

# Implementing the Steps to Resilience

A Practitioner's Guide

Second Edition



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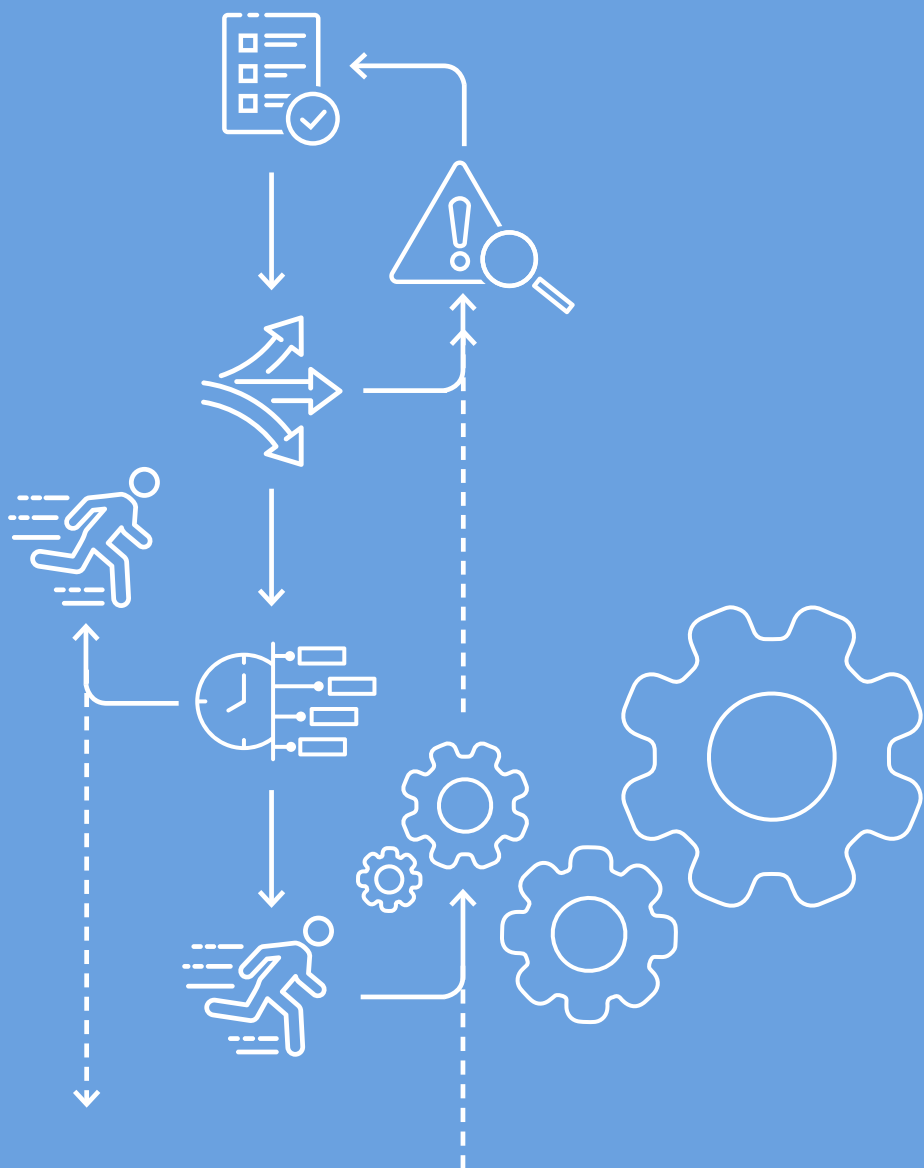
August 2024



For Nina



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## Quick start guide

This guide is intended to be used in two ways. The first is during synchronous and asynchronous training. Practitioners may use this as a workbook, marking it up with notes or filling out exercises. The second is as guidance when working with a community to implement the Steps to Resilience.

Each chapter corresponds to one of the Steps to Resilience and begins with objectives, a list of resources (such as worksheets and other guidance), roles and responsibilities for project team members, opportunities for community participation, and questions for assessing success.

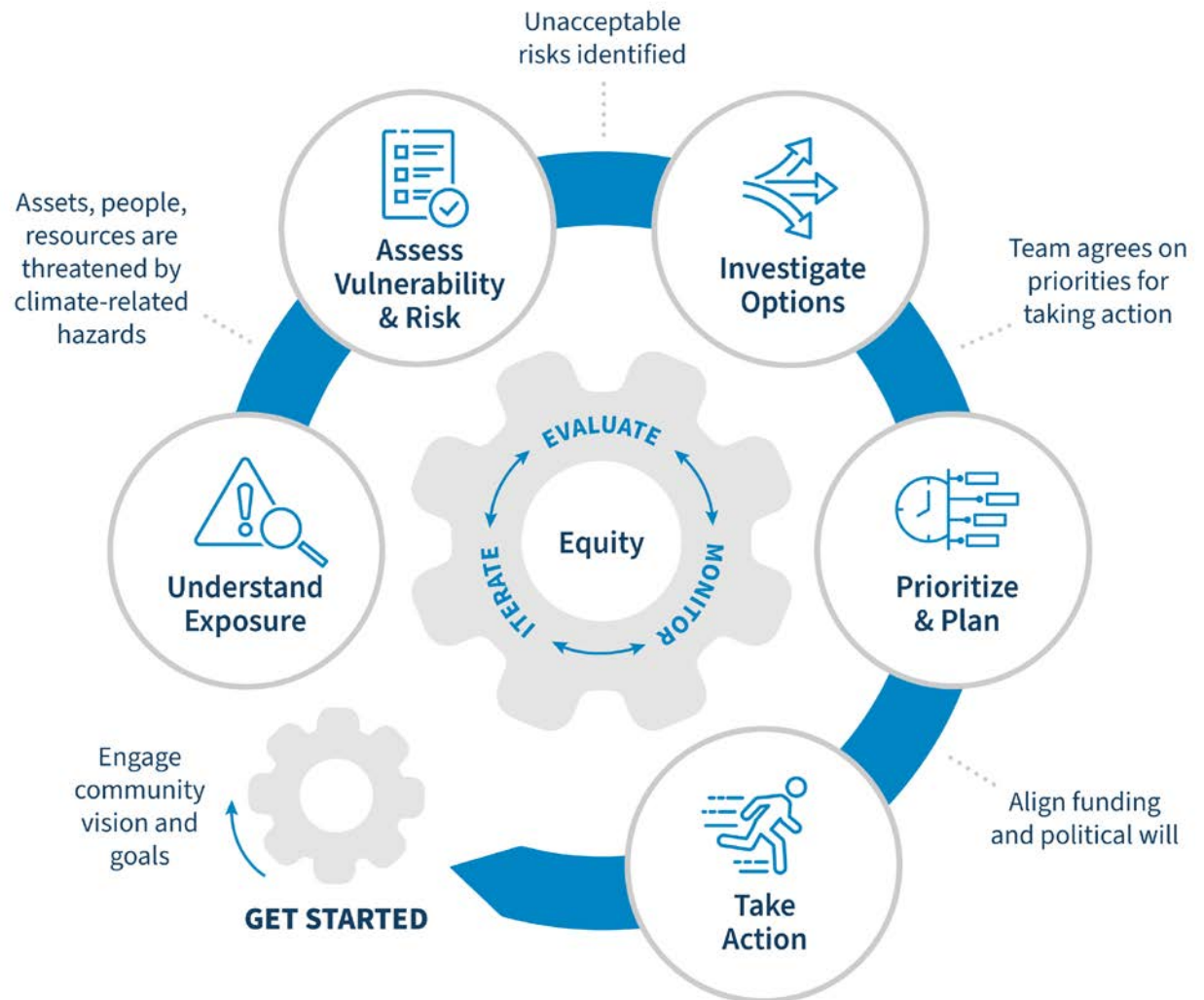


Figure 1. The Steps to Resilience. Source: U.S. Climate Resilience Toolkit.



Charleston, South Carolina. Source: Adobe Stock.

We also provide [Resources](#) that are referenced and linked throughout each step in two formats: (1) exercise worksheets that are meant to be completed by the [practitioner](#), members of the planning team, or a combination; and (2) additional guidance, with in-depth facilitation tips, presentation templates, sources of information, and collections of external resources or job aids.

Among those resources are two fully articulated examples of working through the Steps to Resilience in Charleston, SC, Louisville, KY and the fictional town of Nautilus. These examples are woven into a [formal training program](#) developed to help people learn and apply the Steps to Resilience in their own community-focused planning and implementation.

The bulk of this material is presented as practical guidance rather than academic context. Supporting resources are available in two formats: (1) exercises and worksheets that are meant to be completed by practitioners, members of the planning team, or both; and (2) documented guidance, with in-depth facilitation tips, presentation templates, sources of information, collections of external resources, and job aids. [Table 1](#) outlines all of the steps and objectives presented throughout this guide.

Given varying capacities, different pathways and levels of detail may be needed as practitioners and community members work through the Steps to Resilience. The Steps to Resilience should be applied flexibly to serve the needs of the community.


 <p><b>GET STARTED</b></p>	 <p><b>Understand Exposure</b></p>	 <p><b>Assess Vulnerability and Risk</b></p>
<p><b>Coordinate with the community champions to assemble a planning team and establish goals for the project.</b></p> <ul style="list-style-type: none"> <li>• Assemble a planning team</li> <li>• Plan for Community Participation</li> <li>• Understand background and historical context of the community</li> <li>• Define goals and create a project plan</li> <li>• Define equity-centered goals</li> <li>• Meet with the planning team for a kickoff</li> </ul>	<p><b>Identify people and community assets, hazards, stressors and potential impacts to the community.</b></p> <ul style="list-style-type: none"> <li>• Understand people and community assets, hazards and stressors</li> <li>• Document potential impacts through an exposure matrix</li> <li>• Inventory spatial and qualitative data</li> <li>• Meet with the planning team to review the Understand Exposure step results</li> </ul>	<p><b>Describe the people and community assets that are most vulnerable and at-risk. These become the central to the resilience plan and subsequent actions.</b></p> <ul style="list-style-type: none"> <li>• Determine type of assessment for each potential impact</li> <li>• Develop rulesets to assess vulnerability and risk</li> <li>• Meet with the planning team to review preliminary assessment results</li> <li>• Use assessment results to create impact statements</li> <li>• Finalize assessment and synthesize findings</li> <li>• Meet with the planning team to review final assessment findings</li> </ul>

Table 1. Summary of the Steps to Resilience and component procedures.


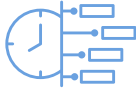

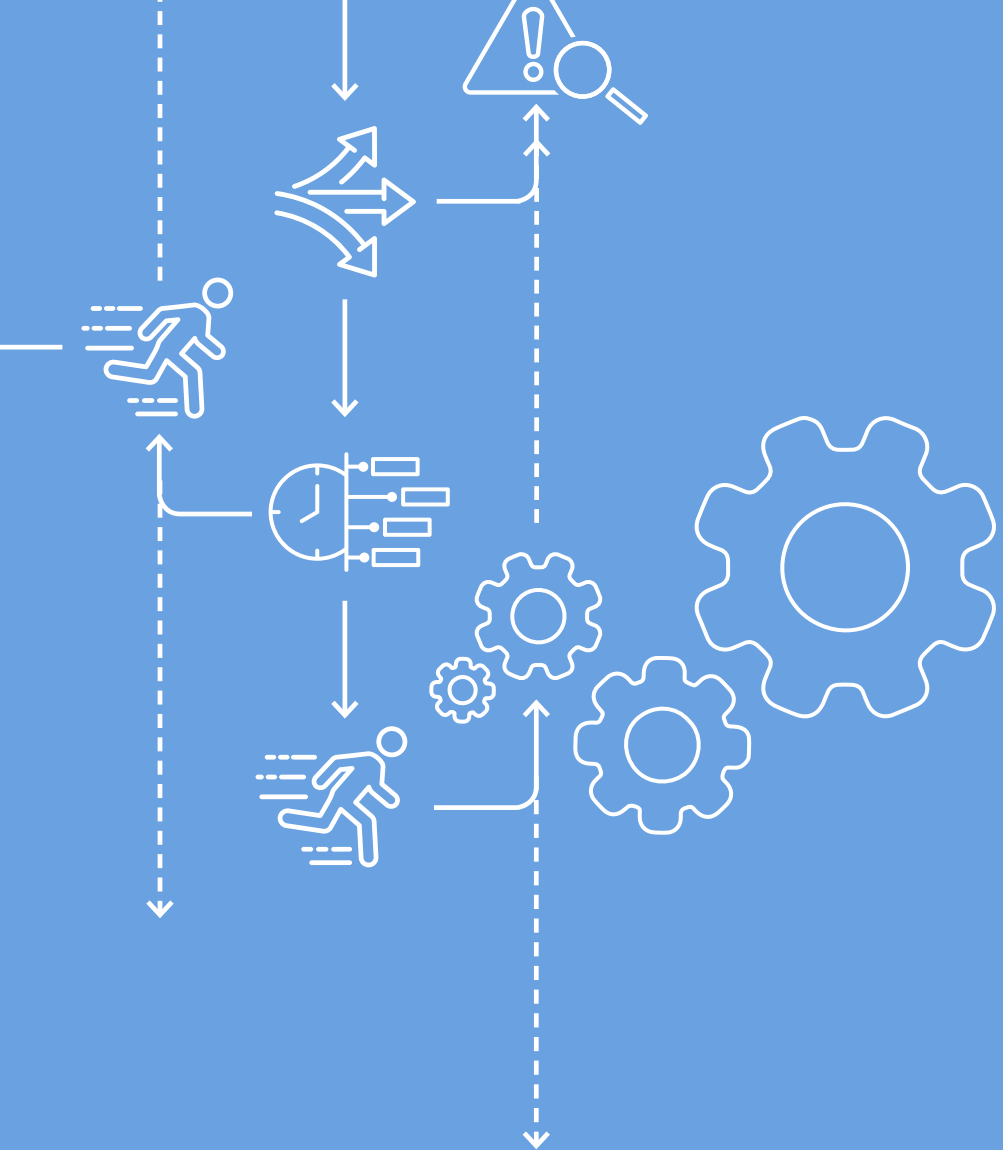
 <p><b>Investigate Options</b></p>	 <p><b>Prioritize and Plan</b></p>	 <p><b>Take Action</b></p>
<p><b>Develop resilience objectives, strategies, and projects that can reduce vulnerability and risk.</b></p> <ul style="list-style-type: none"> <li>• Review vulnerability and risk findings</li> <li>• Refine resilience objectives</li> <li>• Research options</li> <li>• Identify acceptable options in your community</li> </ul>	<p><b>Evaluate and prioritize strategies based on their potential to reduce vulnerability and risk. List the requirements for implementation of the climate resilience plan.</b></p> <ul style="list-style-type: none"> <li>• Prioritize resilience strategies</li> <li>• Evaluate projects and more specific actions</li> <li>• Consider uncertainty and scenario planning</li> <li>• Create an implementation plan</li> </ul>	<p><b>Implement and communicate the plan. Identify funding sources. Monitor results. Iterate.</b></p> <ul style="list-style-type: none"> <li>• Implement the plan</li> <li>• Identify and seek opportunities for funding</li> <li>• Create a plan to monitor and share lessons learned</li> <li>• Iterate and plan for persistent adaptation</li> </ul>

Table 1. Summary of the Steps to Resilience and its procedures. (continued)



# Introduction



# Introduction

While the costs of adapting to [climate change](#) may seem high, the costs of inaction are dramatically higher.<sup>1</sup> Billion dollar disasters have increased in number and cost by a factor of more than four in as many decades.<sup>2</sup> Aging infrastructure, more people and assets in harm's way, and increasing impacts from weather- and climate-related [hazards](#) are convincing communities throughout the country to consider upgrading infrastructure, services, and preparedness.

As local revenue is in demand for many pressing issues, climate may not be the foremost priority for every community. Therefore, climate [adaptation](#) efforts must align with community values if they are to be supported and successful.

A leading issue in American civil discourse is how best to redress inequity in the historical and current access to resources at all levels of society. Climate [adaptation](#) forces one to confront such disparities. Exploitation of natural resources, consumption of fossil fuels, and systematic marginalization of specific groups of people have emerged from a common set of economic and social systems. In many places, the communities of people who are most at [risk](#) to climate-related [hazards](#) are people of color and marginalized communities. Increasing community [resilience](#) requires addressing discriminatory practices, so equitable social values must drive climate [adaptation](#) project prioritization.

