
- ✓ Number of stories
- ✓ First floor elevation
- ✓ Foundation type
- ✓ Design level

You can download HAZUS software here:

<https://www.fema.gov/hazus-software>

Developing Profile Sheets

Profile sheets can help you organize the information you uncover on asset classes or individual assets. These sheets can be used to form high level risk storylines and help you identify key issues that require more attention. A basic profile sheet may be structured differently for individual assets or asset classes, but should include the following information:

- **Describe the asset or asset class.** Describe the key functions of the asset or asset class, the geographic extent of it, who it serves, and any other relevant basic information.
- **Describe key issues.** In your assessment, a few more pressing issues probably emerged, such as vulnerable populations that may be affected, very high risk areas, or significant financial consequences. Highlight the most critical key issues at the top of the profile sheet.
- **Describe the vulnerabilities.** Here, list all of the vulnerabilities you uncovered on the asset or asset class. There are a few basic categories that can help you organize vulnerability types:
 - **Information.** Information vulnerabilities include difficulty obtaining data and information to sufficiently understand and/or manage vulnerability and risk. Lack of information, unavailable information, or poorly coordinated information sources can hinder understanding of vulnerability and risk, or can impact the ability to achieve mitigation or adaptation strategies.
 - **Governance.** Governance vulnerabilities are challenging management characteristics that could increase vulnerability, such as inadequate management approaches that don't or can't account for hazards, inadequate authority or regulatory mechanisms to adjust to hazards thinking, inadequate or unavailable sources of funding, or lack of mechanisms or governance structures to allow for the coordination and partnership necessary to address issues affecting multiple sectors, jurisdictions, or communities.
 - **Functions.** Functional vulnerabilities are functions, roles, or relationships that make assets, services, or sectors especially vulnerable to hazards or severely limit their ability to respond to hazards. For example, a senior facility may be seen as more vulnerable than an identical office building because of the function it serves as well as the dependence of the facility on outside services. Functional vulnerabilities could include lack of system redundancy, dependence on vulnerable assets, the function of the asset itself, or the asset's position in a networked system.
 - **Physical.** Physical vulnerabilities are existing conditions or design aspects of an asset class that make it acutely sensitive or limit its ability to withstand hazards. For flooding, this could include water sensitivity or being highly erodible. For seismic, this could be buildings that are built to older codes that are known to perform poorly in disasters.
- **Describe the consequences.** Consequences summarize the effects that vulnerabilities could have on people, the economy, and the environment. Damage or disruption to an asset or asset class, or loss of the service that it provides, could have significant effects to those who rely on it.
 - **People.** Describe the effects on people where they live, work, recreate, obtain key services, and conduct other day-to-day activities. Consider also how disproportionate impacts are likely to occur to some community members.
 - **Environment.** Describe the effects on the environment, such as damage to wetlands from sea level rise or potential hazardous materials release from liquefaction or ground shaking.
 - **Economy.** Describe the effects on important elements of the regional economy, such as impacts to goods and people movement, employment centers, and business sectors. Also consider the impacts to multiple scales of the economy: neighborhoods, cities, the region, the state, nationally, or even globally.

Outputs

- ✓ Exposure analysis demonstrating which assets are exposed to which hazards
- ✓ Answers to assessment questions

Tools + Worksheets to Support This Step

- ✓ **Rapid Risk Assessment Exercise**
Use this exercise with your project team and/or advisory body if you feel like they need to get a sense of the types of information you will need to conduct your assessment. This exercise expedites and simplifies the Risk Assessment questions to provide a quick overview of the vulnerability of an asset. It is designed to be used with a hypothetical asset and hazard, though you can fill in specifics for your community if you'd like. This exercise is designed to be a warm-up, not a substitute for doing a more detailed risk assessment on any asset or asset class.
- ✓ **Risk Assessment Questions Worksheets (Individual or Representative Asset; Asset Class)**
Risk assessment questions help you understand the underlying causes and components of vulnerability and the potential consequences of those vulnerabilities. These worksheets can be used by asset owners or project team members to quickly provide a snapshot of what data is available on assets and where data gaps are. Prior to providing this worksheet to asset owners, the project team should make an effort to fill in readily-available public information for the asset owner to confirm.

Resources

- ✓ [ART How-to Guide: Exposure Analysis](#)
If you need additional guidance on how to conduct an exposure analysis, this guide can help you pinpoint the assets and geographies that are most likely to be affected by your hazards and helps identify and prioritize where further, targeted mapping, analysis, or studies are needed. While this guide, like all ART materials, are geared towards climate adaptation, the concepts can be used for any assessment to any hazard.
- ✓ [ART How-To Guide: Assessment Questions](#)
This guide provides additional help for using the ART Assessment Questions to collect data and information on assets that will inform your characterization of vulnerability and consequences for assets and asset classes. While this guide, like all ART materials, are geared towards climate adaptation, the concepts can be used for any assessment to any hazard.
- ✓ [ART How-to Guide: Profile Sheets](#)
This guide provides additional help preparing profile sheets that summarize, for a specific asset, the findings of the assessment of vulnerability and consequences due to identified hazards. While this guide, like all ART materials, are geared towards climate adaptation, the concepts can be used for any assessment to any hazard.

✓

Rapid Risk Assessment Exercise

Purpose

This exercise is intended to familiarize your project team and/or advisory body with the types of information you will need to conduct your assessment. **This Rapid Risk Assessment Exercise** expedites and simplifies the Risk Assessment questions to provide a quick overview of the vulnerability of an asset. It is designed to be used with a hypothetical asset and hazard, though you can fill in specifics for your community if you'd like. This is designed to be a warm-up exercise, not a substitute for doing a more detailed risk assessment on any asset or asset class.

Approach

Use this exercise in a workshop or group setting with your project team and/or advisory body. Have people work in small groups of 2-3 with either a hypothetical asset or a specific asset you have in mind. You may want to walk through each section and describe what people should be thinking through in each section and/or have each group talk through their results. This worksheet can be used to do a preliminary assessment to identify gaps in stakeholder representation and/or data necessary for assessments.

Outcomes

This exercise is designed to give users a sense of how to proceed with a more in-depth asset risk assessment. It is not intended to provide a detailed assessment on any asset or asset class.

Resilience Goal:

Asset (pick one):	Hazard (one or both):	Hazard impact statement (see example hazard impacts):
<input type="checkbox"/> City Hall <input type="checkbox"/> Wastewater Treatment Plant <input type="checkbox"/> Senior Housing Complex <input type="checkbox"/> Hospital <input type="checkbox"/> Power Substation <input type="checkbox"/> Other:	<input type="checkbox"/> Earthquake <input type="checkbox"/> Flooding	

Assessment Questions

Existing Conditions <i>Describe the asset and highlight current conditions or stressors that could affect vulnerability</i>		
Asset functions (e.g., type of land use, community served, services provided):	Land Use <input type="checkbox"/> Residential <input type="checkbox"/> Institutional <input type="checkbox"/> Industrial <input type="checkbox"/> Commercial <input type="checkbox"/> Other:	Community Served: <input type="checkbox"/> Elderly <input type="checkbox"/> Youth <input type="checkbox"/> Low income <input type="checkbox"/> Mobility challenged <input type="checkbox"/> Other:
Who owns the asset? Are owner and manager different?	Owner: <input type="checkbox"/> Public <input type="checkbox"/> Private	Manager: <input type="checkbox"/> Public <input type="checkbox"/> Private <input type="checkbox"/> Different than owner? If so, explain:
Has the asset been retrofit for earthquakes or flooding?	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, explain when and to what standard:	