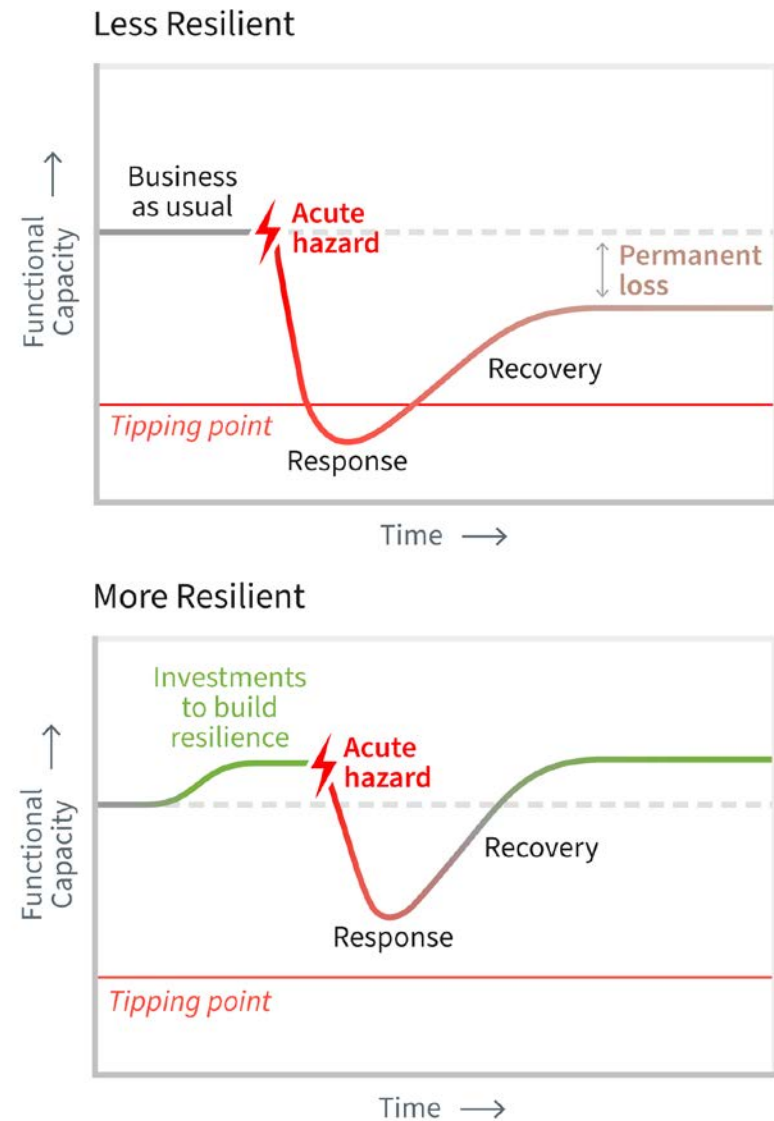
In deciding what efforts to fund and undertake, decision makers need to consider both the true costs of long-term impacts from [climate change](#) and the potential benefits of [resilience](#)-building projects to enhance quality of life. This guide draws on practical experience supporting climate [adaptation](#) around the nation to help others balance these decisions and evaluate their outcomes.

## Climate-informed decisions

Since 2014, the NOAA Climate Program Office has worked through the U.S. Global Change Research Program (USGCRP) to deploy the U.S. Climate Resilience Toolkit (CRT; [toolkit.climate.gov](https://www.climate.gov/toolkit)), a compendium of resources from throughout the federal government for planning and deploying climate [adaptation](#) and [resilience](#)-building efforts at state and local levels. A [risk-management strategy](#) called the Steps to Resilience is a central feature of the toolkit. Aligned with NOAA's mission, **the Climate Resilience Toolkit and Steps to Resilience focus on advancing the use of climate data to support state and local government decision-making.**

Building [resilience](#) means improving conditions so that the system can accommodate future disruptions. The graphs at right (Figure 2) illustrate two levels of [resilience](#). Above, a community asset or service operates at a steady state (business as usual) until an acute [hazard](#) occurs. If the level of service drops below a [tipping point](#), the system does not recover completely. Below, actions to improve community services while reducing [exposure](#), [vulnerability](#) and/or [risk](#) improve overall conditions prior to an acute [hazard](#) increase the system's functional level. From this higher baseline, the same acute [hazard](#) still requires a period of recovery, but no irreversible damage occurs.

Figure 2. A graphical definition of resilience. The system depicted above never recovers from an acute hazard whereas the one below has invested in resilience to events of the same magnitude. Source: U.S. Climate Resilience Toolkit.



Given gaps (known and unknown) in this document, we will continually invest in research to improve this guidance so that, together, [adaptation](#) experts may address ever more potential climate impacts. Please send comments to [noaa.toolkit@noaa.gov](mailto:noaa.toolkit@noaa.gov).

The [Steps to Resilience](#) framework is based on tested practices drawn from diverse disciplines and regions, all concerned with how to use climate information to inform actions that prevent loss of life, property, and essential functions in the natural and built environment.<sup>3</sup>

These comparable frameworks address a variety of potential climate-related impacts through diverse methods [📖 Comparable Risk Frameworks to the Steps to Resilience](#).

The multiplicity of approaches and associated vocabulary from many disciplines is reflected within the Climate Resilience Toolkit.

Systematic methods allow [practitioners](#) to compare their results, measure their efficacy, successfully garner funding and finance, and grow capacity for scaling up and accelerating equitable [resilience](#)-building and [adaptation](#) efforts in every community around the United States and its territories.

This guide does not provide tailored guidance for working in partnership with a tribal entity or community. As the Status of Tribes and [Climate Change](#) (STACC) 2021 report states, “Tribal nations are one of the most active entities in creating climate [vulnerability](#) assessments and [adaptation](#) plans.”<sup>4</sup> Dedicated resources have been developed by and for tribal communities and their partners. [Adaptation](#) and [resilience](#) for and with indigenous people and tribal entities is best produced by Indigenous [practitioners](#) or an individual or a group with significant experience in working with them. We value indigenous leadership and sovereignty in those efforts.

## Climate adaptation practitioners

Climate adaptation must greatly accelerate in order for community resilience and associated quality of life to keep pace with climate challenges.<sup>5</sup> Practitioners may come from the private and public sectors, academia, nonprofit organizations, and for-profit businesses (Figure 2). Practitioners should be familiar with the following skills and seek assistance as needed:

- Read, understand, and interpret climate science literature.
- Work with a planning team and facilitate a process using principles of equity and inclusion.
- Use spatial data and information.
- Work with communities to understand concerns and determine requirements that define vulnerability, risk, and potential impacts from climate-related hazards.
- Access and understand relevant solutions to problems, working with subject matter experts in many domains.
- Develop equitable, finance-ready resilience plans by honing in on the data, methods, tools, and governance structures that can be replicated, compared, and improved quickly.

It would be difficult for a single person to master this diverse set of skills and expertise, so practitioners are advised to build a network of individuals from various disciplines throughout the community. Government Champions and their professional networks often include individuals with technical backgrounds such as GIS, stormwater, planning, communications, and other diverse skills. In under-resourced settings, finding that expertise may require reaching beyond a local jurisdiction. Community Champions can assist

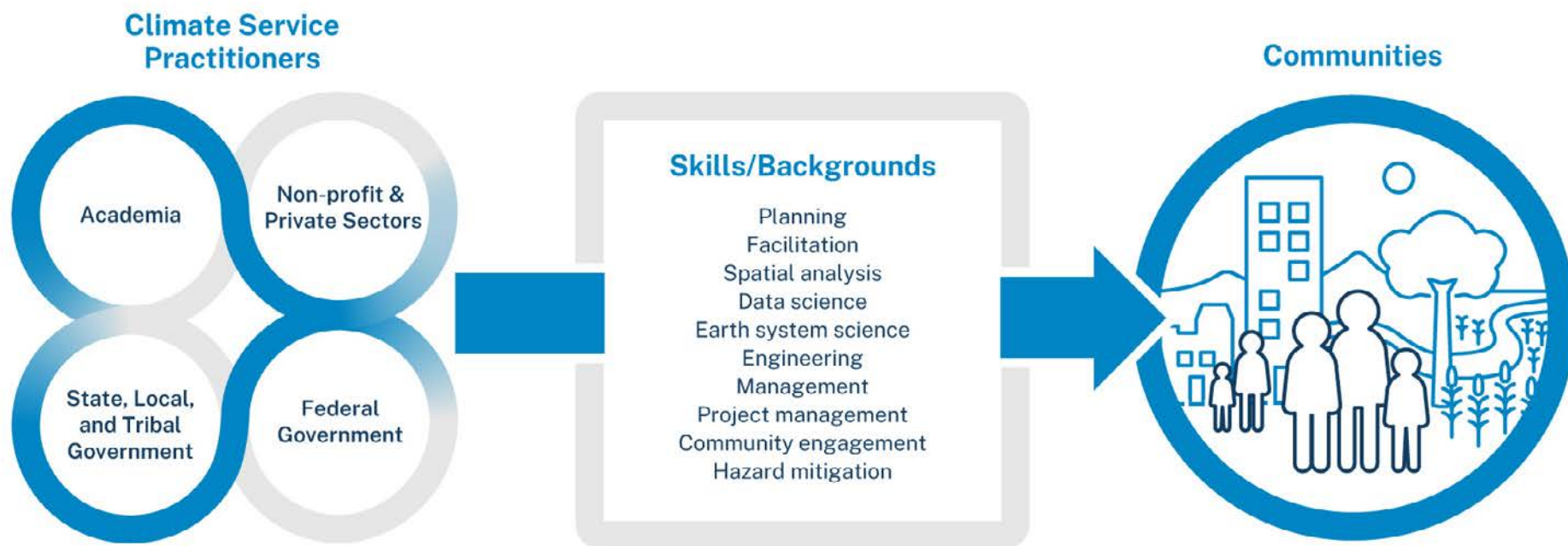


Figure 3. Climate Service Practitioners come from many sectors (interlocking circles on the left) and draw upon a variety of skills, both individually and through support from others (central box), in order to serve communities where they work (circle on right).

in connecting with affected communities or advocacy groups to ensure specific interests are addressed throughout the climate **resilience planning** and implementation process.

**Practitioners** must continually learn about new practices because **adaptation** and **resilience-building** are evolving specialties. Becoming an equity-focused climate **adaptation practitioner** may require years of study and immersion in environmental **justice** and community engagement to understand and address community members' lived experiences.

## Community and government capacity

Local governments may choose to train internal staff or hire climate [adaptation practitioners](#) as consultants. Most communities will blend these two methods of **building capacity**. Project implementation, monitoring and evaluation, community engagement, ensuring that all relevant government operations incorporate up-to-date information about climate-related impacts, and sharing lessons learned with other [practitioners](#) all require expertise and time to follow through.

Consider roles that climate [adaptation/resilience](#) experts, government representatives, and community leaders outside of government can play. We refer to these three personas as (a) [Climate Adaptation Practitioners](#), (b) [Government Champions](#), and (c) [Community Champions](#), respectively. Working together, people performing these roles can develop and implement equitable climate [resilience](#) plans using the Steps to Resilience. At the beginning of each chapter there is a table listing the responsibilities for the [Government Champion](#) and [Climate Adaptation Practitioner](#). There will be times where [Community Champions](#) fulfill part of the responsibilities as well. Each team will be unique. These tasks can shift between planning team members.

## Incorporating equity

**Equity in climate [resilience](#) implies race, class, ability or other social characteristics do not determine preparedness for the impacts of climate variability and change.**<sup>6</sup> Four forms of [equity](#) within resilient social systems are (1) [procedural](#), (2) [distributional](#), (3) [structural](#), and (4) [cultural](#).<sup>7</sup> [Practitioners](#) can use the following five principles to meaningfully incorporate equity in all phases of building climate [resilience](#). See the accompanying essay<sup>8</sup> for a detailed exploration of these topics.

## Focus on root causes and community strengths

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The historical antecedents of [climate change](#) and the disproportionate impacts of its effects on people, communities, and cultures requires [practitioners](#) to take a broad perspective on history and consequences of past decisions. The solutions to the climate crisis will be most effective when they address root causes of conflicts among the needs of people, the environment, and an interconnected economy. Climate [adaptation](#) policies, institutions, and cultural norms have sometimes perpetuated inequities, harming Black, indigenous, people of color (BIPOC), and other disadvantaged people. Countering systemic injustices requires centering belonging, equity, and [justice](#) in the solutions and the process of arriving at them.

Conversely, communities often have positive attributes and strengths serving as the basis for ongoing [adaptation](#). A positive mindset about these strengths can advance climate [adaptation](#) efforts. Institutions, policies, and finance can focus on solutions that increase such community assets.

## Balance power dynamics

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Planning methods often involve a top-down approach wherein decision makers develop a plan which community members might be invited to comment upon, endorse, or, worse yet, accept. In the most egregious cases, communities, often

communities consisting largely of people of color, have been demolished or reconstructed without consent or compensation.

In [community co-design](#), community members are treated as equal collaborators in all phases of a project: initiation, planning, action, and evaluation. Those who would be most impacted are authentically and deeply involved in determining outcomes. A community co-design process can focus on alliances that increase the capacity of historically marginalized communities to influence decision makers and drive change.

## Foster a sense of belonging

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To be effective, climate adaptation [practitioners](#) are urged to develop cultural competence about the community where they are working and devote substantial energy to understanding any and all systemic oppression. [Practitioners](#) will be most effective if they build trust, establish communication agreements, and take the time to get to know community members and leaders. Building this rapport may require [acknowledging past and present harms](#) perpetuated by those in power and working towards [healing and reconciliation](#). To establish reciprocal trust, community partners need to be equal stakeholders and friends. In other words, not just welcomed to the table but supported to be there every step of the way, including with money, data, accommodations, and other resources.

## Apply a place-based approach

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More than 90 percent of U.S. municipalities are modestly sized and resourced, with populations fewer than 25,000 people.<sup>9</sup> Local governments play an essential role in allocating resources to address the complex challenge of [climate change](#) impacts.<sup>10</sup> Both “bottom up” community planning and “top down” national strategies may help regions deal with impacts such as increases in electrical brownouts, heat stress, floods, and wildfires. Such a mix of approaches will require cross-boundary coordination at multiple levels as operational agencies integrate [adaptation](#) planning into their programs.<sup>11</sup> Acting in isolation at the local scale can reduce the effectiveness of adaptive responses or lead to [maladaptation](#). Cross-jurisdictional, cross-functional, cross-cultural collaboration is key. In a [place-based systems approach](#), the local community is the primary source of knowledge. Community members are involved in every step of the process. This iterative process honors learning and accommodates different competencies.

## Evolve with the process

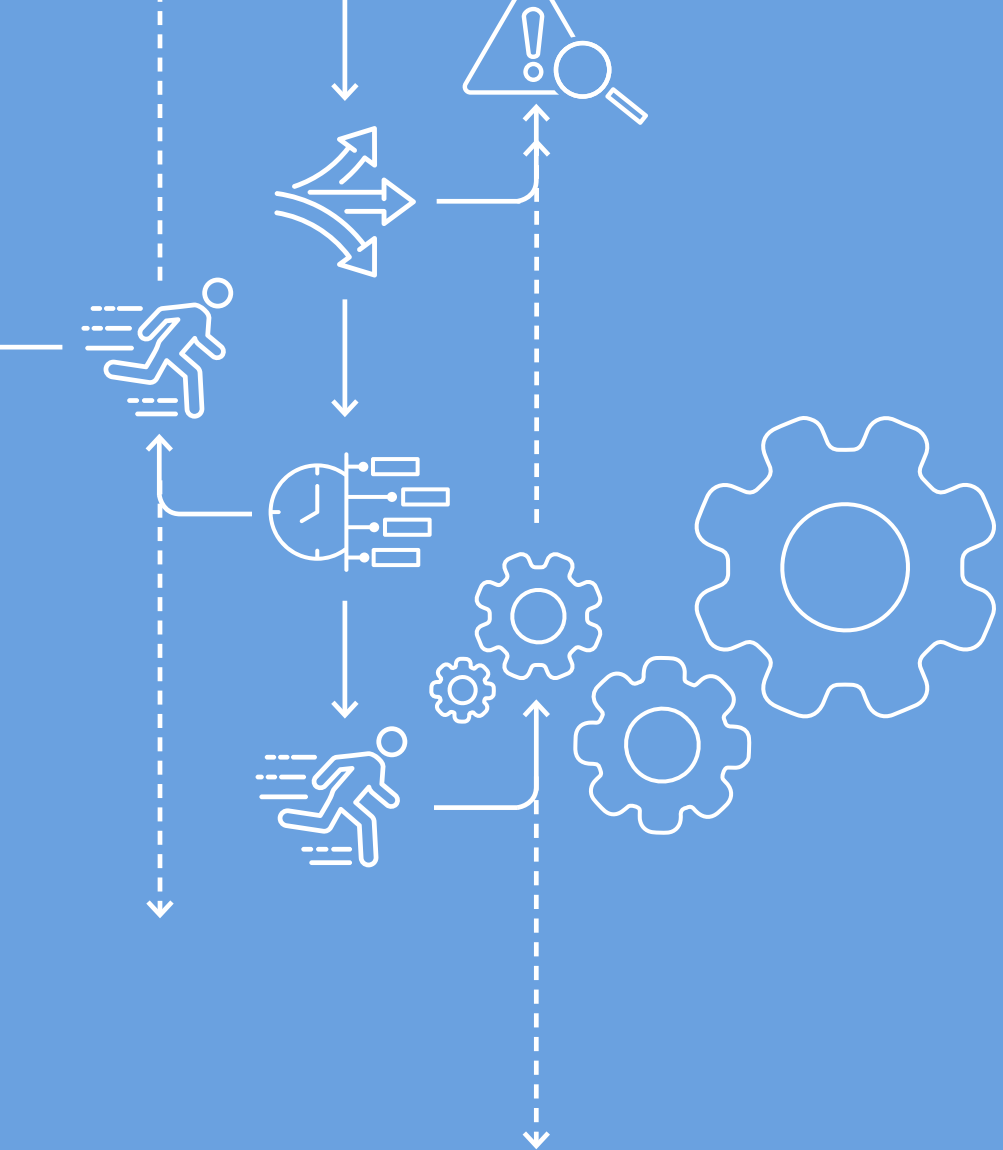
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A common pitfall of community-driven planning is viewing it as a series of linear steps to a predetermined objective. This objective is subjected to minor revisions upon community review or forced upon the community regardless of their opinions. In addition, many planning efforts stall before implementation due to lack of resources and political will. The entire process of integrating equity into a climate [resilience](#) approach must be viewed as a circular iterative process continuing beyond implementation. [Practitioners](#) acknowledge the Steps to Resilience is a long-term process that builds lasting relationships among the community and governmental or other traditional decision makers. This process should bridge the divide between the communities and governance structures. Correct and appropriate deliverables will be created from an equitable process.