Physical Vulnerabilities <i>Identify conditions or design aspects that make an asset particularly vulnerable to impacts</i>	
What characteristics make the asset more or less vulnerable to flooding?	<input type="checkbox"/> Water or salt sensitive mechanical or electronic components <input type="checkbox"/> Openings at-grade or below-grade <input type="checkbox"/> Temporary or permanent barriers <input type="checkbox"/> Pumps or water removal systems <input type="checkbox"/> Other:

EXERCISE

What characteristics make the asset more or less vulnerable to earthquakes?	<input type="checkbox"/> Mobile or manufactured structure <input type="checkbox"/> Unreinforced masonry construction <input type="checkbox"/> Multi-story, concrete, constructed between 1950 and 1971 <input type="checkbox"/> Soft story or house over garage construction <input type="checkbox"/> Other:
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Functional Vulnerabilities <i>Describe asset function and/or relationships with or dependence on other assets that can make them vulnerable to impacts</i>		
Is the asset part of a networked system such that damage to other parts of the system would affect the asset's ability to function?	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, are there alternatives to help maintain continuity of service?	
What external services does the asset rely on?	<input type="checkbox"/> Power <input type="checkbox"/> Communications <input type="checkbox"/> Food	<input type="checkbox"/> Fuel <input type="checkbox"/> Materials/supplies <input type="checkbox"/> Other:
If external services were interrupted, are there back up supplies in place?	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, how long would they last (circle one): Hours Days Weeks	

Governance Vulnerabilities <i>Describe challenges with management, regulatory authority, or funding options for adapting to impacts</i>		
Is the asset protected from flooding by land or assets owned by others?	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, describe:	
What types of permits and from what agencies are necessary to maintain, repair or improve the asset?	<input type="checkbox"/> One agency <input type="checkbox"/> Multiple agencies (circle): Local State Regional Federal	
Are there funding sources that can be used to assess hazard risk, climate vulnerability or resilience?	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes, describe:	

Consequences <i>Describe potential impacts on society, equity, the economy, and the environment</i>		
What scale of economic disruption would occur if the asset was damaged, disrupted, or failed?	<input type="checkbox"/> Local <input type="checkbox"/> Regional <input type="checkbox"/> State <input type="checkbox"/> National	Is this based on a past event or an unplanned disruption? If yes, describe:
Who in the community would be affected by damage, disruption, or loss of asset function?	<input type="checkbox"/> People where they live <input type="checkbox"/> People where they work <input type="checkbox"/> People where they recreate	<input type="checkbox"/> Elderly <input type="checkbox"/> Youth <input type="checkbox"/> Low Income <input type="checkbox"/> Other:
What would the consequences be to ecological services be if the asset was damaged or lost?	<input type="checkbox"/> Habitat or species benefits <input type="checkbox"/> Public access <input type="checkbox"/> Flood risk management	<input type="checkbox"/> Water quality <input type="checkbox"/> Other:

Risk Assessment Questions: Individual or Representative Assets

Purpose

Assessment questions help you understand the underlying causes and components of vulnerability and the potential consequences of those vulnerabilities. You can answer assessment questions in a very detailed way for individual assets that either a visual map inspection or a geospatial analysis has identified as being exposed to a hazard.

Many of the assessment questions are broad and apply to all types of assets, while some are specific to a particular hazard or type of asset, so you will not need to answer all of the questions for all assets. In addition, some questions can easily be answered with readily available information, while others will require research or external input. It can be difficult to know how much effort to expend when answering assessment questions. Instead of spending a lot of effort to uncover hard-to-find, or in some cases nonexistent information, flag critical data needs and knowledge gaps that require further consideration and come back to these when developing your mitigation and adaptation actions.

Approach

It is recommended that a project team member fill out the assessment question worksheet as thoroughly as possible with readily-available information. Then, provide a copy of the worksheet to the asset owner or manager to verify and provide additional information. A project team member should then discuss the answers with the owner or manager to ensure accurate understanding of the assessment answers.

Outcome

Once completed, this worksheet will provide the project team all the information it needs to write a profile sheet for each selected asset that highlights its primary vulnerabilities.

Existing Conditions

Describe the asset and highlight current conditions or stressors that could affect vulnerability

1. Who owns and manages the asset? Note if the owner and manager are different entities.
2. What year was the asset built? What is the remaining service life?
3. Has there been an effort to extend the service life (e.g. improvements, seismic retrofit, mitigation actions)? If so, describe what was done and when.

Physical Vulnerabilities

Identify conditions or design aspects that make an asset particularly vulnerable to impacts

4. Does the asset have characteristics that make it vulnerable to flooding?
4a. Are there water or salt sensitive components of the asset are at-grade or below-grade, e.g., mechanical or electrical equipment, pumps, utilities, building heat, ventilation, power systems, or finished basements?
4b. Does the asset have openings are at-grade or below-grade that are entry points for flooding, e.g., entryways, tubes, tunnels, ventilation grates?
4c. Are their barriers (temporary or permanent) that can protect sensitive components or at- or below-grade entry points? Are there pumps or other systems in place to remove floodwaters if they do enter?
For building assets:
5. Does the asset have characteristics that make it vulnerable to earthquakes?
5a. Is the facility or building a mobile or manufactured structure? If yes, describe the foundation type.

5b. Is the facility or building constructed from unreinforced masonry? If yes, describe how and if seismic hazards have been assessed and/or mitigated.
5c. Is the facility or building multi-story, constructed from concrete and was built between 1950 and 1971? If yes, describe if and how seismic hazards have been assessed and/or mitigated.
5d. For residential buildings (either single family or multifamily), is it cripple wall construction (typically with short unreinforced walls that raise the first floor 1-5 feet above ground level)? If yes, describe how and if seismic hazards have been mitigated (i.e. the home has been bolted to the foundation and/or the cripple wall has been strengthened).
5e. For 1-2 unit residences, is the building house over garage construction? For multifamily residential, are there garages or other large openings on the first floor (soft-story construction)? If yes to either, describe how and if seismic hazards have been assessed and/or mitigated.
6. Have you taken any mitigation measures against wildfire? (e.g, does your city have an inspection system for fire mitigation actions?)

Functional Vulnerabilities

Describe asset function and/or relationships with or dependence on other assets that can make them vulnerable to impacts

7. Is the asset part of a networked system such that damage to other parts of the system would affect the asset's ability to function? Describe what alternatives exist that could help maintain continuity of service if parts of the system are disrupted.
8. What external services, such as power, communications, food or fuel supplies or materials does the asset rely on? If these external services were interrupted, are there back up supplies ready and in place, and how long would they last?
For building assets:

9. Does the asset serve sensitive populations?
9a. Does the asset serve or house the elderly or very young, mobility or medically challenged individuals, or animals? If yes, describe what systems or plans are in place to enable either shelter-in-place or safe evacuation and relocation of the facility if necessary.
9b. Does the asset serve or house community members that are resource limited, e.g., are they low or very low income, housing or transportation cost burdened, renters, or without a car? If yes, what programs or plans in place to help these members prepare for, respond to, or recover from a hazard event?
9c. Does the asset serve or house community members that are ethnically or culturally diverse, have limited English-speaking capacity, or are non-English speakers? If yes, what programs or plans in place to help these members prepare for, respond to, or recover from a hazard event?
For transportation assets:
10. Does the asset serves as a critical access road, emergency or lifeline route, provide sole or limited access to communities or facilities, or provide service to transit dependent communities? If yes, describe the communities, services, and facilities the asset serves.
For recreation, open space, and working lands:
11. Does the asset provide recreational access or opportunities that are unique or limited in the area and/or region, e.g., access for persons with limited mobility, interpretive programs, access to the Bay, etc.? Could these functions be easily replaced in other areas?
12. Does the asset provide or protect habitat for threatened or endangered species? Is this habitat scarce in the region? Could this habitat be established in other areas?
For utility and communication infrastructure assets:
13. Does the asset provide critical services to sensitive populations (see question 12), emergency response providers, or critical facilities?

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Governance Vulnerabilities

Describe challenges with management, regulatory authority, or funding options for adapting to impacts

14. Is the asset protected from flooding by land or assets owned or managed by others (e.g., structural protection, roadways, rail embankments)?
15. What types of permits (and from which agencies) are necessary to maintain, repair or improve the asset? Are there special processes for emergency repairs?
16. What funding sources currently exist that can be used to assess hazard risk or vulnerability to climate change? To improve asset resilience?

Consequences

Describe potential impacts on society, equity, the economy, and the environment

17. What economic disruption would occur if the asset was damaged, disrupted, or failed? Local, regional, state, or national? If your answer is based on a past weather event or an unplanned disruption, describe the type and duration of that disruption.
18. How would the community, particularly sensitive populations (see question 12), be affected by damage, disruption, or loss of asset function?
19. What would consequences to ecological services be if the asset was damaged or lost (e.g. habitat or species benefits, public access to the shoreline, or water quality)? What would the effect of this loss have on locally? Regionally?

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Risk Assessment Questions: Asset Class

Purpose

Assessment questions help you understand the underlying causes and components of vulnerability and the potential consequences of those vulnerabilities. These questions are designed to guide the assessment of an asset class, for example public facilities, residential land uses, parks or ground transportation systems.

Many of the assessment questions are broad and could apply to any asset class, while some are specific to particular types of assets so you will not need to answer all of the questions for a given asset class. While some answers can be gathered through desktop research or geospatial analysis, it is highly recommended to engage stakeholders who own, manage or can represent the asset class to uncover more detailed information about vulnerabilities and consequences.

Approach

It is recommended that a project team member fill out the assessment question worksheet as thoroughly as possible with readily-available information. Then, provide a copy of the worksheet to the asset owner or manager to verify and provide additional information. A project team member should then discuss the answers with the owner or manager to ensure accurate understanding of the assessment answers.

Outcome

Once completed, this worksheet will provide the project team all the information it needs to write a profile sheet for each selected asset that highlights its primary vulnerabilities.

Existing Conditions

Describe the asset class and highlight current conditions or stressors that could affect vulnerability

1. Describe the type of asset in the class and the services and functions they provide.
2. Describe the location, extent or geography of the assets within this class.
3. Describe the ownership and management of assets within this class. Are they public or private entities? Are there many or few?

Physical Vulnerabilities

Identify conditions or design aspects that make an asset particularly vulnerable to impacts

4. Do the assets in this class have characteristics that make them vulnerable to current or future flooding, e.g., water or salt sensitive at or below grade components; openings to floodwater such as entryways, tubes, tunnels, grates; reliance on pumps or temporary flood barriers? Are assets with these characteristics key assets or are there a large number of them?
5. Do the assets in this class have characteristics that make them vulnerable to seismic hazards (ground shaking, liquefaction, earthquake-induced landslide), e.g., fragile building types, long linear assets, constructed with older standards, not seismically retrofit? Are assets with these characteristics key assets or are there a large number of them?
6. Do the assets in this class have characteristics that make them vulnerable to fire, rainfall-induced landslides, or other natural hazards?

Functional Vulnerabilities

Describe asset function and/or relationships of assets in this class on other assets that can make them vulnerable to impacts

7. Are the assets in this class networked such that damage to one part of the system would affect the function or services provided by the asset class? Describe what alternatives exist that could help maintain continuity of service if parts of the network are disrupted.
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8. What external services such as power, communications, food or fuel supplies, goods or materials, or transportation access does the asset class rely on? If these external services were interrupted is there a contingency plan or back up supplies ready and in place, and how long would they last?
9. Describe how and where the asset class serves sensitive populations, e.g., elderly, very young, medically dependent or mobility challenged, low or very low income, housing or transportation cost burdened, renters, or without a car.
10. Describe how and where the asset class serves or houses community members that are ethnically or culturally diverse, have limited English-speaking capacity, or are non-English speakers. What programs or plans in place to help these members prepare for, respond to, or recover from a hazard event?
11. Describe the assets in this asset class that provide critical access, serve as an emergency or lifeline route, provide sole or limited access, or provide service to transit-dependent communities.
12. Describe the recreational, educational or habitat benefits the asset class provides, noting if they are unique or limited in the area and/or region, and if their function could be easily replaced.
13. Describe how and where the asset class provides critical services to emergency response providers or critical facilities.

Governance Vulnerabilities

Describe challenges with management, regulatory authority, or funding options for adapting to impacts

14. What policies are in place that govern or regulate the maintenance, repair or improvement of assets in this class?

15. What types of permits (and from which agencies) are necessary to maintain, repair or improve the assets within the class? Are there special processes for emergency repairs?
16. What funding sources currently exist that can be used to assess hazard risk or vulnerability to climate change? To improve resilience?

Consequences

Describe potential impacts on society, equity, the economy, and the environment

17. What degree and scale of economic disruption would occur if the assets in this class were damaged, disrupted, or failed? Local, regional, state, or national? If based on a past weather event or an unplanned disruption, describe the type and duration of that disruption.
18. What impacts would occur to society and equity if the assets in this class were damaged, disrupted, or failed? Describe the potential consequences to health and safety, community and neighborhood social networks, community mobility, and particularly sensitive populations (see question 9).
19. What impacts would occur to ecosystem service benefits if the assets in this class were damaged, disrupted, or failed? Describe the consequences on water quality, habitats and species, public access, education or flood risk reduction if the asset class was damaged or disrupted. Would the impact be felt locally? Regionally?

Step 5: Summarize Vulnerability



Key points of this step:

- ✓ Summarize assessment information into clear, outcome-oriented problem statements

After you have conducted your risk assessment you will need to summarize your findings to identify the most significant risks in your community. These findings will help you to craft appropriate and responsive mitigation and adaptation actions and create a clear and cogent “story” to help support decision-making by elected officials and other stakeholders and provide a foundation for seeking funds to reduce risks and increase community resilience.

This can be best achieved by developing problem statements. Problem statements help communicate the critical planning issues that emerged during the risk assessment, for example which critical assets are particularly vulnerable, what areas currently have repetitive losses, or how many high hazard areas are currently zoned for future development. Problem statements can help you prioritize and focus on the areas that have the greatest need for mitigation or adaptation based on the vulnerabilities and consequences identified. They can also help clearly communicate which issues require collaborative decision making, shared funding, or changes in laws, regulations, policies or other processes. Problem statements can be developed for each hazard, asset class, or specific individual assets you evaluated in your risk assessment.

The first step in writing problem statements is to review the exposure analysis maps and answers to the assessment questions. It is often the case that a number of assets will have similar characteristics, conditions and challenges, so it makes sense to read through and reflect on all of the answers before beginning to summarize.

The second step is to use the answers to the assessment questions to write brief summary statements describing the vulnerabilities and consequences identified. Depending on the process, the statements can summarize the assessment findings for individual assets, particular asset categories or services, the community as a whole, or the agencies and organizations that own, operate or manage the assets evaluated.

When writing problem statements, it is helpful to consider what vulnerabilities or consequences to include, and which can be coalesced into a single problem statement or which should have stand-alone problem statements. Pay special attention to statements that uncover prioritized hazards that should be considered in the near future. These typically fall under the following categories, but you may identify new ones:

Sample Problem Statements

“The North Creek Sewage Treatment Plant is located in the 100-year floodplain and has been damaged by past flood events. It serves 10,000 residential and commercial properties and it is the primary treatment plant for this area.”

“City Hall is located in an area that is likely to experience very high levels of shaking in either a San Andreas or Hayward earthquake. The building is an unretrofitted unreinforced masonry building built before 1930 and therefore highly vulnerable to damage in an earthquake.”