## Endnotes

- 1 B.M. Sanderson. and B.C. O’Neill. Assessing the costs of historical inaction on climate change. *Sci Rep* 10, 9173 (2020). <https://doi.org/10.1038/s41598-020-66275-4>
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- 6 Fang et al., *Centering Equity in Climate Resilience Planning and Action: a Practitioner’s Guide*, 2022. <https://doi.org/10.25923/765q-zp33>
- 7 Kapwa Consulting, 2020. Definitions are provided in the Glossary under the term “equity.”
- 8 Fang et al., 2022.
- 9 Abrash Walton et al., 2016
- 10 National Research Council, 2010
- 11 Melillo et al. 2014, p. 671-672



**Get Started**

## Get Started



## Overview

Gather a team and agree on the scope of your potential project. Reach out to and recruit individuals from groups that can affect or will be affected by adaptation actions. Engage stakeholders who are in a good position to identify community concerns or assets of interest. Consider how to deepen or broaden engagement to ensure long-term success and buy-in with any decisions or outcomes. Be transparent at all stages, including how the scope and objectives of the **resilience** planning process was or will be agreed upon.

### Objectives

- Assemble the planning team
- Ensure community participation
- Understand community history
- Consult existing plans and resilience efforts
- Define equity-centered vision, values, and goals
- Project kickoff

### Practitioner's Guide Resources

- [1.1 Planning Team Contacts – Worksheet](#)
- [1.2 Plans, Initiatives, and Context Inventory – Worksheet](#)
- [1.3 Vision, Values, and Goals – Worksheet](#)
- [1.4 Project Timeline – Worksheet](#)
- [1.5 Kickoff Meeting Agenda – Worksheet](#)
- [1.6 Kickoff Meeting Slides – Template](#)

### Additional Resources

- [Comparable Risk Frameworks to the Steps to Resilience](#)
- [Community Disaster Resilience Zones and National Risk Indices Resources](#)
- [Facilitation Basics for Coastal Managers \(Instructor-led Course\)](#)

### Questions for assessing this step:

- Does your community have a current and future **resilience** problem (**risk**) due to a climate-related **hazard**(s)?
- In the planning team, is the full range of stakeholder perspectives represented in identifying community concerns or assets?
- Have you reached consensus on your **resilience**-related vision, values, and goals?

## Opportunities for community participation:

This step also presents an opportunity to use cross-sector partnerships to increase project capacity. These can include partners from the following sectors.

### Key Concepts

#### Community

A state, regional, county, local municipal, or tribal government, its residents, private businesses, organizations with a focus on local concerns, and non-governmental groups. The Steps to Resilience focuses on community representatives from each of these groups who are willing to be active stakeholders in building [resilience](#).

#### Climate Adaptation Practitioner

A climate adaptation and [resilience](#)-building professional that is skilled at building local capacity for climate [resilience](#) analysis, decision-support, and guidance.

#### Government Champion

A liaison within local government to other government staff and leaders (elected and appointed). [Government champions](#) maintain relationships with community members as well as governance organizations and personnel.

#### Community Champion

An individual from a community-based organization or stakeholder group who accepts responsibility for involving their constituents in decisions made throughout the Steps to Resilience.

#### Vision

A concise statement defining what the community desires for a climate-resilient future. It addresses the current shortfalls (pain points) and generates a common goal, hope, and encouragement.

#### Values

The primary things that the community cares about. Values define what makes a community special and establishes the baseline for quality of life.

#### Goals

The desired outcomes that need to be adopted to achieve the [resilience](#)-related community vision. Goals are overarching and consist of detailed objectives and targeted strategies. Goals seek to address known climate and [non-climate stressors](#) and related [hazards](#). Goals should be [equity](#)-centered.

# Get Started Roles and Responsibilities

Government Champion		Climate Adaptation Practitioner
<ul style="list-style-type: none"> <li>Assess why the community is in need of this type of planning effort (pain points compared to cost of continuing).</li> <li>Understand the role of a risk framework (specifically the Steps to Resilience) and its importance for decision-making related to risks from a changing climate.</li> <li>Identify key government stakeholders and lead the task of recruiting them for the planning team as appropriate. This could include recruiting Community Champions.</li> <li>Help establish project vision, values, and goal(s).</li> <li>Set the scope of the resilience project based on community needs and available resources.</li> <li>Understand local/ regional/ state governance structures and identify resources and key individuals to assist with the planning team in support of the project.</li> </ul>	<ul style="list-style-type: none"> <li>Help execute project goals.</li> <li>Collaborate with the broader community to garner support to move forward including key political and business leaders.</li> <li>Identify needs articulated by marginalized communities. Ensure equitable approaches.</li> <li>Provide access to relevant background information and existing plans and initiatives.</li> <li>Flexibly adapt to new information, resources and situations, and iterate.</li> <li>Collaborate with the planning team to agree on the study area.</li> </ul>	<ul style="list-style-type: none"> <li>Coordinate with the Government Champion on assessing the need of the community to engage in this planning effort.</li> <li>Understand the role of a risk framework (specifically the Steps to Resilience) and its importance for decision-making related to risks from a changing climate.</li> <li>Coordinate with Government Champion to support gathering a Planning Team.</li> <li>Coordinate with Government Champion to support development of vision, values, and goals.</li> <li>Ensure that project goals are applied throughout the Steps to Resilience.</li> <li>Coordinate with the Government Champion on the scope of the project and develop an implementation plan.</li> <li>Integrate key community information into the resilience plan.</li> </ul>

Table 2. Roles and responsibilities of the government champion and climate adaptation practitioner.



Planning team members will bring a variety of expertise that can both improve the process and contribute to positive outcomes. Source: Whitney Hansen, Fernleaf.

## In practice

### Gather a planning team

Before getting started, the climate [adaptation practitioner](#) must ensure the community they are planning to support is ready to confront climate issues and develop a climate [adaptation plan](#). A group with decision-making authority should articulate shared goals and desired outcomes. The team must include a [government champion](#) with sufficient influence to weigh in on decisions within the relevant jurisdiction. Likewise, sufficient numbers of community representatives and champions who will hold government representatives accountable for taking steps to implement recommended actions need to be involved. Working together, the team will identify the most urgent climate-related impacts to address as well as the resources needed to achieve their goals. The Climate Adaptation [Practitioner](#) will apply the Steps to Resilience to focus attention on where to invest limited resources to lower [risk](#).

[Climate change](#) is one of the main [stressors](#) increasing [risk](#) (the chance of a loss) in most places in the USA. The numbers and costs of Billion Dollar Disasters from severe storms, tropical cyclones, flooding, wildfire, drought, winter storms and other [hazards](#) are increasing. The federal government has published studies and accompanying maps that show where [risk](#) is high. These include the National Risk Index (NRI), CEJST, CDRZ and EPA's Disaster Resilient Design Concepts.

See [Community Disaster Resilience Zones and National Risk Indices Resource](#) for more information about these tools and how they may help in your practice.

Another [stressor](#) is continuing development of previously natural or vacant land. Altering land use and waterways exacerbates climate-related [risk](#). The ([risk](#)) problem is getting worse, and losses are mounting at unprecedented rates. Insurance companies are raising premiums and an increase in federal disaster payments will either add to the national debt or increase taxes.

But studies show that investing in [resilience](#) yields big returns - more than a 4:1 Benefit Cost Ratio. Therefore, if a community can first assess its [vulnerability](#) and [risk](#), and then determine the actions required to lower this [risk](#), they can begin to build community [resilience](#).

To Get Started the Climate Adaptation [Practitioner](#), [Government Champion](#), [Community Champions](#), and other team members consider the community's perception of [risk](#) from climate-related [hazards](#). The following questions can help the team determine if a community has a [resilience](#) problem and whether there are resources and sufficient commitment to address it.

- Does your community face current and or future [risk](#) associated with climate-related [hazard\(s\)](#)?
- Has the community experienced a recent “pain point” related to a [hazard](#)? Was the pain sufficient to elicit the community to consider taking action to build [resilience](#)?
- Is the community ready to engage and support climate [resilience](#) efforts both financially and logistically?
- Is the team ready to analyze the problem and also develop a plan that is robust enough to get implementation funds?
- Is it possible to discuss climate change (and how it is changing [risk](#)) openly in your community?



- Are there resources to support a [practitioner](#), a [government champion](#) and/or an empowered [community champion](#)?

Finding one or more [Government Champions](#) is essential before the team can get traction. [Government Champions](#) act as the liaison to all members of local government; they are key to locating and developing relationships with regional governance organizations and personnel. The [Government Champions](#) is the conduit between the work of the team and the government entities required to move the work from planning to action. [Government Champions](#) can come from a variety of backgrounds and disciplines including, but not limited to planning, stormwater, engineering, community development, emergency management, or public safety. Key attributes for success include an understanding of the [resilience](#) problems facing the community, support from senior executives, working knowledge of key government functions such as GIS, engineering, planning, public safety, and budgeting, and relationships with other government entities and local community groups.

[Community Champions](#) may also be necessary to successfully achieve goals that a broad community will support. Civic leaders such as representatives from non-profit, advocacy, or community-based organizations may have the stature and capacity to convene government and community members in a process that involves weighing decisions and values. [Community Champions](#) can also provide critical expertise or play important roles in generating and sustaining community support for [resilience](#) goals and project implementation.

**Gather a planning team** that will remain engaged in the process. Consider establishing advisory committees of collaborators whose specific interests may be engaged only during various stages.



**Iterate!** The StR are iterative. Team membership and roles may need to change over time depending on the goals within a given project phase.

Use the contact list resource [1.1 Planning Team Contacts - Worksheet](#) to identify planning and core advisory team members. At minimum, involve government agency representatives and community leaders in the core team, focusing especially those rooted in frontline communities.

Make note of the government departments or community perspectives that are represented. Evaluate whether any important perspectives are missing and whether additional involvement is critical before moving forward.<sup>12</sup>

Use cross-sector partnerships to increase project capacity. Consider including partners from the following sectors.<sup>13</sup>

**Local government staff:** representatives from government agencies (Public Works, Emergency Management, Sustainability, Housing, Health and Human Services, Finance, Transportation, Parks and Recreation), including those responsible for social and economic priorities.

**Community partners:** leverage existing community partnerships and foster new relationships with trusted frontline community leaders, faith-based groups, and community-based organizations and groups working to advance racial, economic, and environmental equity, sustainability, community development.<sup>14</sup> Consider synergies in goals and anticipated outcomes. When possible, compensate community partners for lending their expertise<sup>15</sup> and give them an equal voice to shape all aspects of the process as part of the planning team.

**Regional Governance:** regional, state, and federal agency representatives with jurisdiction over relevant transportation, energy, and water infrastructure systems, as well as social services such as public housing, welfare, [risk](#) insurance, and building codes.

**Private sector and philanthropic organizations:** leverage existing partnerships with the private sector and seek new relationships with community leaders such as the Chamber of Commerce or local anchor institutions that have a large stake in community [resilience planning](#) (universities, hospitals, companies that employ large numbers of local residents). Consider synergies in organizational mission and sectors of action.

**Scientific and expert stakeholders:** individuals or groups that can help elevate a sense of place and value for the ecosystems and their ecological functions will play a key role in including natural assets. Not all experts need to be engaged in every stage of the process, but consider them as potential participants on the broader planning team. For example, ecological scientists can help fill the information gaps early in the process, while resource managers may be most valuable during implementation decisions.<sup>16</sup>

**Residents** of the community who have expertise and are willing to participate on a planning team bring invaluable perspectives to planning efforts.



Source: Cade Martin, Dawn Arlotta, USCDCP.

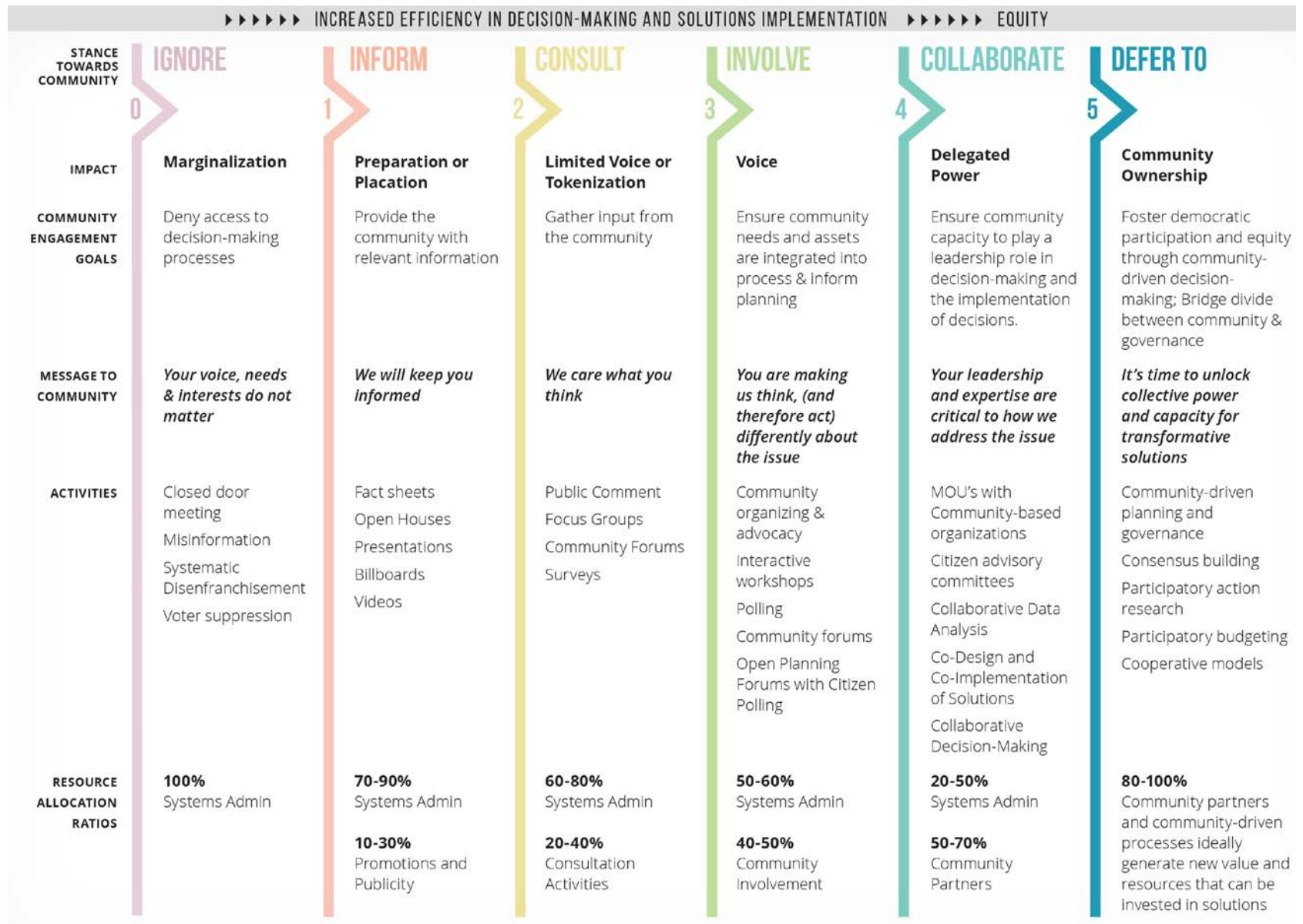
## Community participation

Meaningful community participation is indispensable for equitable public planning. Particular emphasis should be placed on the experience, knowledge, and expertise of **frontline communities** in understanding strengths, values, and vulnerabilities; shaping goals and strategies; and, determining priorities for building **resilience**. As described in the Spectrum of Community Engagement to Ownership,<sup>17</sup> community participation requires intentional collaboration built on a foundation of trust, transparency, and reciprocal relationships among local government agencies and communities they serve.<sup>18</sup> Strong community and local government capacity, adequate resources to support sustained collaboration, and leadership support are essential conditions for collaborative governance that shifts the power of decision making into the hands of communities most impacted by those decisions.

**Resilience planning** teams must evaluate existing capacity, capabilities, and resources available for local government staff and community members to participate in **resilience planning**. The Facilitating Power guidebook<sup>19</sup> provides guidance about techniques for evaluating readiness and for articulating goals for community involvement.

Before proceeding with the Steps to Resilience, government staff may need training to be effective liaisons to and with communities. It may be necessary to host listening sessions for community and government leaders and representatives to learn about climate issues and community priorities. These activities cost money and time. It may be necessary to identify sources of funds to support community participation.<sup>19</sup> Before proceeding with the StR, government staff may need training to be effective liaisons to and with communities. It may be necessary to host listening sessions for community and government leaders and representatives to learn about climate issues and community priorities. These activities cost money and time. It may be necessary to identify sources of funds to support community participation.<sup>18</sup>

# THE SPECTRUM OF COMMUNITY ENGAGEMENT TO OWNERSHIP



**Table 3.** Spectrum of Community Engagement to Ownership. Source: Rosa Gonzalez of Facilitating Power.

**Practitioners** can use the USDN Equity and Buildings Framework<sup>17</sup> to create a community participation plan. This plan includes the following elements.

- A clear purpose for seeking participation (“why”).
- “Who” will be engaged.
- How will historically marginalized and **frontline communities** be prioritized?
- “How” and “when” participation from community members will be sought.

**Frontline communities** have a critical role in every step of the **resilience planning** process, especially in identifying and advancing solutions. Community engagement can take place in a variety of ways and at various levels.<sup>20</sup> You may benefit from incorporating expert guidance when implementing community engagement strategies. For example, an existing community-based organization (CBO) may be well suited to help you engage with **frontline communities**.

## Understand community history

As described in the principles of **Equity in Climate Resilience** section, it’s important to understand the historical legacies of racism, colonization, and socioeconomic differentiation shaping the community. Examples include segregation, urban renewal, hazardous waste and pollutants in proximity to low-income and minority groups, and how present-day institutions, policies and practices continue to further entrench social and economic inequalities. To build this understanding, a **practitioner** should seek out the perspectives of impacted communities through analysis, reports, and other information produced by the community. This understanding is critical for working with historically marginalized communities,<sup>21</sup> connecting climate vulnerabilities to their root causes, and identifying solutions that address these causes.

The [Mapping Inequality](#) tool can be used to understand the history of and impacts of a practice called redlining across the nation. This discriminatory practice consists of the systematic denial of services such as mortgages, insurance loans, and other financial services to residents of certain areas, based on their race or ethnicity.

## Consult existing plans and [resilience efforts](#)

A community that is new to climate [resilience planning](#) may spend more time getting started than those who have already conducted a [vulnerability](#) assessment.

You can use any existing plans, initiatives, and context inventory resources [1.2 Plans, Initiatives, and Context Inventory - Worksheet](#) to compile background information.

Comprehensive plans and [hazard mitigation](#) plans are common in most communities and can be used in lieu of [vulnerability](#) assessments in some cases. Utilizing and improving such plans saves costs and minimizes duplication. In addition, the team can gain knowledge about local experiences, concerns from the community, the relationship between [hazards](#) and natural processes,<sup>22</sup> and what additional resources may be available as the project progresses. The list of existing plans will also be used in later steps.

## Vision, Values, and Goals

Developing and documenting the group's vision, values, and goals is the main task of Get Started. The community looks at the impacts and costs various **hazards** have had on the community. If the pain of that **hazard** was great enough, the community will address it in their vision, values and goals.

### Vision

The **Vision** is a concise statement defining what the community desires for a climate-resilient future. It addresses the current concerns and states a common goal. The **Government Champion** can use this vision statement to discuss what the **resilience planning** process hopes to accomplish.

### Values

The vision also needs to address community **Values**. Values describe what the community really cares about. Values reflect community members' emotions about what makes their community special. A good values statement establishes what community members see as their baseline for quality of life. Values can be defined through discussion about which community assets people are most interested in protecting (infrastructure, property, services).

### Goals

**Goals** are the desired outcomes that will achieve the **resilience**-related community vision. Goals are overarching; they can also include detailed objectives and targeted strategies. Goals seek solutions to known climate and **non-climate stressors** and related **hazards**. Goals should be **equity**-centered, ensuring that all people and neighborhoods benefit from actions.



Use the vision, values, and goals resource [1.3 Vision, Values, and Goals - Worksheet](#) to elicit the community's vision for a climate-resilient future. You can also use this to record goals and values. Don't worry about finalizing these statements at this point. You may want to modify them based on input over the course of the project. Developing a vision helps a community define the future it wants. Community participation in a shared vision can build an encouraging work environment and help create the conditions for fundamental change.

During goal-setting, be sure to address the equitability of desired outcomes. What social **equity** goals will help achieve the long-term community vision? The concept of Targeted Universalism (establishing universal goals and using targeted strategies to achieve those goals) can be helpful in the goal-setting phase.<sup>23</sup> Goals related to climate **resilience** can also address pre-existing **stressors** in the community such as food insecurity, shortage of affordable housing, and **exposure** to hazardous materials resulting from social, economic, and environmental inequities.

**Equity**-centered goals can foster a sense of belonging, power-sharing, and community well being.<sup>24</sup> Goal-setting can be facilitated using the framework of multidimensional aspects of **equity** introduced in the [Incorporating Equity](#) section. Goals should consider **procedural equity**, **distributive equity**, and **structural (or contextual) equity**.<sup>25</sup> Members of the planning team may be able to identify needs already articulated by marginalized communities, and broader community involvement during later stages of the project could help refine these goals.



Stakeholders and decision-makers in the Minnehaha Creek Watershed District participated in an outreach event to explore recent and projected flooding impacts and to consider potential solutions. Source: Minnehaha Creek Watershed District.

You can coordinate with government and community champions to gain buy-in on project goals from the broader community. Using the project timeline resource [1.4 Project Timeline - Worksheet](#), create a project timeline and identify important milestones.

Finalize planning team membership and roles. Return to the contact list to make sure records are complete, including preferred modes of communication. Determine if additional expertise is needed or if any stakeholder groups are not represented. Use the project timeline resource to document all aspects of the community participation plan. Make this document available to everyone involved.

Commit to full transparency: document every step of your process. This will serve you well when it is time to evaluate the work or recommend procedures to other groups. Establish a system for storing and sharing information, files, spatial data, meeting notes, and other written records to benefit everyone on the planning team. Make this file sharing system accessible to the entire team.

## Project kickoff

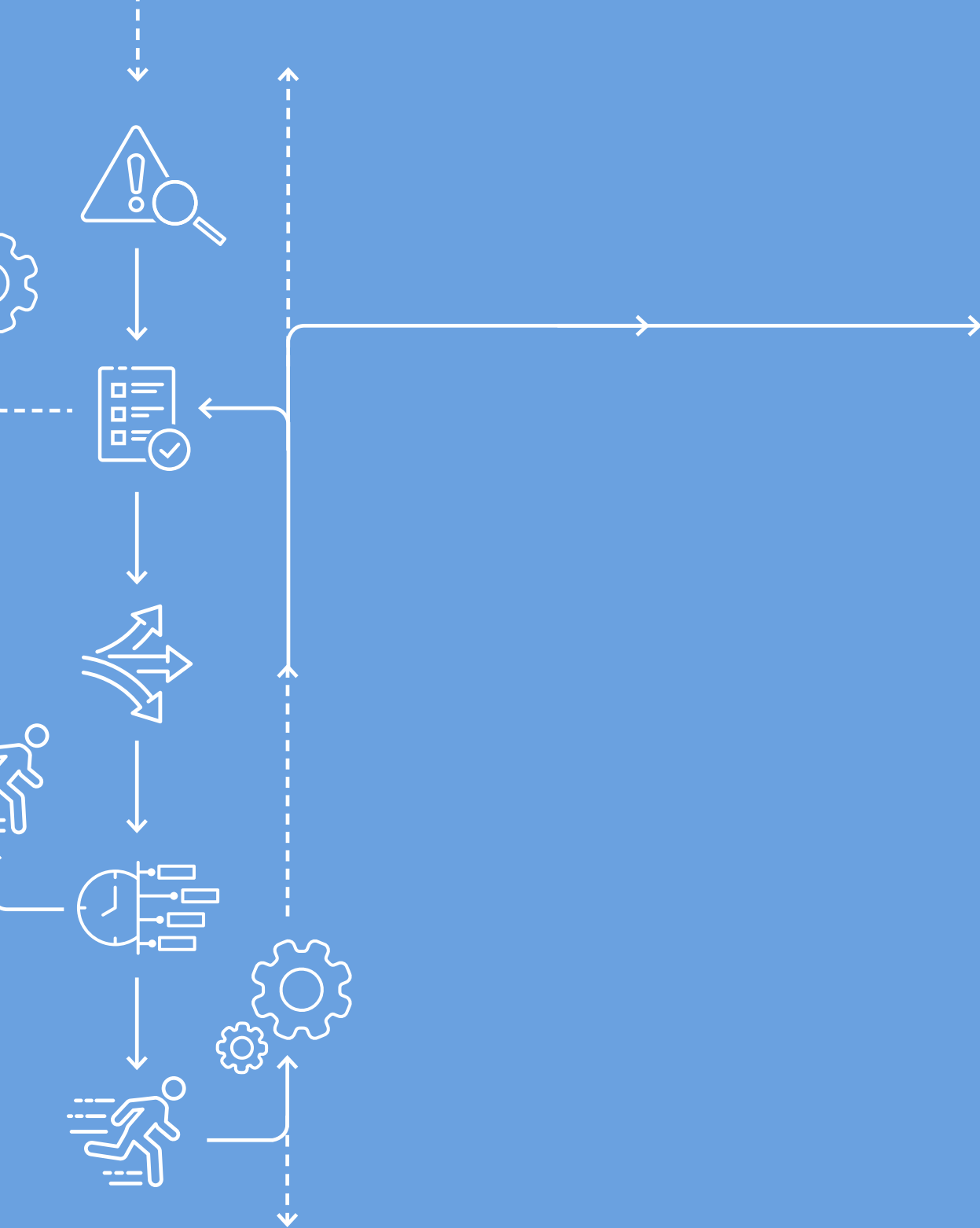
Plan, promote, and produce a kickoff event to announce your project to the larger community. Provide a broad overview of the project plan, timeline, and project goals. Introduce the team and the government and [community champions](#) to community members. Depending on the community and the scope of the effort, you may want to schedule a pre-event alignment meeting with government decision makers and/or elected officials to seek their support for the effort.

Include the full planning team in the kickoff meeting. This meeting also gives you an opportunity to check if/how membership of the planning team reflects your [equity](#) goals.

Use this annotated agenda [📄 1.5 Kickoff Meeting Agenda - Worksheet](#) and presentation template [📄 1.6 Kickoff Meeting Slides - Template](#) to develop your meeting agenda and materials.

## Endnotes

- 12 See Principle 2 on Page 17 and Fang et al. 2022
- 13 See more about local government staff, community partners, neighboring jurisdictions, and private sector or philanthropic organizations in Ready-to-Fund Resilience Guide Characteristic 1: Use cross-sector partnerships to increase project capacity.
- 14 Additional information about these partnerships can be found in the *Ready-to-Fund Resilience Guidebook Technical Document* and its Table 2 that summarizes the potential outcomes of partnerships.
- 15 Documented examples for compensating community members: <https://shelterforce.org/2021/02/26/paying-community-members-for-their-time/> and also this from Portland - <https://www.portland.gov/civic/advisorygroups/stipends>
- 16 From section 2.5, “Assemble Key Nature-based Solutions Stakeholders” in *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*.
- 17 Hays et al. Equity And Buildings: A Practical Framework For Local Government Decision Makers (2021)
- 18 Yuen et al. Guide to Equitable Community-driven Climate Preparedness (2017)
- 19 The Spectrum and additional information on using it can be found in *From Community Engagement to Ownership: Tools for the Field with Case Studies of Four Municipal Community-Driven Environmental & Race Equity Committees*.
- 20 *From Community Engagement to Ownership* also provides a helpful summary of “Essential Conditions for Collaborative Governance” that may be helpful for communities looking to advance their level of engagement with the community.
- 21 Fang et al. 2022.
- 22 Natural processes that are influenced by human-induced stressors can generate hazards. For a summary of natural processes, associated hazards and drivers, see Table 7 in *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*.
- 23 Powell et al., <https://belonging.berkeley.edu/targeted-universalism>
- 24 Vital Conditions for Community Health and Well-being Framework identifies ‘Belonging and Civic Muscle’ as one of the seven conditions that promote community well-being. See the discussion by Well Being Trust: [https://thriving.us/vital-conditions/belonging-civic-muscle/#what\\_you\\_need\\_to\\_know](https://thriving.us/vital-conditions/belonging-civic-muscle/#what_you_need_to_know)
- 25 A few references that discuss different dimensions of equity in the context of adaptation and resilience: Foster et al. 2019, Yuen et al. 2017); Meerow et al. 2019, GCC Equitable Adaptation Legal and Policy Toolkit.



## Understand Exposure



## Overview

Evaluate community assets to document their exposure to climate-related hazards. Check that you have considered the full range of potential climate impacts for your location.. This will help ensure that you perform a comprehensive assessment of vulnerability and risk in the following step. The process may require exploring multiple sources of information such as climate projections, Traditional Ecological Knowledge, community knowledge, and observational data.

### Objectives

- Identify people and community assets, hazards, and stressors
- Document potential impacts through an exposure matrix
- Delineate study area and inventory spatial, quantitative, and qualitative data
- Meet with the planning team to review results

### **Practitioner's Guide Resources**

- ☰ [2.1 Systems Thinking and Conceptual Models - Guidance](#)
- ☰ [2.2 Build a Conceptual Model - Worksheet](#)
- ☰ [2.3 Community Asset Themes - Worksheet](#)
- ☰ [2.4 Identifying Hazards, Climate Stressors, Social Vulnerability, and Non-Climate Stressors - Guidance](#)
- ☰ [2.5 Evaluate Hazards and Stressors - Worksheet](#)
- ☰ [2.6 Potential Impacts Matrix - Worksheet](#)
- ☰ [2.7 Sources for Spatial Data - Guidance](#)
- ☰ [2.8 Spatial Data Collection - Worksheet](#)
- ☰ [2.9 Tips for Collecting Spatial Data - Guidance](#)
- ☰ [2.10 Community Asset Types and Spatial Data - Worksheet](#)
- ☰ [2.11 Social Vulnerability Indicators and Spatial Data - Worksheet](#)
- ☰ [2.12 Annotated Agenda for Meeting to Review Exposure - Template](#)
- 🗨️ [2.13 Meeting to Review Exposure Slides - Template](#)

### **Additional Resources**

Vulnerability and Risk Basics (Risk and Risk Management Narrative)

- ☰ [CSCI Risk and Risk Management Narrative](#)

## Key Concepts

### People and community assets

People, resources, ecosystems, infrastructure, and the services they provide; the tangible and intangible things that people or communities value.

### Hazard

An event or condition that may cause injury, illness, or death to people or damage to assets.

### Climate stressor

A condition, event, or trend related to climate **vulnerability** and change that can exacerbate threats/**hazards**.

### Non-climate stressor

A change or trend unrelated to climate that can exacerbate threats/**hazards**.

### Exposure

The presence of **people and community assets** in places where they could be adversely affected by **Hazards**.

## Opportunities for community participation

- Identify community strengths, values, tangible, and intangible assets
- Document community experiences and insights from past events
- Identify community **stressors**, including disparities in access to resources
- Gather qualitative data from community members and partners
- Assess gaps in quantitative data by comparing with community knowledge and experiences

## Questions for assessing this step

- Is the full range of stakeholder perspectives represented in identifying community concerns or **people and community assets**?
- Are there key things the community values (assets) that are **exposed** to harm from climate-related **hazards**?
- What will future conditions look like for your location during the full lifecycle of the community assets? Will these future conditions increase your current **risk**?



# Understand Exposure – Roles and Responsibilities

Government Champion	Climate Adaptation Practitioner	
<ul style="list-style-type: none"> <li>• Help the Climate Adaptation Practitioner identify information about specific facilities, infrastructure types, or natural assets that are important to the community or that provide protective benefits.</li> <li>• Help with inventorying potential impacts resulting from exposure.</li> <li>• Collaborate with the planning team to agree on the study area.</li> <li>• Be familiar with participatory data collection and analysis for community experiences and challenges.</li> <li>• Flexibly adapt to new information, resources, and situations and iterate.</li> </ul>	<ul style="list-style-type: none"> <li>• Be able to articulate the relationships between people and community assets, hazards, and stressors and how future change could increase vulnerability and risk for each impact pair.</li> <li>• Identify people and community assets, and collect spatial data by working with the Government Champion.</li> <li>• Identify hazards, and linked stressors and collect spatial data from local, state, and national sources.</li> <li>• Evaluate hazards and linked stressors using risk indices and other tools.</li> <li>• For climate-related stressors, identify what future conditions look like for your location for the full planning cycle (30 years, 50 years).</li> </ul>	<ul style="list-style-type: none"> <li>• For non-climate stressors, identify projected future development, economic, and demographic conditions) for the full planning cycle (e.g., 30 years or 50 years).</li> <li>• Identify social vulnerability indicators that are relevant for the community (from Census Data and Social Vulnerability Indices).</li> <li>• Construct a Potential Impacts Matrix.</li> <li>• Meet with the Government Champion and Planning Team to discuss the Potential Impacts Matrix and review Goals.</li> </ul>

Table 4. Roles and responsibilities of the government champion and climate adaptation practitioner in this step.

## In practice

### Identify people and community assets, hazards, and stressors

In the previous step, the planning team determined they have a current and future **resilience** problem (**risk**) related to a climate-related **hazard(s)**. The **Government Champion** formed a Planning Team to help address the issue. The team is ready to start the Steps to Resilience **risk assessment** to determine which parts of their community are most vulnerable and at **risk**, and to determine what they can do to build **resilience**. Many teams choose to enlist a **Climate Adaptation Practitioner** to assist them.

**Risk** is the chance of a loss. Put another way, **risk** reflects the potential for a negative consequence where something of value is at stake.

Performing a **risk assessment** starts with looking at which of your assets are exposed to **hazards**. **Exposure** is the presence of **people and community assets** (things we value) in places where they could be adversely affected by **hazards**.

Start with a comprehensive list of **community assets**. Check historical records, current conditions, and future **projections** to characterize which of your assets are exposed to climate-related **hazards**, now or in the future. To quantify **exposure**, you'll need to convert climate data into information that is suitable for decision making. To gather this information, start with the conceptual model at left.