“Five of the eight public elementary schools in this city are in moderate or high ground shaking areas and one is located in both a liquefaction zone and in the 100-year floodplain. One middle school is not currently in any hazard zone but will likely experience future flooding with 36” of sea level rise. There is a data gap around the retrofit status of any of the schools; it is unknown if any have been seismically retrofitted.”

- ✓ Consequences that produce broad or wide ranging effects on society and equity including impacts to a large geographic area, large numbers of residents, or highly vulnerable populations such as those with special needs.
- ✓ Vulnerabilities or consequences that negatively impact the environment by reducing ecosystem benefits provided by natural areas, such as flood risk reduction, water quality improvement, and supporting biodiversity.
- ✓ Consequences that significantly affect the economy at multiple scales, including local, regional, statewide and national.
- ✓ Vulnerabilities that are urgent because impacts will occur in a shorter timeframe than it takes to address the vulnerabilities identified. For example, there may be a stretch of shoreline that will allow inland areas to flood either with small amounts of sea level rise or under current storm conditions, but addressing this issue requires a long lead time to due to complexities in ownership, management, financing, and regulatory oversight.
- ✓ Vulnerabilities or consequences that could cause cascading effects on other assets, services, or communities. This is particularly an issue for networked assets, such as transportation, utilities, and shoreline protection, which are interconnected in a manner such that failure of one part of the system will disrupt the rest of the system. This will also be an issue for assets that rely on other assets to maintain functionality, for example hospitals, nursing homes, and wastewater treatment plants that rely on uninterrupted power supplied by others.

Outputs

- ✓ Problem Statements
- ✓ **Fulfillment of Element B3 in FEMA's Local Mitigation Plan Review Tool Checklist**

Resources

- ✓ [**ART How-to Guide: Key Planning Issues**](#)
This guide provides additional information on identifying the project's key planning issues for which the project team and advisory body will collaboratively develop strategies for implementation to address the issues. While this guide, like all ART materials, are geared towards climate adaptation, the concepts can be used for any assessment to any hazard.
- ✓ [**ART How-to Guide: Issue Statements**](#)
This guide helps users synthesize the existing conditions, vulnerabilities, and consequences for each asset into issue statements. While this guide, like all ART materials, are geared towards climate adaptation, the concepts can be used for any assessment to any hazard.

Step 6: Identify strategies



Key points of this step:

- ✓ Develop an initial list of strategies that are responsive to your problem statements and can help solve your community's vulnerabilities
- ✓ Basic information on each strategy that sets you up to properly evaluate strategies (in Step 7) and create ownership for strategies

Once you've identified your key vulnerabilities within your community, you need to identify strategies or actions that can help address the vulnerabilities. Strategies should link directly to your problem statements: strategies offer the solutions to the problems you identified in assessment. While you can draft mitigation and adaptation strategies from scratch, there are already many sources for best practice strategies that you can pull from. You may pull strategies from existing city documents like past LHMPs, Safety Elements, Housing Elements, Climate Action Plans, Sustainability Plans, or Climate Adaptation plans, from your State Hazard Mitigation Plan, or from one of the many sources included here. The strategy sources we've identified provide you with a wide range of robust best practices with clear explanations and implementation steps.

It's more important to select fewer, more actionable strategies than a long laundry list of potential strategies. You may want to select one or a handful of strategies that are responsive to each problem statement, or a few strategies that respond to each of your most pressing hazards or vulnerabilities. You may also want to consider strategies that fit into a range of action types, for example, evaluation projects, programs or city operations, policies that need to be developed, coordination between multiple stakeholders, or education and outreach programs. You could also consider strategies that use different processes or implementation mechanisms, like long-range planning documents, land use planning tools like zoning, capital planning processes, daily operations, emergency planning, project planning and design regulations, or new initiatives designed and developed specifically for mitigation and adaptation projects. When selecting strategies, also consider who the responsible agency would be for implementing it and who possible partners may need to be.

Strategies should be selected with stakeholder input. Your internal team should all have input on strategy selection, as should any external stakeholders, especially those who will be key partners in implementing strategies, such as land or asset owners aside from the jurisdiction, regulators, asset managers, or community members who will be affected. Outreach at this point can also help identify or make contact with key partners for implementation.

Developing Robust Strategies

This step focuses on developing an initial list of potential strategies that are responsive to your particular issue statements; however, you will need to gather some information on each strategy for the next step, evaluation and prioritization. Through the process of developing a basic profile of each potential strategy,

you may start to uncover how easy or feasible the strategy would be to implement, or you may engage stakeholders who wish to work together or be champions for a particular strategy. To help with ensuring that you have adequate information on each strategy you've selected, we've developed a worksheet where you can fill in information on developing and implementing the strategy to ensure that the strategies you've selected are directly responsive to your community's issues and are feasible to implement.

Different vulnerabilities may require different types of actions to create meaningful solutions. The following are examples of ways to categorize and consider strategies.

- **Operation** – strategies to enact operational and governance-related improvements
- **Programmatic** – strategies to expand or create new programs, activities, and initiatives
- **Plans, Regulations, and Policy Development** – strategies to develop or revise policies, plans, regulations and guidelines
- **Capital Improvement/Infrastructure Projects** – strategies designed to address physical and functional deficiencies and needs in the natural and built environment
- **Education/Outreach/Coordination** – strategies related to initiating or expanding partnerships and relationships, communicating and sharing information, and building awareness
- **Evaluation** – strategies to improve feedback, input, and data and information or conduct further or new analysis

Additionally, strategies may have multiple characteristics that help – or hinder - your resilience-building process. For example, some solutions may be preliminary or unlocking, meaning they must be done first in order to make future actions possible; some strategies may be easier than others for individual agencies or asset managers to undertake themselves without having to form new partnerships or collaborations; some strategies are multi-benefit, providing community benefits or improving the performance of the asset to multiple hazards; lastly, some strategies may require a long lead time and therefore should be started early.



Each strategy also has a process or mechanism for implementation that should be identified early on. This can assist with developing ownership early on as well as thinking through timelines and cycles for some of the processes. The processes we've identified are:

- **Long-range planning** – these are mechanisms like master plans or climate action plans that articulate a long-range vision for your community
- **Land use planning** – this includes elements like General Plans or Specific/Area plans that dictate how current and future land use planning decisions should be made
- **Capital planning** – this includes capital improvements plans, and is essential if the strategy requires financial support for staff or capital improvements
- **Operations** – this includes the annual budgeting process, which can incorporate the financial planning for strategy implementation
- **Emergency & hazards planning** – this includes incorporation into the local hazard mitigation plan, emergency response plans, or preparedness planning
- **Project planning & design** – this includes public/private development projects like housing developments, which may be necessary to implement specific strategies
- **New initiatives** – this includes anything that needs a whole new effort like a new department, legislation, or ballot measure because it cannot be developed through current, existing processes

Sample Problem Statements & Strategies

Operational Strategy

Problem Statement: *The city has a lack of staff to enforce building codes and adherence to retrofit policies.*

Strategy: *Within the next year, build staffing capacity to implement and support plan implementation.*

Policy Strategy

Problem Statement: *Electric power outages occur on a regular basis during winter storms, resulting in businesses in core commercial areas to lose customers.*

Strategy: *Within the next five years, require all new commercial solar installations to include energy storage with a minimum of 3 hours downtime.*

Education/Outreach/Coordination Strategy

Problem Statement: *There are over fifteen agencies and twelve non-profits involved in addressing sustainability and resilience in the city, resulting in substantial gaps, duplication, and increased competition for funding.*

Strategy: *Develop and convene a regional sustainability council to coordinate and align efforts of the agencies and non-profits.*

Outcomes

- ✓ Draft list of appropriate strategies to address your hazard problem statements
- ✓ Basic information on each strategy to assist in evaluating and prioritizing strategies
- ✓ **Fulfillment of Element C4 in FEMA's Local Mitigation Plan Review Tool Checklist**

Tools + Worksheets to Support This Step

- ✓ **Strategy Idea Sources Handout**

This handout presents a number of sources for pre-developed strategies that address common hazards and asset classes. The sources can be used to provide ideas and language for local strategies that are responsive to your own individual problem statements. This guide is geared towards the Bay Area in California, but many of the strategies can be applicable in other areas that have similar hazards. For other types of hazards, see the Resources section for other strategy sources.