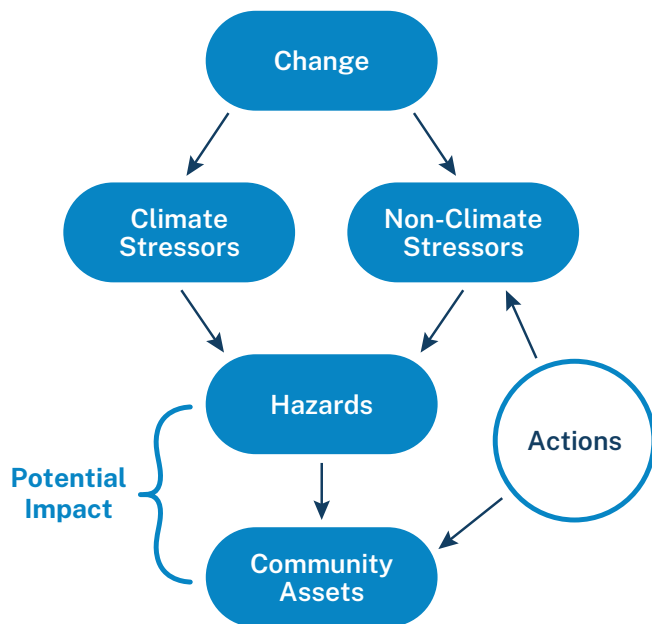


Figure 4. Conceptual model of potential climate-related impacts. Source: U.S. Climate Resilience Toolkit.

Figure 4 articulates the relationships among **people and community assets**, **hazards**, and **stressors** and how future change could increase **vulnerability** and **risk**. **Exposure** of **people and community assets** to **hazards** can lead to a **potential impact**. Actions to build **resilience** generally focus on those assets or the **non-climate stressors** which can be managed to ameliorate **potential impacts**.

The Systems Thinking with Conceptual Models **2.1 Systems Thinking and Conceptual Models - Guidance** exercise can be used by the planning team to create their own conceptual models.

### **People and community assets**

**People and community assets** are the groups, places, natural resources, infrastructure, and services the planning team agrees are important to protect. They include social, financial, cultural, political assets, and strengths of the community. These are the things the community values, that promote well being, power the community's economy, and make the neighborhood, community, or city special and unique. What is it about the people and sense of place that are unique? What are the strengths of the community?

Work with your planning team to compile information about specific facilities, infrastructure types, and natural assets that are important to the community or that provide protective benefits. Include locations of entities such as SNAP food retailers, emergency shelters, medical facilities, and farmers markets. In addition, explore the full range of natural areas, going beyond recreational assets such as trails and parks to include wetlands and waterways, riparian buffers and floodplains, urban tree canopies, habitat corridors, and other natural assets. Broadening the community's awareness of

Community Asset	Type
<b>Cultural &amp; Community Services</b>	Social services, faith-related services, recreation, community centers, senior services, childcare services, libraries, historical sites and properties
<b>Food, Medical, and Shelter Facilities</b>	Grocery stores, pharmacies, nursing homes, snap retailers, hospitals and healthcare-related facilities, emergency shelters
<b>Government-owned Properties</b>	Police and Fire Stations, city-owned properties, schools, emergency operations and logistics centers
<b>Commercial and Industrial Property</b>	Businesses, hotels, banks, mixed-use, industrial/ manufacturing properties. This can also include jobs and sales volume that businesses provide.
<b>Residential Property</b>	Single-family residences, multi-family residences, condos, group homes, assisted housing
<b>Parks, Greenways, Open Space (formally designated)</b>	Parks, trails, undeveloped recreation areas
<b>Natural Areas</b>	Wetlands, waterways, riparian buffers and floodplains, urban tree canopies, habitat corridors, remnant natural ecosystem patches
<b>Roads and Mobility</b>	Major and minor roads, critical access to essential and emergency services

Table 5. Example Community Asset themes and types.



Specific data can also be collected for the project. The inset image, taken with a forward looking infrared (FLIR) camera, shows heat and is overlain on a regular photograph for context. In the FLIR image, lighter or brighter colors indicate warmer areas, while darker areas are cooler. Source: Science Museum of Virginia

these assets can help [practitioners](#) in later steps to steer conversations on multiple co-benefits of natural assets such as protective benefits and community well-being and recreational benefits.<sup>26</sup>

[Practitioners](#) and the planning team can use the Defining Community Asset Themes resource [2.3 Community Asset Themes - Worksheet](#) to begin placing [community assets](#) into themes (Table 5). These can be based on the combination of FEMA lifelines and critical infrastructure categories,<sup>28</sup> local knowledge, and community values. Themes reflect any given community's unique circumstances and will be used later during spatial data collection for [vulnerability](#) and [risk assessments](#).

### **Hazards and climate stressors**

What are your community's primary climate-related [hazards](#)? Examples of climate-related [hazards](#) include flooding, wildfire, and heat waves (Table 6). Communities can draw on their collective experience and trusted sources of information to identify relevant potential [hazards](#) for their area.

Compile a list of climate-related [hazards](#) that have occurred or could occur in your region. Include a list of possible data sources for documenting these [hazards](#). Ask your planning team to review the list and offer feedback.

**Climate stressors** are conditions, events, or trends related to climate variability and change that can exacerbate **hazards**. For example, rising sea levels can exacerbate the effects of coastal flooding. While coastal flooding may be a current issue, rising sea levels are a **stressor** that can make the problem worse in the future. Because **climate stressors** can worsen the impacts of **hazards** over time, they are an important consideration for long-range planning.

Use the following resources to identify and evaluate **hazards** and stressors.

The Identifying Hazards and Stressors document [2.4 Identifying Hazards and Stressors - Guidance](#) provides guidance for using tools and information.

The Evaluate Hazards and Stressors worksheet [2.5 Evaluate Hazards and Stressors - Worksheet](#) provides a space to record your answers to the questions posed in the Identifying Hazards and Stressors resource.

### **Non-climate stressors**

**Non-climate stressors** include changes in land use, use of resources (energy and water), and infrastructure, economic, and social conditions that can exacerbate the impacts of a **hazard**. For example, impervious surfaces (unrelated to climate) are known to contribute to increased runoff, erosion, and flooding in urban areas. Changes in **non-climate stressors** can have a more immediate and measurable influence on **hazards** than **climate stressors**.

Hazards	Climate Stressors	Non-climate Stressors
Tidal Flooding	Sea level rise	Aging infrastructure
	Heavy precipitation	Increased development/impervious surfaces
Storm Surge	Sea level rise	Aging infrastructure
	Tropical systems	Increased development/impervious surfaces
Flooding (both Rainfall Induced and Coastal)	Sea level rise	Increased development/impervious surfaces
	Increase in rainfall frequency/intensity	Aging/undersized infrastructure
Extreme Heat	Temperature variability	Increased development/impervious surfaces
Wildfire	Drought	Wildland/urban interface (WUI) development/fuels and vegetation, historic fire suppression
	Temperature variability	Human-caused ignitions, historic fire suppression
Landslides	Increase in rainfall frequency/intensity, high temperatures, and snowstorms	Development/vegetation removal
Supply chain interruption	Heavy precipitation	Supply use/demand
	Tropical storms	

**Table 6.** Potential climate-related hazards and associated climate and non-climate stressors that can exacerbate impacts of the hazard. Source: U.S. Climate Resilience Toolkit.

## Document potential impacts with an exposure matrix

Return to the information collected about [hazards](#) and [stressors](#)  
[2.5 Evaluate Hazards and Stressors - Worksheet](#) and [community assets](#)  
[2.3 Community Asset Themes - Worksheet](#) and work with the core team to inventory the range of [potential impacts](#) resulting from [exposure](#).

Use the Potential Impacts Matrix resource [2.6 Potential Impacts Matrix - Worksheet](#) to determine which of your [community assets](#) are exposed to various [hazards](#).













Potential Impact 	Hazards			
	Community Assets	Flooding	Landslides	Wildfire
City-owned Facilities				
Commercial Properties				
Residential Properties				
Endangered Fish Population				

Table 7. Example matrix of potential impacts, where  indicates exposure of an asset to a hazard, and therefore a potential impact.



## Nature-based Solutions Consideration:

A community's climate risks are heavily influenced by non-climate stressors such as impervious surfaces and upstream conditions, such as land cover, land use, or disturbances such as deforestation. To create a conducive space for nature-based solutions in later steps, now is the time to understand the broader geographic context, scale, and consequences of landscape processes, such as watershed dynamics.<sup>28</sup>

Returning to the conceptual model, this exercise encourages you to consider which hazards have the potential to impact each community asset. In a later step, you'll evaluate and measure these potential impacts in a structured way to help communities to make informed decisions.

## Inventory spatial, quantitative, and qualitative data

Once the study area has been delineated, the practitioner can begin building an inventory of relevant spatial datasets. Most communities use a mix of local, state, and federal data, depending on the location and scale of the project and general data availability.

The Sources for Spatial Data resource [2.7 Sources for Spatial Data - Guidance](#) includes a list of recommended data products and sources. For some community assets, additional data sources will need to be consulted.

## Delineate study area

The planning team must agree on the extent of the study area. Not all projects will involve an entire governmental jurisdiction such as a town, city, or county. Many impactful projects will involve single neighborhoods or smaller geographic areas. To establish the scope of your resilience study, the Planning Team examines where the "pain points" are in the community. Review your Vision, Values, and Goals to make sure the study area is properly defined and focused.

The Planning Team should take a realistic approach to bound the study area based on resources, time, and community and political interests. This can keep the planning team focused on projects the community will support, and they can accomplish.

## Inventory spatial data

Use your [community asset themes](#) and your [hazards](#) and [stressors](#) research to build an inventory of spatial data you need to use. There are three categories of spatial data that need to be collected for the assessment: boundaries and property records, [community assets](#), and [hazards](#).

Before beginning the collection, [practitioners](#) may want to review tips for collecting spatial data [2.9 Tips for Collecting Spatial Data - Guidance](#). This resource details how and where these datasets can be found.

To carry out the spatial data collection, use the Spatial Data Collection sheet [2.8 Spatial Data Collection - Worksheet](#) to record information you collect from various data sources.

## Boundaries and property records

Parcel data from the local tax assessor's office will serve as the foundation of your community asset data for your [vulnerability](#) and [risk assessment](#). This dataset will also represent facilities and services identified as valuable [community assets](#). Any additional

## Nature-based Solutions Consideration:

Practitioners can employ a range of methods to identify a community's natural assets, such as beaches, forests, coral reefs, wetlands, that provide different types of ecosystem services. Employing a combination of existing data sources, remote sensing, and community knowledge will help build a comprehensive understanding of natural assets and features in an area that is not limited to formally designated parks and recreational amenities (e.g., trails, fishing piers). Rather, practitioners should help communities explore the full range of natural assets such as wetlands and waterways, riparian buffers and floodplains, urban tree canopies, habitat corridors, and remnant natural ecosystem patches that may provide protective benefits or other services.<sup>29</sup>

community asset data you collect will be overlain or spatially intersected with parcel boundaries in your assessment. The parcel data may be a combination of spatial (data representing a geographical area) and tabular (data displayed in columns or tables) data, and it will be important to keep track of which data are in which format in the resource.

An additional dataset showing building footprints can help you determine whether structures in your study area lie within a hazard extent. Building footprints may not be available from the community, but may be available from state or national sources. The community may also have access to datasets characterizing uses of buildings or properties.

The study area boundary, parcel data, building footprints, and other necessary attributes are included in the “Boundaries and Underlying Data” section of the Spatial Data Collection sheet [2.8 Spatial Data Collection - Worksheet](#). If possible, give this list directly to GIS specialists on the project team as they are most likely to have access to the spatial data you need.

### Community asset theme spatial data

Refer to the the community asset resource [2.3 Community Asset Themes - Worksheet](#). Use the themes from this exercise to complete the associated section of the Spatial Data Collection resource. Use the parcel data and/ or another dataset to determine whether you have sufficient information to include the community assets listed in those themes. Add each asset to the sheet with the corresponding dataset.

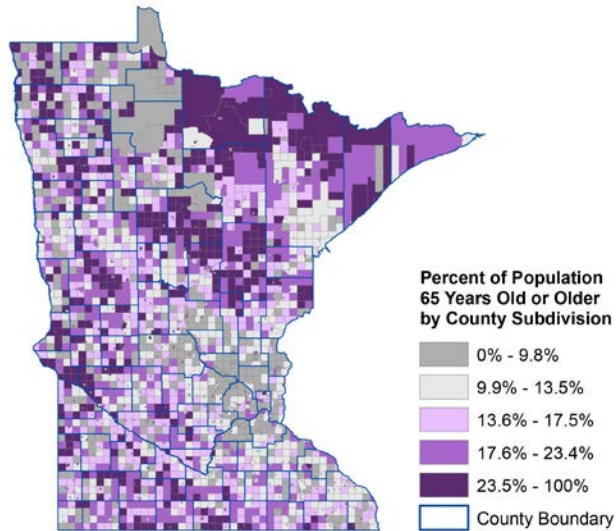
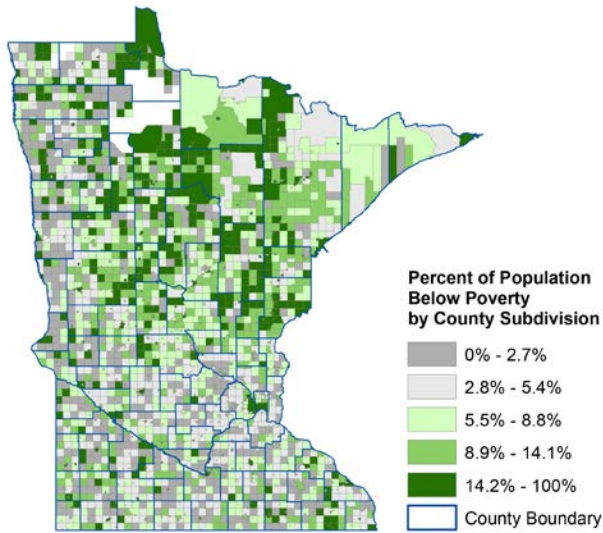


Figure 5. Decision makers can identify where to focus their resilience-building efforts by identifying where relatively high numbers of vulnerable people live. Source: Minnesota Department of Health.

If GIS-formatted data are unavailable, the next best option is tabular data containing latitude and longitude coordinates or addresses that can be geocoded. These data will be spatially intersected with the parcel data to add granularity to the parcel use codes.

### Community asset types

Grouping specific types of properties or services into common themes can help you move through the details of your assessment. Under a community asset theme of “Critical Facilities,” you can further delineate assets into **police**, **fire**, and **emergency operations centers**. These are often identified using the tax assessor parcel use codes and or additional spatial data.

Refer back to the community asset resource [2.3 Community Asset Themes - Worksheet](#), where you developed community asset themes. Use the Community Asset Types and Spatial Data resource [2.10 Community Asset Types and Spatial Data - Worksheet](#) to develop corresponding community asset types. Examples are provided within the resource for guidance. This list will be used in the Assess Vulnerability and Risk step for the spatial analysis and can be a reference throughout the remainder of the project.

### Hazards spatial data

The “Hazards Spatial Data” section in the Spatial Data Collection resource [2.8 Spatial Data Collection - Worksheet](#) can be used to identify the spatial data that you need to collect for each hazard, including source, year, file

location, and important attributes. These data will often come from federal or state sources, unless a community has completed a local study. Spatial data may be available as vector-based polygons or raster files. Collect hazard data that covers the full extent of the study area.

In addition to spatial data, you may collect narrative assessments. These brief descriptions can also be recorded here, along with any supporting documentation.

### **Socioeconomics**

Socioeconomic indicators from the most recent U.S. Census Bureau American Community Survey or decennial census (whichever is most recent) can be collected at the tract or block group scale.

Use the Social Vulnerability Indicators and Spatial Data resource [2.11 Social Vulnerability Indicators and Spatial Data - Worksheet](#) to learn how to download and use census data, as well as record what indicators and datasets have been collected.

### **Identify gaps and limitations of quantitative data; consider qualitative data**

As spatial data is collected, be sure to identify if anything is missing. For example, pumping stations for stormwater might be a community asset, but such data may not be publicly available. One may need to request them from a governmental department. Another

gap could exist if a community has only a tabular list of certain facilities and no spatial data. If no data exist for any community asset type, make a note of the gap so it is not forgotten or ignored.

If no or limited spatial data exist for the **hazard** at hand, then the assessment may be done through qualitative methods such as narrative documentation. These differences will be covered in the Assess Vulnerability and Risk step. It is important to note when such cases arise and integrate the understanding of data limitations when drawing insights from the **vulnerability** assessment in the Assess Vulnerability and Risk step. Community experiences and challenges documented through reports developed by community-based organizations or revealed through conversations with community partners and residents can be important sources of qualitative data. The Planning Team can also consider participatory data collection and analysis) for community experiences and challenges that are not adequately represented in the existing qualitative or quantitative data.<sup>30</sup>

## Meet with the planning team to review results

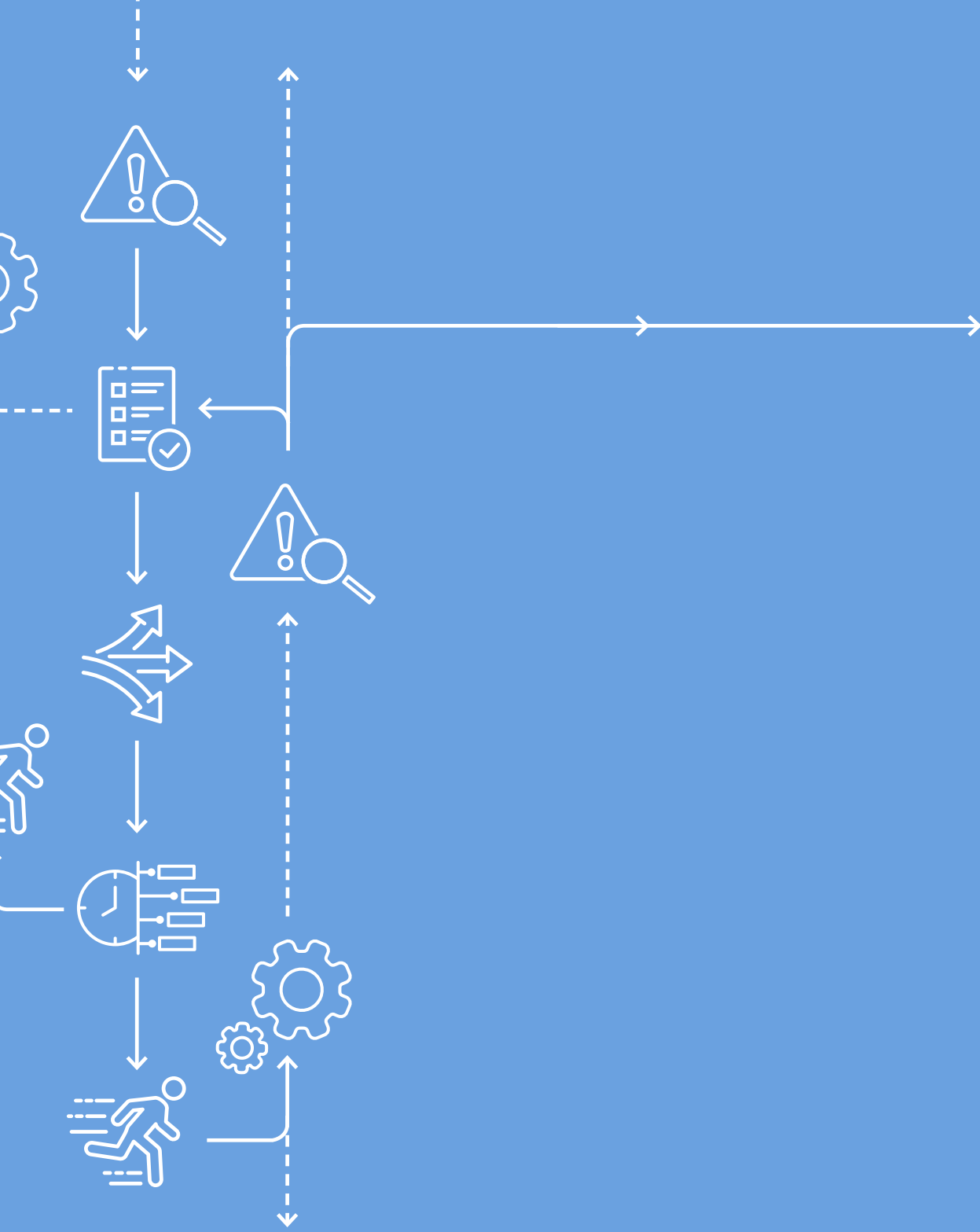
This meeting will provide an overview of the **hazards** and **community assets** identified (including asset themes), and data collection progress. The meeting should also include an updated discussion of community **exposure** and perceived **risk** from climate related **hazards**. Comparing the perceived **risk** to your community vision, values, and goals (developed in Get Started), the planning team should revisit the questions posed at the beginning of this chapter to make sure all stakeholders are committed to moving to the next step of assessing **vulnerability** and risk.

This meeting should include the full planning team, the community champion(s), and community members should be invited to attend. An annotated agenda is provided [📄 2.12 Annotated Agenda for Meeting to Review Exposure - Template](#), along with a companion presentation template [📄 2.13 Meeting to Review Exposure Slides - Template](#). Both can be updated as needed.

## Endnotes

- 26 Additional reading on community assets in the context of natural systems can be done in section 2.1 of *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*.
- 27 FEMA Lifelines and PPD21 Critical infrastructure categories include asset types that are often combined into one or multiple asset categories in this process.
- 28 Section 2.3 of *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*.
- 29 Section 2.1 of *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*.
- 30 See brief discussion on ‘Valuing Qualitative Data’ in Fang et al. (2022) and references therein





# Assess Vulnerability and Risk



## Assess Vulnerability and Risk

### Overview

Evaluate the **vulnerability** of your **community assets** by considering their qualities of **sensitivity** and **adaptive capacity**. Characterize risk based on the **probability** of the **hazard** and the magnitude of potential loss. Define these attributes by incorporating community input. This chapter addresses processes and expected outcomes and increases the community's capacity to conduct and understand **vulnerability** and risk assessments. By the end of the step, the community will understand how **hazards** potentially impact populations and **community assets**.

#### Objectives

- Determine type of assessment for each potential impact
- Develop rulesets and assess vulnerability and risk
- Review preliminary assessment with planning team
- Use assessment results to create impact statements
- Finalize assessment and synthesize findings
- Review assessment findings with planning team

## Resources

- ☰ 3.1 Determine Assessment Type - Worksheet
- ☰ 3.2 Guiding Questions for Narrative Assessments - Worksheet
- ☰ 3.3 Ruleset Library - Guidance
- ☰ 3.4 Ruleset Development - Worksheet
- ☰ 3.5 From Rulesets to Maps - Worksheet
- ☰ 3.6 Quality Control Checklist - Guidance
- ☰ 3.7 Preliminary Results Meeting Agenda - Template
- ☐ 3.8 Preliminary Results Meeting Slides - Template
- ☰ 3.9 Preliminary Results Feedback - Worksheet
- ☰ 3.10 Develop Impact Statements - Worksheet
- ☰ 3.11 Vulnerability and Risk Synthesis Report - Template
- ☰ 3.12 Impact Statements Workshop Agenda - Template
- ☐ 3.13 Impact Statements Workshop Slides - Template

## Opportunities for community participation

- Share your analysis publicly. Involve frontline community representatives in evaluating data and in analyzing underlying drivers of inequities
- Identify intersectional and compounding vulnerabilities

## Questions and metrics for assessing this step:

- Were you successful in finding and using climate-related [hazard](#) data (mapped or otherwise) to assess the impact these [hazards](#) will have on the [community assets](#)?
- Is there significant current [risk](#) and [vulnerability](#) in your community to justify moving to the next step of investigating [options](#) to build [resilience](#)?

- Will future climatic conditions adversely change the **hazards** that impact **community assets** (function, integrity, access, cost) as defined and valued by the affected communities?
- Can the assessment process be repeated by participants for subsequent iterations of this process either due to later learning or emerging challenges?

## Key Concepts

### Vulnerability

The propensity or predisposition of assets to be adversely affected by **hazards**. **Vulnerability** encompasses **exposure** to **potential impacts**, **sensitivity**, and **adaptive capacity**.

### Sensitivity

The degree to which a system, population, or resource is or might be negatively affected by **hazards**.

### Adaptive Capacity

The ability of a person or community asset, or system to adjust to a **hazard**, take advantage of new opportunities, or cope with change.

### Risk

The potential for negative consequences where something of value is at stake. In the context of the assessment of climate impacts, the term **risk** is often used to refer to the potential for adverse consequences of a climate-related **hazard**. **Risk** can be assessed by multiplying the **probability** of a **hazard** by the magnitude of the consequence or loss.

### Probability

The likelihood of **hazard** events occurring, traditionally determined from the historic frequency of events.

### Magnitude of the Consequence

A subsequent loss of value that follows from damage or loss of an asset.

# Assess Vulnerability and Risk Roles and Responsibilities

Government Champion	Climate Adaptation Practitioner
<ul style="list-style-type: none"> <li>• Develop familiarity and ease with the proper use of the terms risk, vulnerability, exposure, sensitivity, and adaptive capacity. Understand how these terms relate to one another when assessing vulnerability and risk.</li> <li>• Assist the practitioner, as needed, in the classification of vulnerability and risk.</li> <li>• Collaborate with the planning team to agree on where and why people are most vulnerable to hazards.</li> <li>• Assist the practitioner and planning team, as needed, to build out rulesets (vulnerability and risk) for the community.</li> <li>• Identify locations and criticality of community assets.</li> <li>• Identify the most acute and widely experienced pre-existing (non-climate) stressors in the community.</li> <li>• Collaborate to develop impact statements.</li> <li>• Flexibly adapt to new information, resources, and situations and iterate.</li> </ul>	<ul style="list-style-type: none"> <li>• Develop familiarity and ease with the proper use of the terms risk, vulnerability, exposure, sensitivity, and adaptive capacity. Understand how these terms relate to one another when assessing vulnerability and risk.</li> <li>• Determine Assessment Type for each Impact Pair (spatial vs. narrative).</li> <li>• For spatial assessments, construct an exposure map for each impact pair.</li> <li>• Construct rulesets (vulnerability and risk) for each impact pair.</li> <li>• Using the rulesets, construct vulnerability and risk maps for each impact pair.</li> <li>• Construct summary risk/vulnerability maps for the community that show ranked risk for each impact pair.</li> <li>• Develop Impact Statements for each impact pair.</li> <li>• Construct a summary table of risk/ vulnerability that compares to the Impacts Matrix from the previous step.</li> </ul>

**Table 8.** Assess Vulnerability and Risk roles and responsibilities of the government champion and climate adaptation practitioner.

## In practice

### Determine type of assessment for each potential impact

Assessments of vulnerability and risk may be spatial or narrative. Use the questions outlined in the Determine Assessment Type resource [3.1 Determine Assessment Type - Worksheet](#) to determine if a spatial or narrative assessment should be performed for every potential impact identified in the previous step (Understand Exposure).

#### Spatial assessments

Spatial assessments are most often performed at the level of individual facilities or properties using parcel and building spatial data collected in the previous step. Characteristics of the assets are then used to classify them into low, medium, and high levels of vulnerability and risk. Natural assets also may be mapped and analyzed for vulnerability and risk in their own right and for their role in reducing risk of climate-related hazards to communities.<sup>31</sup> Most of the content of this chapter addresses details pertinent to spatial assessments.

#### Narrative assessments

For general planning purposes or when spatial data are not readily available, narrative assessments may be necessary or sufficient. Narratives can provide a detailed history of a past hazard and potential future impacts, in scale and magnitude. The assessment

should include information related to the types of community assets that are most commonly impacted by this [hazard](#). Contextual maps and other data or graphical illustrations may be helpful to support a narrative assessment. As with a spatial data-supported assessment, the goal is to use available contextual information and data to understand what conditions could lead to [vulnerability](#) for the community.

The Narrative Assessment Development resource [3.2 Guiding Questions for Narrative Assessments - Worksheet](#) provides guiding questions and an example of developing a narrative assessment.

The Hazards and Stressors resource [2.4 Identifying Hazards, Climate Stressors, Social Vulnerability, and Non-Climate Stressors - Guidance](#) may be a useful resource for developing these narratives.

### **Sector-based assessments**

Although either type of assessment can be done at the community or multi-jurisdictional scale, there may be a need to complete a sector-based assessment. This type of assessment may evaluate impacts to sectors that serve the community but exist outside its borders. Supply chains, transportation, water, and energy are essential to any community but generally involve multiple jurisdictions. Because of the scale of these sector assets, disruptions to these can be one of the largest vulnerabilities to a community. In the previous step, Understand Exposure, these extrinsic impacts were defined along with the study area. A sector-based assessment can be either spatial or narrative.

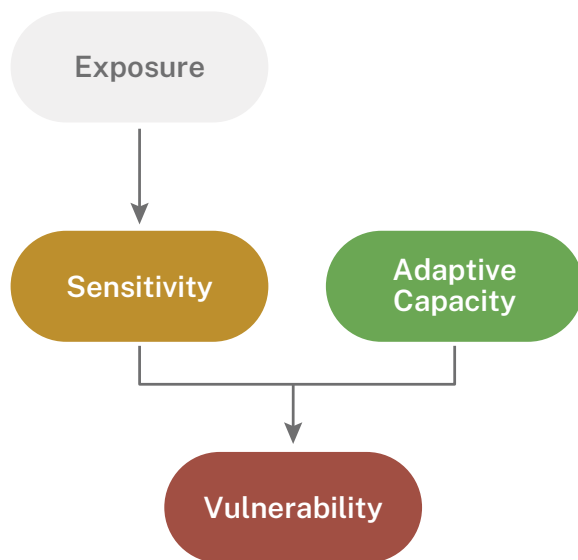


Figure 6. Components of vulnerability.  
Source: U.S. Climate Resilience Toolkit.

## Exposure

**Exposure** is the presence of people and **community assets** and ecosystems in places where they could be adversely affected by **hazards**. To map **exposure**, overlay the appropriate **hazard** map with the impacted asset (defined by parcels or comparable area outline).

See the first step in the mapping example in [3.5 From Rulesets to Maps - Worksheet](#).

## Vulnerability

Two factors comprise **vulnerability**: **sensitivity** and **adaptive capacity** (Figure 6). This section focuses on how to evaluate individual buildings on land parcels in a city’s tax database. Parcel data are often available in digital mapping formats that make it simple to use property attributes to translate the ideas being taught here. The examples used here are not meant to preclude other methods of assessment, such as narrative assessments or sector-based assessments (see above), nor are these methods meant to exclude social systems concepts.

### Sensitivity

Consider the use of the parcel. Does it provide a crucial service to the community? If the answer is “yes,” that parcel has **high sensitivity**. A good example of a parcel with **high sensitivity** is the land on which a hospital is located. A parcel with **lower sensitivity** might be the location of a warehouse with equipment that can be moved easily.



## Nature-based Solutions Consideration:

Assessments can consider the vulnerability of natural systems. Doing so in parallel with other valued community assets allows communities to identify when and where existing and intact natural systems can continue providing benefits and services, and where it is necessary to proactively protect or restore ecosystems. Read more about assessing the vulnerability of natural systems in section 3.1 of Incorporating Nature-based Solutions into Community Climate Adaptation Planning.

## Adaptive Capacity

**Adaptive capacity** is associated with the ability to cope with **potential impacts** (Table 9; Figure 8). **Adaptive capacity** addresses characteristics of the community asset or population that ensure they will remain intact following a climate-related **hazard**. For example, a building built above the floodplain or with flood **mitigation** equipment intrinsic to its physical plant has high **adaptive capacity**. A structure could be said to have low **adaptive capacity** if it lacks these characteristics.

## Rulesets to assess vulnerability

How can one measure and evaluate **sensitivity**, **adaptive capacity**, and **vulnerability**? The answer lies in applying consistent and systematic rules, which we call “**rulesets**.” By translating asset characteristics into standard measures of **sensitivity**, **adaptive capacity**, and **vulnerability**, **rulesets** help the planning team focus on the largest **potential impacts**.

In this section, we describe how to assign **high**, **medium**, and **low** classifications to **sensitivity**, **adaptive capacity**, and **vulnerability**; **vulnerability** is derived through the combination of **sensitivity** and **adaptive capacity**. In the following section, the same process is repeated to assign **high**, **medium**, and **low risk** categories to assets and asset classes based on another set of **rulesets**.

What follows are **rulesets** for determining **sensitivity** of structures in parcels that are occasionally exposed to flooding. In this example, all assets lie within an area that experiences occasional flooding.

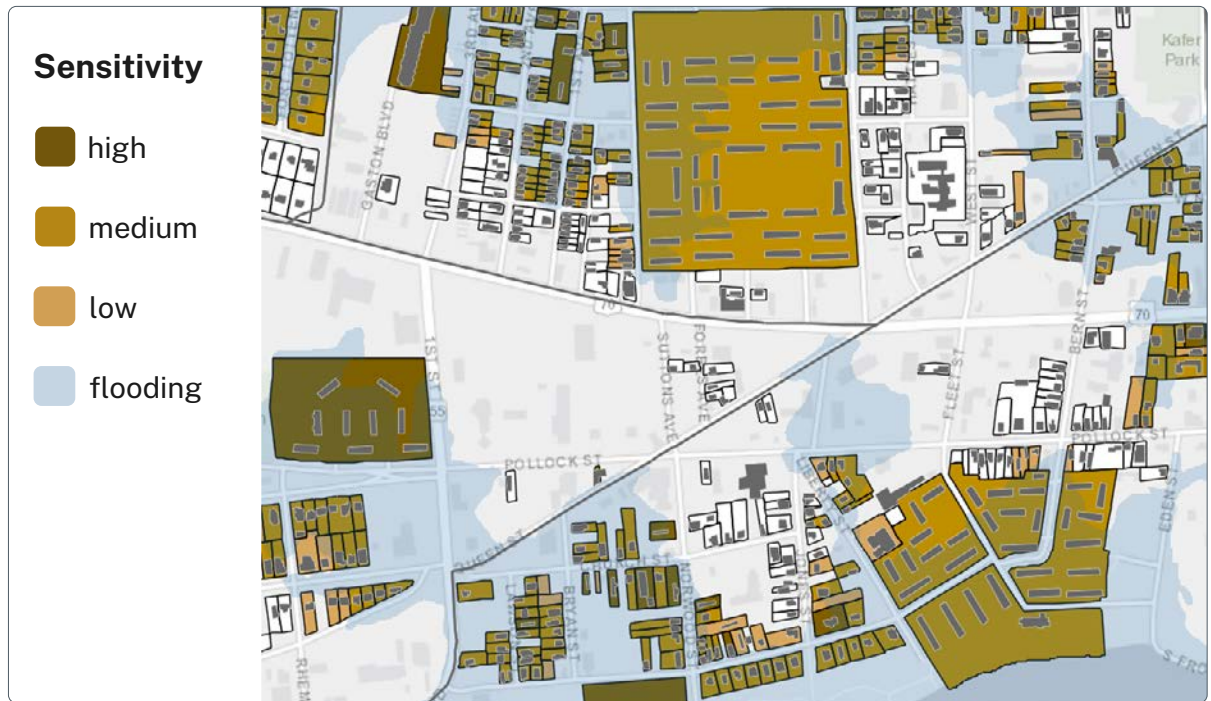


Figure 7. Sensitivity of structures whose parcels overlap the 100-year floodplain.