Resources

- ✓ **[ART Adaptation Response Open House Engagement Exercise](#)**

This guide provides instructions for an engagement exercise to be done with advisory body members and other stakeholders during an Open House-style workshop. This workshop is designed to provide familiarity to participants with the components of a strategy and be able to provide feedback on draft strategies that have emerged from your assessment process. While this exercise, like all ART materials, are geared towards climate adaptation, the concepts can be used for any assessment to any hazard.

Strategy Idea Sources

Purpose

This handout presents a number of sources for pre-developed strategies that address common hazards and asset classes. The sources can be used to provide ideas and language for local strategies that are responsive to your own individual problem statements. This guide is geared towards the Bay Area in California, but many of the strategies can be applicable in other areas that have similar hazards.

2011 Regional Hazard Mitigation Plan

Hazards Addressed	Asset Classes Addressed	Source
Earthquake Landslide Wildfire Flood Security Dam Failure Levee Failure Tsunami Drought Agriculture Pandemic Flu	Infrastructure Health Housing Economy Government Education Environment Land Use	ABAG

Comprehensive list of strategies developed for previous Regional Hazard Mitigation Plan. Wide range of strategies, but little detail on implementation. Covers many hazard types and asset types. Some jurisdictions may be familiar with these strategies and have them included in their previous hazard mitigation plans.

<http://resilience.abag.ca.gov/wp-content/documents/ThePlan-G-2010.pdf>

Bay Area Regional Resilience Initiative

Hazards Addressed	Asset Classes Addressed	Source
Earthquake	Governance Housing Infrastructure Economy and Business	ABAG

This 2013 report identifies an action plan for the region to improve regional capacity for disaster resilience in four sectors. Many of the actions are regional in implementation, but there are several local strategies as well. Actions align with identified regional priorities adopted by ABAG's Regional Planning Committee.

http://resilience.abag.ca.gov/projects/resilience_initiative/

Stronger Housing, Safer Communities: Strategies for Seismic and Flood Risks

Hazards Addressed	Asset Classes Addressed	Source
Ground shaking Liquefaction Current and future flooding	Housing Community members	ABAG and BCDC, developed in coordination with AECOM

Contains 40 strategies for state, regional, and local governments to address seismic and flood hazards for current and future development. Strategies are responsive to risk statements based on vulnerability analysis of housing and community capacity. Each strategy contains 2-3 pages of implementation guidance. Also includes a table designed to guide jurisdictions towards financing options to implement the strategies.

http://resilience.abag.ca.gov/projects/stronger_housing_safer_communities_2015/

Adapting to Rising Tides Project

Hazards Addressed	Asset Classes Addressed	Source
Current Flooding Future Flooding	Community Land Use, Facilities and Services Transportation Utilities Shorelines	BCDC

Dozens of adaptation responses that describe actions and implementation options to address flooding vulnerability. Responses are organized by category: Overarching; Community Land Use, Facilities and Services; Transportation; Utilities; and Shorelines. Also includes a guide to orient the reader to the types of information provided on the cards, and a glossary to define terms and acronyms used in the responses.

http://www.adaptingtorisingtides.org/wp-content/uploads/2015/04/Adaptation_Responses_Intro-All.pdf

State of California Multi-Hazard Mitigation Plan

Hazards Addressed	Asset Classes Addressed	Source
Earthquake Floods Wildfire Levee failure Landslides and other earth movements Tsunami hazards Climate-related hazards Volcanoes Other hazards (natural & manmade)		California Governor’s Office of Emergency Services

The plan does not contain a list of strategy action, but identifies several possible goals and mitigation actions that can be implemented at a local level. Each hazard section includes possible mitigation actions that can be adapted locally and developed into a strategy.

http://hazardmitigation.calema.ca.gov/docs/SHMP_Final_2013.pdf

Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards

Hazards Addressed	Asset Classes Addressed	Source
Drought Earthquake Erosion Extreme Temperatures Flood Hail Landslide Lightning Sea Level Rise Severe Wind Severe Winter Weather Storm Surge Subsidence Tornado Tsunami Wildfire	Structure and Infrastructure Natural Systems	FEMA

Comprehensive resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters. Many of the strategies are fairly generic, and serve as a starting point for local innovation and planning projects.

http://www.fema.gov/media-library-data/20130726-1904-25045-0186/fema_mitigation_ideas_final508.pdf

Resilient City Initiative

Hazards Addressed	Asset Classes Addressed	Source
Earthquakes	Existing Buildings New Buildings Lifelines Infrastructure	SPUR

San Francisco-based initiative to improve the resilience of the built environment. Topic-specific reports provide strategy recommendations for mitigating existing buildings, improving the seismic performance of new buildings, upgrading infrastructure, helping residents shelter in place, improving preparedness, and planning for disaster recovery.

<http://www.spur.org/featured-project/resilient-city>

Center for Climate Strategies Adaptation Guidebook

Hazards Addressed	Asset Classes Addressed	Source
Climate Change	Infrastructure Built Environment Natural Systems Health and Society Economic Activities	Center for Climate Strategies

Comprehensive compendium of strategies that address a wide variety of climate change issues, including sea level rise, drought, extreme heat, and changing ecosystems. Strategies are not very robust, but can serve as a starting point for locally-developed strategies.

www.climatestrategies.us/library/library/download/908

Getting Climate Smart Strategy Toolbox

Hazards Addressed	Asset Classes Addressed	Source
Climate Change	Water Management Agriculture Energy, Transportation & Urban Infrastructure Tourism & Recreation Public Health & Safety Oceans & Coastal Resources Fisheries & Aquatic Ecosystems	National Resources Defense Council

Similar to the previous resource, contains a comprehensive compendium of strategies that address a wide variety of climate change issues. Can serve as a starting point for locally-developed strategies.

<http://www.nrdc.org/water/climate-smart/files/getting-climate-smart-strategy-toolbox.pdf>

Step 7: Evaluate Strategies



Key Steps:

- ✓ Engage stakeholders to evaluate strategies
- ✓ Prioritize strategies that reflect your community's goals, capacity, and desired outcomes

Once you have an initial list of strategies, you will likely need to evaluate the strategies to decide which strategies are most relevant, most achievable, or highest priority in your jurisdiction. Carefully considered evaluation criteria can provide a tool for evaluation. Evaluation criteria can be an essential tool to gauge the priorities and values of different agencies, organizations, communities, or other stakeholders to ensure that your strategies are well-balanced to reflect your community's goals. Evaluation criteria can also reveal new perspectives in how different strategies impact the four frames of society and equity, economy, environment, and governance, or whatever frames your community has identified. By evaluating strategies through these frames, you can identify and highlight the benefits and tradeoffs of strategies in each frame, which can be very useful when garnering political, community, and financial support for implementation. The four frames can reveal some of the following characteristics of each strategy:

- **Society and equity:** Effects on communities and the services on which they rely, with specific attention to disproportionate impacts due to inequality.
- **Economy:** Economic values that may be affected such as costs of physical infrastructure damages or lost revenues during periods of recovery.
- **Environment:** Environmental values that may be affected, including ecosystem functions and services and species diversity.
- **Governance:** Factors such as organizational structure, ownership of assets, management responsibilities of assets, jurisdictional mandates, and the mechanisms of participation that affect vulnerability to hazard impacts.

The evaluation criteria should be used not just by the core project team, but by any individual or group who will play a significant role in implementation. Vetting and evaluating strategies is a key piece of community outreach to ensure that your plan for building resilience represents what the community wants and needs for a safer future. Additionally, various city departments may have different perspectives on things like ease of implementation, and identifying potential issues during the evaluation phase can help prevent unexpected roadblocks in the future. Strategy evaluation is also another chance to build buy-in and support from decision-makers and the community.

Building Consensus on Priorities

If many of your strategies rate similarly and you have trouble prioritizing strategies, the following questions may help you identify your top priorities:

- ✓ Is there a champion? Is there someone who strongly believes it is a top priority and is willing and able to devote time and resources to implementing it in the short term?
- ✓ Is it aligned with other ongoing or planned efforts? Can you adapt projects already underway to include mitigation or adaptation efforts, or if you implement the strategy does it meet multiple goals?
- ✓ Is it an “easy win”? An easy win is a strategy that is easy to achieve and provides a high level of benefit.
- ✓ Is it an “unlocking” strategy? Unlocking strategies are interim steps that open the door to other action. For example, do you need to do additional studies or involve new stakeholders before you can implement a priority strategy?

We’ve included an evaluation criteria spreadsheet for your use, but you should adapt it to meet your community’s needs.

Santa Cruz County Local Hazard Mitigation Plan Prioritization Criteria

The following is another example of a prioritization criteria.

Very High Priority

- A project that meets multiple plan objectives
- Benefits exceed cost
- Has strong community support
- Addresses those hazards presenting the highest risk
- Funds are identified or potentially available
- Project can be completed in one to five years once project is funded.

High Priority

- Project meets at least one plan objective
- Benefits exceed costs
- Funding has not been secured
- Project can be completed in one to five years once project is funded

Important

- Project mitigates the risk of a hazard
- Benefits exceed costs
- Funding has not been identified and/ or timeline for completion is considered long-term (five to ten years)

Outcomes

- ✓ Prioritized list of feasible, impactful strategies with stakeholder buy-in
- ✓ **Fulfillment of Element C5 in FEMA's Local Mitigation Plan Review Tool Checklist**

Tools + Worksheets to Support This Step

- ✓ **Evaluation Criteria Worksheet**

This worksheet should be used by the project team, as well as by the advisory body, to evaluate and prioritize strategies for implementation. The worksheet uses five categories of criteria to develop a total score: feasibility, social benefits, economic benefits, environmental improvement, and community objectives. Jurisdictions can also change scoring criteria to reflect local priorities. It is important that multiple stakeholders fill out this worksheet to ensure that multiple voices and viewpoints are included in strategy prioritization.

Resources

- ✓ **[ART Adaptation Response Open House Engagement Exercise](#)**

This guide provides instructions for an engagement exercise to be done with advisory body members and other stakeholders during an Open House-style workshop. This workshop is designed to provide familiarity to participants with the components of a strategy and be able to provide feedback on draft strategies that have emerged from your assessment process. While this exercise, like all ART materials, are geared towards climate adaptation, the concepts can be used for any assessment to any hazard.

Evaluation Criteria Worksheet

Purpose

This worksheet was developed to provide a tool for evaluating and prioritizing which strategies to implement. The worksheet uses five categories of criteria to develop a total score: feasibility, social benefits, economic benefits, environmental improvement, and community objectives. Jurisdictions can also change scoring criteria to reflect local priorities. It is important that multiple stakeholders fill out this worksheet to ensure that multiple voices and viewpoints are included in strategy prioritization.

Approach

This worksheet should be worked through by the project team, as well as by the advisory body and any key stakeholders that will have a role in implementation. Use this worksheet to evaluate every strategy you are considering. It is important to get as much feedback as possible on this worksheet, as each stakeholder will evaluate strategies differently, and it is critical to include the perspectives of everyone who could assist with, or possibly hinder, the implementation of strategies. For more guidance on how to use this worksheet in a group setting, look at the [ART Adaptation Response Open House Engagement Exercise](#).

Outcome

After several team members and stakeholders have completed this worksheet, you will have a score for each strategy that will help guide its feasibility and priority. Higher scores generally denote higher feasibility and priority.

Scoring Key	
+1	Criteria definitely met
0	Unsure/don't know
-1	Criteria not met/negative effects

WORKSHEET

Strategy Name	Feasibility						Social benefits*				
	Funding	Political support*	Local Champion*	Administrative*	Technical*	Legal*	Access	Life Safety	Awareness	Social Capacity	Vulnerable Residents
	With existing or expected funding sources	Likelihood of political support	Supported by a strong advocate or local champion	With existing operations or procedures	With existing technology or know-how	With existing authorities or policies	Protects access to jobs or services	Protects residents lives and prevents injuries	Increases public awareness	Builds social networks and community capacity	Protects especially vulnerable community members
EXAMPLE: Develop a soft story retrofit program to protect most vulnerable residents	1	1	1	1	1	1	1	1	1	0	0

* Indicates overlap with FEMA Worksheet 6.1, Mitigation Action Evaluation Worksheet

WORKSHEET

Recreation	Economic benefits				Environmental Improvement*					Community Objectives		Total score
	Jobs	Commuter Movement	Reduces Disruptions	Reduces Damage*	Habitats and Biodiversity	Water Quality	GHG	Water Use	Energy Use	Community Objectives*	Existing Plans	
Maintains recreational or educational opportunities	Promotes or retains jobs	Maintains commuter movement	Reduces service or network disruptions	Reduces asset damage, e.g., to structures or infrastructure	Creates or maintains habitat and biodiversity	Maintains or improves water quality	Reduces GHGs	Reduces water use	Reduces energy use	Advances other community objectives	Supports exiting plan objectives, i.e., general plan policies	13
0	1	0	0	1	0	0	0	0	0	1	1	13

Step 8: Develop Implementation Plans



Key points of this step:

- ✓ Snapshot of implementation steps to jump-start implementation of prioritized strategies

Once you've identified and evaluated your strategies and developed a short list of actionable, responsive strategies with local buy-in, it is helpful to draft an initial implementation plan that identifies the key next steps for implementing the strategy. This builds on the Strategy Development Information table in Step 6. Together, these tables represent a 1-page summary of each strategy with key information that should help the agency responsible for implementation begin their task. The result of this activity should be a three to five year plan that maps out the activities, priorities, and order of magnitude costs for each strategy. Things to consider in this step:

- ✓ What is the best timeframe for the implementation plan? Less than five years is reasonable and is relatively predictable. Some strategies, such as major infrastructure projects, may require a longer timeframe, especially as part of a general plan, and require ten to twenty years. The longer the timeframe, the less information, certainty, and feasibility the strategy will have.
- ✓ Do you control the dependencies that will lead to the success of the strategy? For instance, does a strategy rely on a different organization passing a policy or funding the activity? The more dependencies and the more actors involved in achieving a strategy will likely require more time and resources to complete.
- ✓ Can you move forward some easy, win-win strategies early, even if they are not a priority? People and decision-makers like to see action and if there is a way to move forward some activities quickly, make that clear in the implementation plan.
- ✓ Does a strategy connect to another project? If so, review the timeline for that effort and make sure the implementation plan is responsive to that timeline.
- ✓ The Implementation Plan is a final opportunity to ground-truth the feasibility of a solution and make sure it will actually be effective. If a strategy has been moved forward to this point, and it is more aspirational than realistic, adjust implementation to reflect that reality.