#### Ruleset for Sensitivity to Flooding

*If this is a critical facility (e.g., hospital or fire station), then its sensitivity is high.*

*If a structure is important, but its function can be replaced during an emergency, then its sensitivity is medium.*

*If a structure does not provide an essential service, then its sensitivity is low. (an example might be a parking lot)*

Referring to the [rulesets](#) above, an analyst consulted spatial data for every building on every taxation parcel in the study area. Because the function of every building is known from the city's taxa database, the analyst can associate a score of [high](#), [medium](#), or [low](#) with every building and tax parcel. The colors in the map in Figure 7 indicate the [sensitivity](#) of every taxable parcel in the 100-year floodplain in the city.

[Rulesets](#) for [adaptive capacity](#) require that the analyst discern each building and/or parcel's capacity to absorb or withstand flood waters. The following [rulesets](#) focus on construction practices in three periods of time and their increasing focus on codes and standards for flood [mitigation](#). Here, the analyst has determined that old structures were built with a relatively minor focus on the engineering requirements to accommodate floodwaters; such buildings and parcels are labeled with a low [adaptive capacity](#). [Medium adaptive capacity](#) parcels contain buildings that can accommodate the flow of floodwater but not at the rate and depth expected for the newest buildings. The newest buildings in this example are thought to be capable of withstanding the frequency and intensity of flooding that are expected in the future. These buildings and parcels are labeled with high [adaptive capacity](#).

### Ruleset for Sensitivity to Flooding

*If this is a building constructed without floodplain development requirements were in place, then its adaptive capacity is low.*

*If a building is constructed after some floodplain development requirements were established, then its adaptive capacity is medium.*

*If a building is constructed to withstand impacts expected even with consideration of climate change, then its adaptive capacity is high.*



Figure 8. High, medium, and low categories for adaptive capacity of properties that intersect the floodplain. Source: Fernleaf.

Because each of the [rulesets](#) above utilizes data from a city taxation database, it is relatively simple to assign [adaptive capacity](#) categories to every parcel and building. The map below (Figure 8) depicts a landscape with properties that span each of the categories noted above.



Waterbury, Vermont flood. Source: Nicholas Erwin, [CC BY-NC-ND 2.0](#).

Use the [3.3 Ruleset Library - Guidance](#) to build [rulesets](#). The example [rulesets](#) may be easily modified, as necessary.

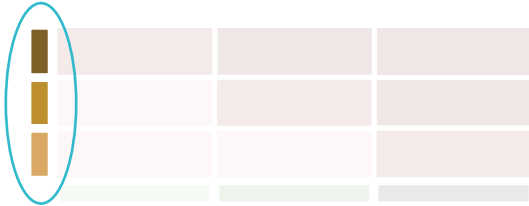
The [3.4 Ruleset Development -Worksheet](#) can be used to articulate original [rulesets](#) with the planning team.

To develop your own [rulesets](#), incorporate unique, site-specific information, including community input and site-specific data, such as the following.

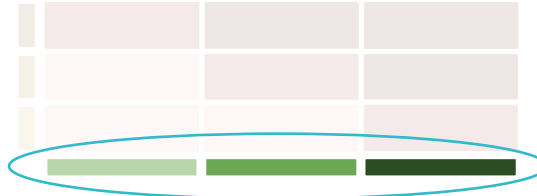
- Locations and criticality of [community assets](#); seek input from the planning team and community members.
- Locally focused [hazard](#) models can reveal potential flood depth during extreme events.
- Local ordinance information, such as floodplain, steep slope, and other development requirements, can be used to articulate and map adaptive capacity to specific [hazards](#).
- Community planning maps and documents occasionally reveal specific vulnerabilities and [risks](#).
- Community concerns may vary depending on how far into the future the team looks. For example, sea level rise-driven flooding thresholds will differ 30 and 50 years into the future.

## How to use this chart

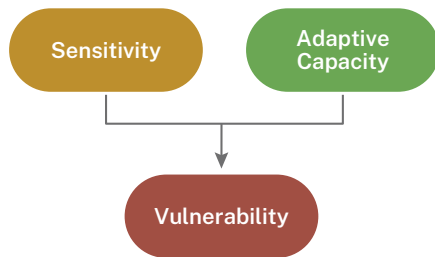
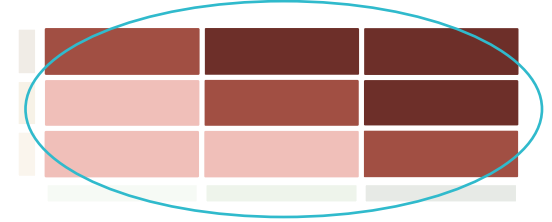
1. Select the appropriate row to indicate if your asset's sensitivity is high, medium, or low.



2. Select the appropriate column to indicate if your asset's adaptive capacity is high, medium, or low.



3. Check where your asset's Sensitivity and Adaptive Capacity intersect to determine its vulnerability.



(Repeated Figure 6)

Sensitivity	high	medium vulnerability	high vulnerability	high vulnerability
	medium	low vulnerability	medium vulnerability	high vulnerability
	low	low vulnerability	low vulnerability	medium vulnerability
		high	medium	low
		Adaptive Capacity		

**Table 9.** Sensitivity and adaptive capacity are the component metrics for vulnerability. Vulnerability is classified into low, medium, and high categories based on the rulesets listed in the text, above. Such a vulnerability analysis can be applied within spatial or narrative assessments.

Once you've identified an asset's [sensitivity](#) as [high](#), [medium](#), or [low](#) and its [adaptive capacity](#) as [low](#), [medium](#), or [high](#), it is possible to determine the asset's overall [vulnerability](#) to the [hazard](#) of interest (Table 9).

[High sensitivity](#) (e.g., a hospital in a floodplain) in combination with [medium](#) or [low adaptive capacity](#) (e.g., built without engineering requirements that address flooding concerns) produces an overall [high vulnerability](#) score (dark red, Table 9).

[Medium vulnerability](#) is assigned to assets with [high sensitivity](#) and [high adaptive capacity](#), [medium sensitivity](#) combined with [medium adaptive capacity](#), and [low sensitivity](#) combined with [high adaptive capacity](#) (medium shade of red, Table 9).

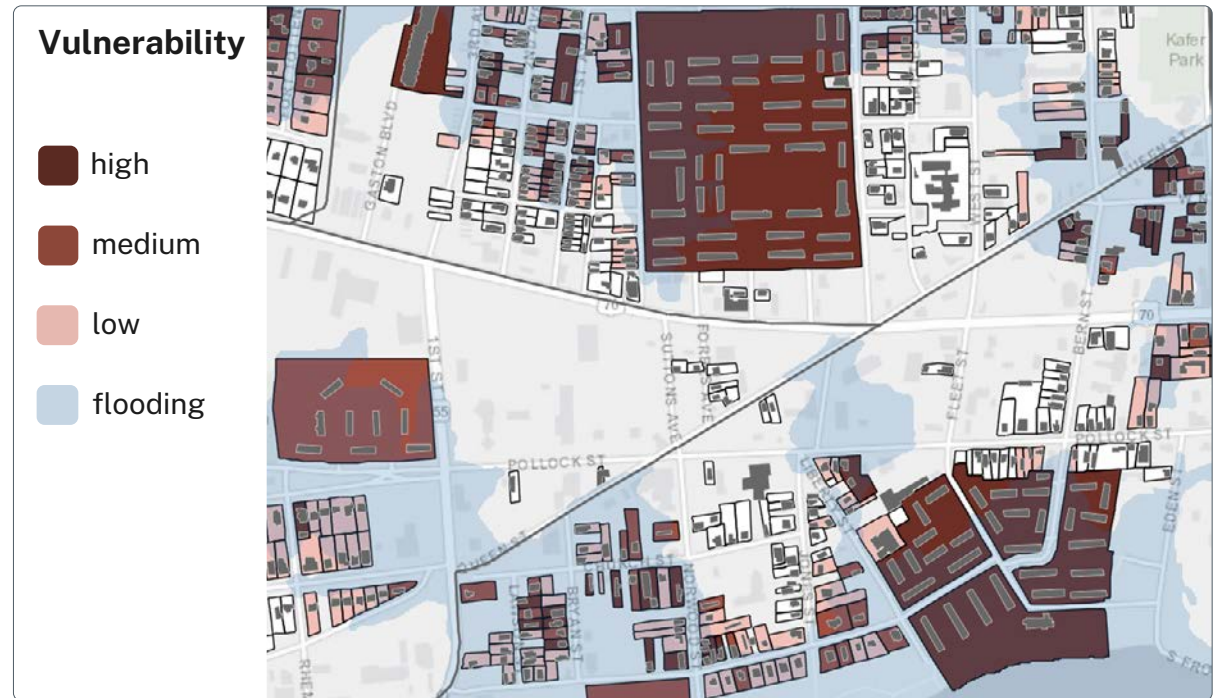


Figure 9. Example spatial analysis output generated for vulnerability. Source: Fernleaf.

Low vulnerability (light red shade in Table 9) is associated with assets that have both medium sensitivity and low adaptive capacity. In addition, low vulnerability is assigned to assets with low sensitivity combined with low or medium adaptive capacity. Low vulnerability is depicted with a light red shade in Table 9.

Populations and community assets with both high sensitivity and low adaptive capacity have the highest vulnerability. The map below (Figure 9) shows a three-class vulnerability assessment using the vulnerability classification shown in Table 9 and based on the sensitivity and adaptive capacity rulesets described above.



## Nature-based Solutions Consideration:

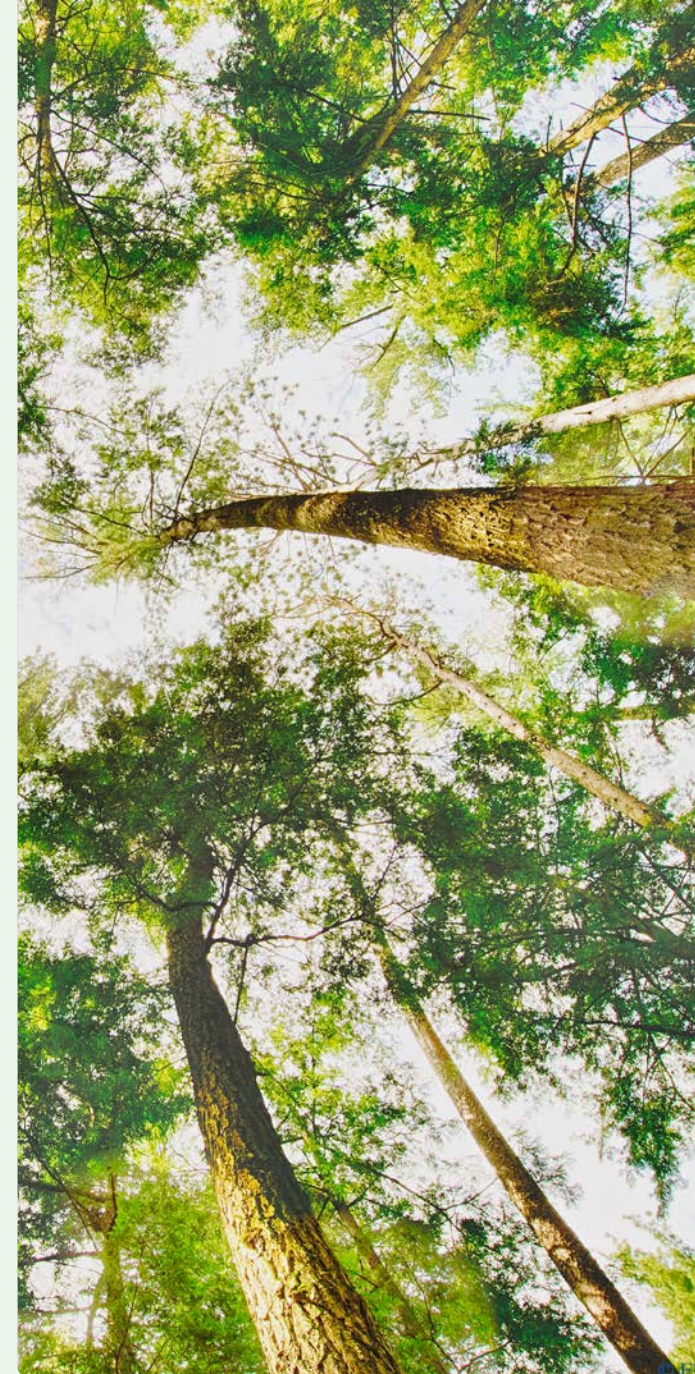
Species and ecosystems vary in their **sensitivity** to climatic shifts, as well as their **adaptive capacity** to accommodate or cope with change. Depending on the type, pace, and scale of climatic impacts, many species and ecosystems will require specific **adaptation** measures to maintain or enhance their capacity to deliver benefits and services.

In natural systems, **sensitivity** refers to the extent to which species or natural systems would be affected by or respond to changing direct or indirect climatic impacts. Factors such as physiological characteristics, plasticity, and evolutionary potential can increase or decrease a species' **sensitivity**. Information on ecosystem thresholds or **tipping points** can be a useful **indicator** to understand their ability to withstand climate impacts.

**Adaptive capacity** in ecological systems depends on the diversity and flexibility across traits (e.g., metabolic rates, reproductive strategies), organizational levels (e.g., genetic species, populations), and interactions with suitable habitats (e.g., habitat diversity, connectivity) while for species **adaptive capacity** is influenced by attributes such as genetic diversity, dispersal capacity, mode of reproduction, and physiological tolerance. A range of factors influence the species and ecosystem's capacity to adapt. Information gathered for assessing **sensitivity** can inform the **adaptive capacity** assessment as well. The external factors that affect **adaptive capacity**, for instance, habitat connectivity, may require additional considerations. **Practitioners** can leverage **ecological indicators** and existing habitat assessments for understanding **adaptive capacity**.

Learn more about these **vulnerability** concepts in the context of natural systems in section 3.1, "Assessing vulnerability of natural assets," in *Incorporating Nature-based Solutions in Community Climate Adaptation Planning*.

Source: Elvis Kennedy on Flickr.



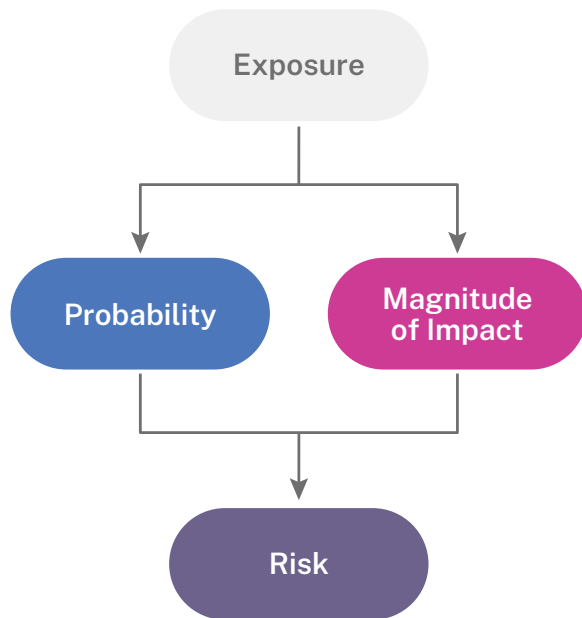


Figure 10. Risk is a function of probability and magnitude of impact.

## Risk

Risk is the product of **probability** of the **hazard** occurring and the magnitude of consequence (Figure 10).

$$\text{Risk} = \text{Hazard Probability} \times \text{Magnitude of Impact}$$

## Probability

**Probability** is often characterized using the annualized likelihood of the **hazard** occurring. To determine the **probability** of a **hazard** occurring, start by examining historical records for your region of interest to get a sense of how frequently the **hazard** occurred in the past. Then, check climate **projections** to determine if conditions that promote the frequency or severity of the **hazard** are projected to change over time.