Implementing strategies is the on-the-ground work that takes ideas into action. In many ways, implementation is the most difficult step of resilience-building, because of the potential for inaction and many potential barriers like lack of funding, lack of political buy-in, lack of staff capacity, lack of authority over key assets, or a complex and limiting regulatory context. One of the most critical steps of implementation is getting departments to take ownership and responsibility for implementing projects, as well as getting critical stakeholders on board. Hopefully, engagement of the right stakeholders has been taking place throughout the project, especially in the strategy selection and evaluation steps. If you've done a thorough job of your assessment and strategy selection, you should have a good sense of who the players may need to be for each strategy, including who regulates or sets policy, who owns key assets, who is responsible for paying, and who may have an interest in not seeing a project go through.

Information for Effective Implementation

To further chart a course of action, we've included a section on implementation in the Strategy Development and Implementation Worksheet to help you compile information that can form the basis for a work plan, like what actions or activities would need to take place to implement the strategy, who the staff lead is, and what the estimated budget and timeline may be. This information can also provide talking points to advocate for the implementation of the strategy to stakeholders or your city council, such as the strategy's evaluation score, potential benefits and co-benefits, how it relates to existing city policies, and who may be able to fund the strategy.

Planning for implementation will also utilize the pieces of information you filled in on the top half of the Strategy Development and Implementation Worksheet; the strategy types and process/implementation mechanism portions can be particularly helpful in identifying actions or activities and developing a work plan.

Catalysts for Implementation

Case studies of past successes show that certain key elements help catalyze action. Some of these catalysts include the following ideas:

1. **Political buy-in.** Elected officials, like councilmembers, have the power to expedite or stymie action. Building a supportive political climate and addressing the concerns of councilmembers can make the difference between action and inaction. Garnering support from elected officials can help projects occur quickly.
2. **Sustained commitment.** Many actions can take years to implement. Projects may span multiple terms of office for elected officials and multiple funding cycles. Successful projects have a committed staff that is able to sustain commitment throughout varying political cycles and see a project through. It helps to have an advocate at a high level (see above point about political support), but beyond elected officials, who may cycle in and out of office before a project is complete, engagement of department heads, city administrators, city managers, or someone similar helps ensure implementation success. Given that staff and city

Implementation as a Campaign

Implementation can be part of long-term sustainability for resilience building, ensuring ongoing support and funding for future projects and initiatives. Below are some key principles to think about to align implementation with the garnering of support.

- Understand the needs and wants of “voters” (stakeholders and community members)
- Get a read on the atmosphere with surveys and polling.
- Sell “voters” on ideas in a way that makes them feel invested in the outcome
- Utilize as an effective means to conduct fundraising
- Build a culture (and messaging campaign) that is receptive to desired outcome (s)
- Plan on a lot of ongoing public outreach and education – people have short memories and need constant reminders about why they should care.
- Time projects when the atmosphere is “right”. Just because a timeframe was identified in a plan does not mean it cannot be done earlier or later to benefit from external conditions.

directors may cycle out over the course of a project, a continuity plan is also important to ensure that projects can be carried out no matter who is working on them.

3. **Focus actions where the money is.** Varying priorities from funders means that sources of funding may not align with all actions identified and prioritized. Many grants are fairly specific about which projects are eligible for funding. Rather than focusing on an action without regard to where funding will be coming from, select actions that align with funding priorities from federal, state, or philanthropic funders. As priorities and funding sources shift, more and different actions may become timely to implement.
4. **Piggyback on successful local projects.** What kinds of projects are already successful in communities? Every community has a unique capital spending pattern, which reveals the priorities of the community. These priorities should have been identified early on in the project, and hopefully strategies and actions already align with existing community priorities. But it is also helpful to look at existing projects to see where resilience actions may be able to piggyback. For example, if parks and recreation are a high spending priority, consider adapting resilience actions to utilize park projects to enhance stormwater and flooding control through retention ponds that double as attractive features, rain gardens, or other natural stormwater management strategies.
5. **Use existing processes, groups, or sources of funding.** Similar to capitalizing on existing successful projects that are already likely to be funded and built, consider how existing working groups, departments, or funding streams can be adapted to include actions that advance resilience. For example, if a community already has a sustainability council that brings together cross-agency staff or department heads, that group may be able to expand their mission to advance resilience as well. Additionally, current investments in infrastructure maintenance may be able to be adapted to incorporate protective actions like waterproofing or seismic retrofit to improve the longevity of infrastructure without the need for new bond measures or other sources of funding.
6. **But don't be afraid to build something new if it's needed.** Sometimes it makes more of a statement and political splash to create an entirely new effort, especially if the effort has the ability to garner a lot of excitement and involvement from a wide variety of stakeholders. For example, BCDC's 2009 Rising Tides design competition generated region-wide interest in climate adaptation, leading to the development of the Adapting to Rising Tides Program which has worked with many cities and counties since the competition to develop in-depth vulnerability assessments and sea level rise adaptation strategies for the region. Another example is the Rockefeller 100 Resilient Cities Chief Resilience Officer concept, which creates a new high-level, cross-disciplinary position within cities devoted exclusively to building communitywide resilience.
7. **Consider your partners.** Many resilience projects are complex, with multiple owners, regulators, or users of assets that need retrofit, moving, or rebuilding. By identifying and engaging with all involved stakeholders from the beginning, more realistic solutions can be identified that take into account all of the moving pieces involved in implementing a solution. Partners are critical to resilience-building. Cities need the cooperation of other agencies and regulators, community groups, politicians, asset owners, and residents to make change happen. Not only can partners minimize political struggle, but the right partners can act as additional capacity for city staff, particularly if they can bring funding, skills, or political skill, reducing the workload on city staff and catalyzing more action.

Every community will need a different tool kit for implementing resilience-building actions, building off of existing daily processes to create a new form of decision-making and action-taking. Implementing resilience actions is not just the final step in the resilience-building process, but a manifestation of the process as a whole. Therefore planning for action and implementation starts from the very beginning, before strategies have even been identified. Ensuring successful implementation stems from active engagement of stakeholders, coordinated decision-making, and wide-ranging capacity building to minimize barriers to action and garner meaningful support.

Outcomes:

- ✓ Completed Strategy Implementation Information Worksheets for each prioritized strategy
- ✓ **Fulfillment of Element C5 in FEMA's Local Mitigation Plan Review Tool Checklist**
- ✓ **Fulfillment of Element C6 in FEMA's Local Mitigation Plan Review Tool Checklist**

Tools + Worksheets to Support This Step:

- ✓ **Strategy Development and Implementation Guide Handout**
This handout provides two tools to help you fill out a Strategy Development and Implementation Worksheet: a description of what to include in each field, and an example from a real-life strategy. Review this handout with your project team prior to developing a worksheet for each strategy to ensure that worksheets are filled out consistently and that everyone understands the key pieces of information that are needed to effectively develop an appropriate and responsive strategy and plan for its implementation.
- ✓ **Strategy Development and Implementation Worksheet**
This blank worksheet is a template for recording key information about a strategy that can assist in fleshing out the ideas put forth in the strategy as well as key information needed to move into implementation of the strategy. Your project team should fill out this worksheet for every strategy your team is considering including in your project. First, as you are selecting possible strategies, work through the top half of the worksheet. After going through the evaluation step, move to the bottom half of the worksheet only for those strategies that you will be implementing.

Strategy Development and Implementation Guide Handout

Purpose

This handout provides two tools to help you fill out a Strategy Development and Implementation Worksheet: a description of what to include in each field, and an example from a real-life strategy. Review this handout with your project team prior to developing a worksheet for each strategy to ensure that worksheets are filled out consistently and that everyone understands the key pieces of information that are needed to effectively develop an appropriate and responsive strategy and plan for its implementation.

STRATEGY DEVELOPMENT INFORMATION							
Problem Statement	<i>This is the problem statement that the strategy is responding to. This should come out of your risk assessment and should include community goals.</i>						
Strategy Name	<i>This is the name of the strategy – try to keep it to a few words.</i>						
Strategy Summary	<i>This is a short description of what the strategy does.</i>						
Hazard(s) Addressed	<i>Identify which hazard this strategy responds to.</i>						
Strategy Type	Operational <i>Strategies to enact operational and governance-related improvements</i>	Programmatic <i>Strategies to expand or create new programs, activities, and initiatives</i>	Plans, Regulations, and Policy Development <i>Strategies to develop or revise policies, plans, regulations, and guidelines</i>	Capital Improvement/ Infrastructure Projects <i>Strategies designed to address physical and functional deficiencies and needs in the built environment</i>	Education/ Outreach/ Coordination <i>Strategies related to initiating or expanding partnerships and relationships, communicating and sharing information, and building awareness</i>	Evaluation <i>Strategies to improve feedback, input, data and information or conduct further or new analysis</i>	
Process/ Implementation Mechanism	Long-Range Planning <i>e.g., master plans, climate action plans</i>	Land Use Planning <i>e.g., general plan, specific plan</i>	Capital Planning <i>e.g., capital improvement plan</i>	Operations <i>e.g., annual budgeting</i>	Emergency & Hazards Planning <i>e.g., hazard mitigation plans</i>	Project Planning & Design <i>e.g., private and public development projects</i>	New Initiatives <i>e.g., legislation, ballot measure</i>

Responsible Agency	<i>Which department has the proper authority, capacity, and knowledge to implement the strategy.</i>
Partners	<i>Internal or external stakeholders who have some decision-making authority, political influence, policy or regulation authority, or who can assist with implementation.</i>
STRATEGY IMPLEMENTATION INFORMATION	
Priority (Evaluation Score)	<i>Evaluation score and priority level. Priority levels may vary by jurisdiction for different scores (for example, a score of 10 may be high priority in one jurisdiction and medium priority in another).</i>
Actions/ Activities	<i>Steps that need to be taken to implement the strategy.</i>
Staff Lead	<i>Who has responsibility for overseeing the project and ensuring that the actions are taken.</i>
Cost Estimate	<i>General estimate of the cost of implementation. This can be quantitative or qualitative (no cost, low, medium, high).</i>
Benefits (losses avoided)	<i>General estimate of the impact of the strategy. Can be quantitative (lives, homes, or dollars saved), or qualitative (low, medium, high benefit).</i>
Potential Funding Sources	<i>How the implementation of the strategy might be funded. This may include general operation funds, grants, fees, or other financing tools.</i>
Timeline	<i>How long it will take to implement the strategy. You may choose to set a date by which the action should be implemented, or use a qualitative timeline estimate (near term, long term).</i>
Related Policies*	<i>Goals or policies already in place that support or assist the strategy. This may be in your general plan, climate action plan, housing element, climate adaptation plan, or sustainability plan.</i>

Example Strategy: ABAG/BCDC Stronger Housing, Safer Communities

STRATEGY DEVELOPMENT INFORMATION							
Problem Statement	The City of East Palo Alto experiences coastal flooding during extreme storms. One-quarter of the city and many single-family homes are within the coastal watershed that experiences flooding now. These storms are anticipated to increase in the future causing more frequent and extensive flooding.						
Strategy Name	Reduce flood risk through integrated watershed management						
Strategy Summary	Identify appropriate projects that sustain or enhance watershed functions while protecting development from shoreline flooding and riverine flooding.						
Hazard(s) Addressed	Current Flooding, Future Flooding						
Strategy Type	Operational	Programmatic	Plans, Regulations, and Policy Development	Capital Improvement/ Infrastructure Project	Education/ Outreach/ Coordination	Evaluation	
Process/ Implementation Mechanism	Long-Range Planning	Land Use Planning	Capital Planning	Operations	Emergency & Hazards Planning	Project Planning & Design	New Initiatives
Responsible Agency	Planning and Building Department						
Partners	FEMA, developers						
STRATEGY IMPLEMENTATION INFORMATION							
Priority (Evaluation Score)	13						
Actions/Activities	Conduct additional analysis of appropriate watershed projects, partner with FEMA for guidance and assistance, incorporate projects into long-term city plans, and pursue implementation of identified projects						
Staff Lead	Jane Doe						
Cost Estimate	\$50,000 planning, \$300,000 - \$1 million implementation						
Benefits (losses avoided)	Improves habitats and biodiversity, improves water quality, protects vulnerable residents and recreational uses, protects built environment						
Potential Funding Sources	FEMA						
Timeline	18 months planning, 3-5 additional years for implementation						
Related Policies	Existing policies for management of estuaries along shoreline to enhance bay shoreline flooding protection capacity						

Strategy Development and Implementation Worksheet

Purpose

This blank worksheet is a template for recording key information about a strategy that can assist in fleshing out the ideas put forth in the strategy as well as key information needed to move into implementation of the strategy.

Approach

Your project team should fill out this worksheet for every strategy your team is considering including in your project. First, as you are selecting possible strategies, work through the top half of the worksheet. Use this information as you evaluate each strategy. After going through the evaluation step, move to the bottom half of the worksheet only for those strategies that you will be implementing.

Outcome

After completing the top half of the worksheet, you will have adequate information on the strategy to evaluate and prioritize strategies. After completing the bottom half of the worksheet for the strategies you've selected to implement, you will have a basic road map for how to implement the strategy. Together, the table provides a succinct summary of each strategy adequate for your Hazard Mitigation Plan or any other plan you're developing, as well as a document that creates ownership and accountability for implementation.

WORKSHEET

STRATEGY DEVELOPMENT INFORMATION							
Problem Statement							
Strategy Name							
Strategy Summary							
Hazard(s) Addressed							
Strategy Type	Operational	Programmatic	Plans, Regulations, and Policy Development	Capital Improvement/ Infrastructure Projects	Education/ Outreach/ Coordination	Evaluation	
Process/ Implementation Mechanism	Long-Range Planning	Land Use Planning	Capital Planning	Operations	Emergency & Hazards Planning	Project Planning & Design	New Initiatives
Responsible Agency							
Partners							
STRATEGY IMPLEMENTATION INFORMATION							
Priority (Evaluation Score)							
Actions/ Activities							
Staff Lead							
Cost Estimate							
Benefits (losses avoided)							
Potential Funding Sources							
Timeline							
Related Policies*							

Next Steps

Going through the process outlined here results in a wealth of positive outcomes. This process represents an easily accessible, comprehensive, and adaptable way of thinking about risk assessment that meets regulatory requirements but goes above and beyond to allow users to place themselves and their priorities within the universe of resilience thinking for their own community. Going through this process establishes an understanding and culture that facilitates engagement, assessment, and action. Just walking through this process helps communities become more resilient because the steps allows users to develop the capacity to talk about and implement resilience projects. Using this process can build connections, conversations, and ideas that lead to ongoing better actions; build constituencies around issues and solutions; and build the political capacity and power base of all those involved.

The ideal outcome of the assessment process is sustained, repeated action to reduce risks and increase resilience around natural hazard mitigation and climate adaptation while also incorporating other goals such as environmental sustainability, maintaining or enhancing quality of life, or improving the local economy. Action before a short-term disaster or long-term stressor helps to protect or improve all of these elements after the disaster or stressor causes unwanted impacts on your community. Though the lens provided in this guide focuses on natural hazard mitigation, inclusive of climate change, it is critical to learn to view other goals through this lens so that all stakeholders within the community can relate to and identify themselves within this arena. The success of implementation depends on the successful integration of stakeholders into the process to cultivate a culture of resilience and ensure that the community believes in the outcomes as much as the team does.