### **Ruleset for Sensitivity to Flooding**

*If a parcel is in a 25-yr floodplain, then its probability is high.*

*If a parcel is in a 100-yr floodplain, then its probability is medium.*

*If a parcel is in a 500-yr floodplain, then its probability is low.*

Federally mandated floodplain boundaries provide one source of information for inundation extent and frequency. Simply using 25, 100-, and 500-year floodplain boundaries, one may assign high, medium, and low probability categories to every parcel and property in a city (Figure 11). It is widely observed that historically delineated floodplains do not adequately capture the frequency and extent of flooding given the **climate change**

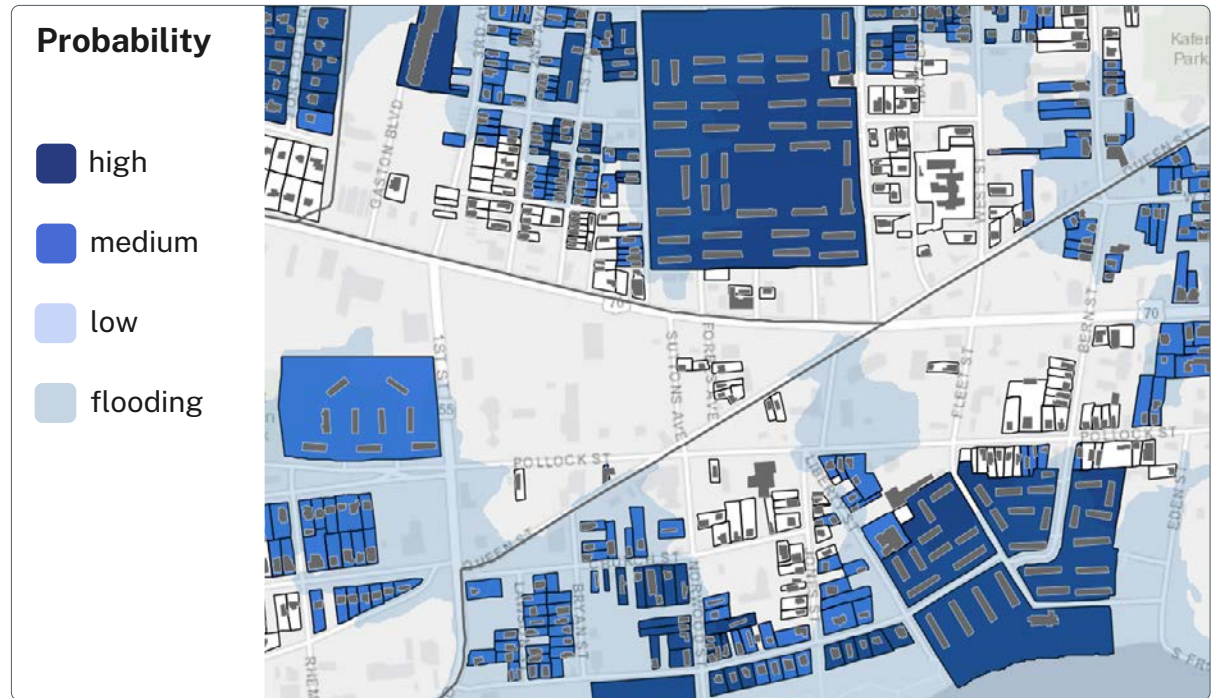


Figure 11. Rulesets and spatial analysis of probability. Source: Fernleaf.

that has been observed in recent decades. This problem will be magnified in the future as extreme precipitation becomes more severe and frequent.

If a 100-year floodplain (area with a 1% chance of flooding each year) was mapped more than a decade in the past, one should evaluate whether increased precipitation intensity and frequency bring increased flood **probability** and therefore **risks**. For most areas of the United States, **climate change** has brought heavier downpours, sea level rise, and other hydrologic changes that have boosted probabilities of flooding. Therefore, understanding observed and anticipated **climate change** can improve understanding of the **risk** of climate-related impacts that could befall community assets. This information can improve the determination of appropriate **rulesets** to evaluate the **risk** of the impact.

## Magnitude of Impact

**Magnitude of impact** refers to the level or intensity of loss that could result if the **hazard** were to occur. In the following example, the **magnitude of impact** is tied directly to the severity of flooding in a coastal area, with **high** magnitude associated with deep water, **medium** impact associated with moderate flood depth, and **low potential impact** associated with the shallowest flooding levels.

### Ruleset for Sensitivity to Flooding

*If a structure is exposed to a potential flood depth of 3 feet or greater in stillwater zones, then its magnitude of impact is high.*

*If a structure is exposed to a potential flood depth of 1 foot to 3 feet in stillwater zones, then its magnitude of impact is medium.*

*If a structure is exposed to a potential flood depth of less than 1 foot in stillwater zones, then its magnitude of impact is low.*

### Nature-based Solutions Consideration:

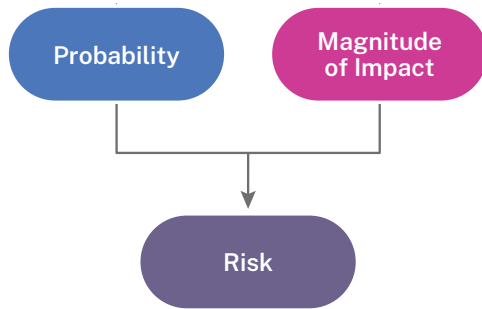
Because we live within complex human-natural systems, we must understand how and where climate or other factors may alter the probability and magnitude of hazard such as riverine flooding, coastal flooding, extreme heat, drought, and wildfire.<sup>32</sup>



Figure 12. Magnitude of impact for a coastal community. The highest impact zones are areas where flood depth is expected to be deepest. Medium impact is associated with moderate flood depths, and low impacts would be expected where floodwaters are expected to be most shallow.

## Rulesets to assess risk

Table 10 demonstrates how **probability** and **magnitude of impact** are combined into one overall value for **risk** (Figure 12). The combination of **high probability** and **high magnitude of impact** conveys **high risk**.



(Repeated Figure 9)

Probability	high	medium risk	high risk	high risk
	medium	low risk	medium risk	high risk
	low	low risk	low risk	medium risk
		low	medium	high
		<b>Magnitude of Impact</b>		

**Table 10.** Risk is classified into low, medium, and high categories after rulesets are applied to probability and magnitude of impact (see text, above). A risk analysis such as this can be applied within spatial or narrative assessments.



Figure 13. Risk associated with coastal flooding.

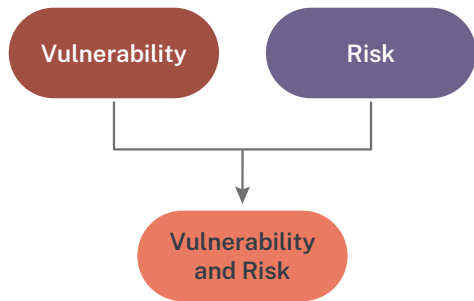


Figure 14: Vulnerability and Risk.

Risk	high	medium combined vulnerability and risk	high combined vulnerability and risk	high combined vulnerability and risk
	medium	low combined vulnerability and risk	medium combined vulnerability and risk	high combined vulnerability and risk
	low	low combined vulnerability and risk	low combined vulnerability and risk	medium combined vulnerability and risk
		low	medium	high
		<b>Vulnerability</b>		

Table 11. Classification of combined vulnerability and risk. Source: Fernleaf.

### Combined vulnerability and risk

Vulnerability and risk provide distinct views of how exposure to climate-related hazards can disrupt people’s lives and community-valued services and assets. These independent metrics may be combined into one overall metric with ordinal values of high, medium, and low. Having analyzed and mapped these data through an agreed-upon assessment of rulesets, the resilience planning team may focus on populations and community assets with medium or high combined vulnerability and risk.



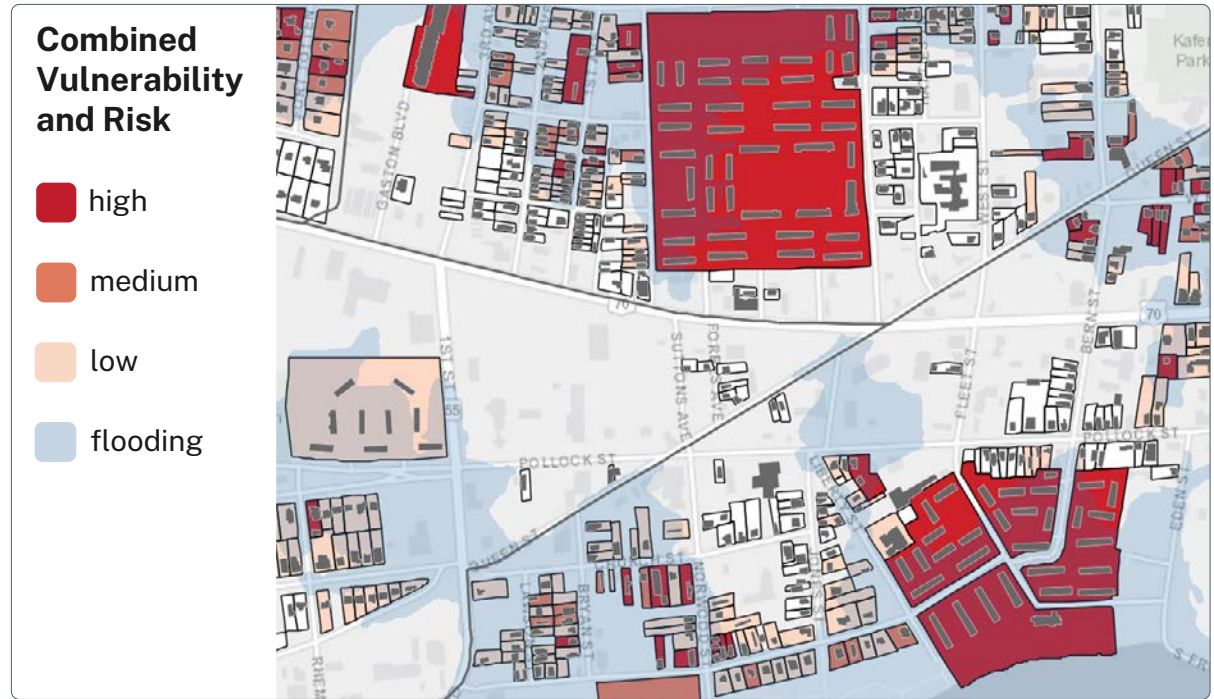
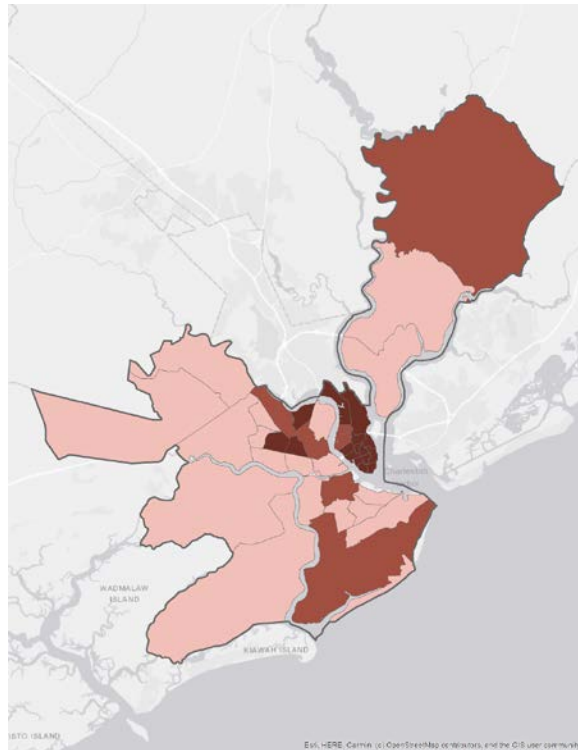


Figure 15. Example spatial analysis output generated for combined vulnerability and risk. Source: Fernleaf.

By combining these metrics (Table 11; Figure 15), [practitioners](#) can quickly screen the highest priority community assets and resources exposed to a given climate-related [hazard](#) and consider [options](#) according to different levels of [risk](#). The combination of [vulnerability](#) and [risk](#) encourages communities to consider high impact but low [probability](#) events as well as assets that are highly vulnerable but at low [risk](#).



### Vulnerability

- high
- medium
- low

Figure 16. Example neighborhood-level map of vulnerability to extreme heat.  
Source: Fernleaf, Charleston, SC

## Application of vulnerability and risk concepts to heat and health

The [ruleset](#) examples provided above are for direct impacts to physical assets in the built environment, but a similar spatial analytical approach can be applied to understand health impacts at a neighborhood level. When scientific studies link population groups or pre-existing health conditions with [hazard](#)-related health outcomes, aggregate data on “sensitive or at-risk populations” (terminology often used in public health contexts) can be used in combination with environmental data to identify areas with concentrated [vulnerability](#) in a community. For example, older adults and infants, pregnant women, and individuals with pre-existing conditions such as diabetes, cardiovascular diseases, and asthma are known to have higher biological [sensitivity](#) to extreme heat; outdoor workers (particularly those who are undocumented) and athletes are more likely to be exposed to extreme heat; income, poverty, and race have been associated with increased hospital admissions during extreme heat events. Figure 16 shows a screening-level [vulnerability](#) assessment for extreme heat. Census block groups with “high” [vulnerability](#), depicted in dark red, have several coinciding characteristics: high numbers of older individuals and infants; highly developed land cover; high percentages of low-income households; and low tree canopy coverage.

## Understand pre-existing stressors and disproportionate impacts to people

[Hazards](#) are known to disproportionately impact low-income individuals, people of color, other marginalized groups and historically underserved neighborhoods that already face chronic economic, social, and environmental challenges in [frontline communities](#).<sup>33</sup> Examples of these pre-existing, [non-climate stressors](#) at the community level can include challenges in access to basic needs (housing, food, water), resources (transportation, health care), and opportunities (education, recreation, economic) as well as social capital.

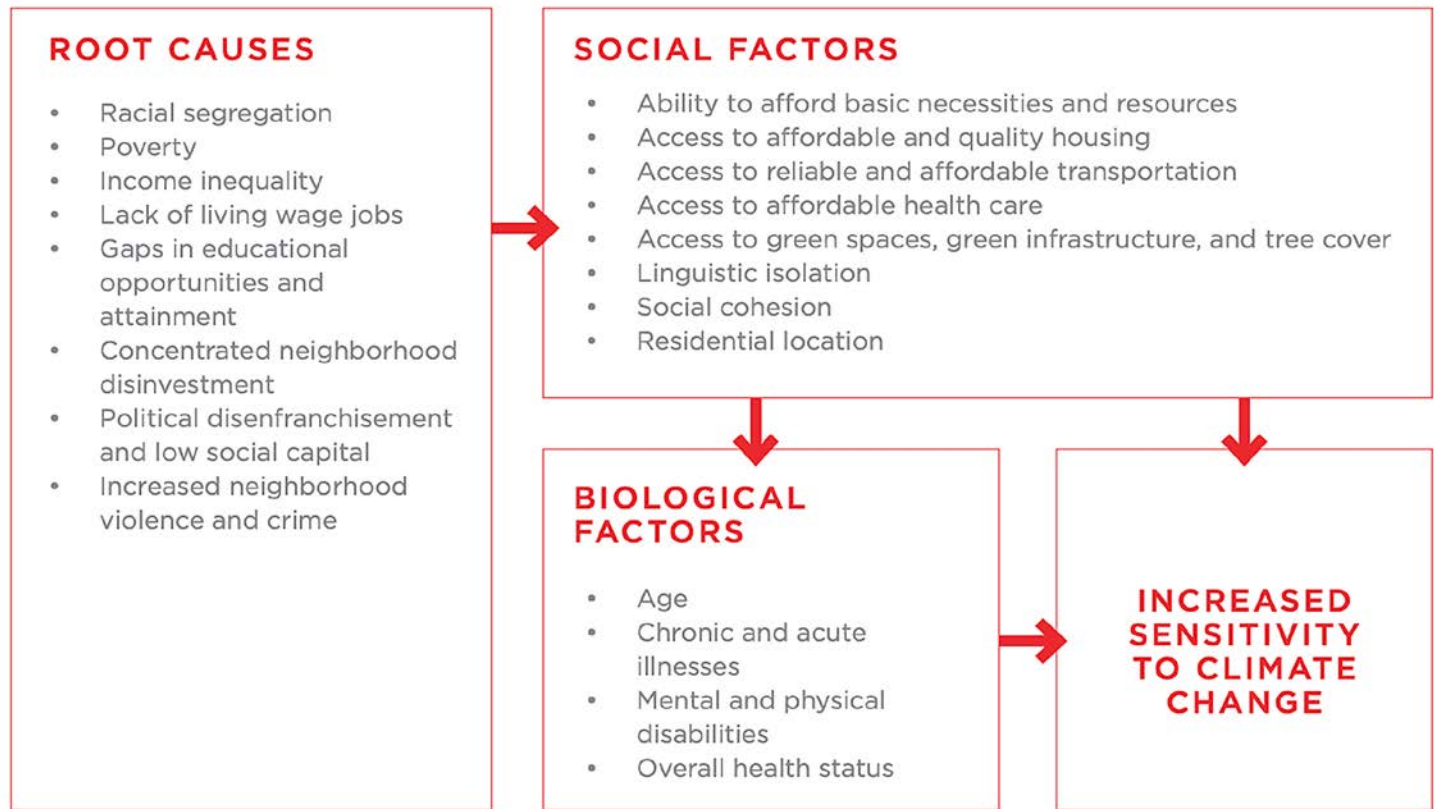


Figure 17. Relationships between root causes, social and biological factors. Source: USDN.

The root causes of these challenges lie in historical and contemporary structural inequities, i.e. “the interpersonal, intrapersonal, institutional and systemic mechanisms that organize the distribution of power and resources differentially across lines of race, gender, class, sexual orientation, gender expression and other dimensions of individual and group identity.”<sup>34</sup> Societal inequities are reflected in differential climate vulnerabilities of some people and communities as well as are exacerbated by [climate change](#).<sup>35</sup> The figure above (Figure 17) from USDN’s Guide to Equitable, Community-driven Climate Preparedness Planning<sup>36</sup> shows the relationship between root causes, social, and biological factors.

Pre-existing **stressors** in a community can result in greater **sensitivity** of some people, groups, and neighborhoods to climate **hazards** (Figure 17). **Stressors** may also reduce an asset's ability to adapt to, cope with, and recover from climate **hazards**. Areas where **stressors** are concentrated may experience disproportionate losses and negative impacts to well being and safety following **hazards**. In addition, disproportionate impacts can also result from uneven **exposure** to climate **hazards**.<sup>37</sup> Below are several ways **practitioners** can help the planning team develop this understanding:

### **Spatial indicators**

Spatial **indicators** of **stressors** can reveal the unequal distribution of resources and opportunities across neighborhoods. Spatial **indicators** can also help the team visualize where multiple **stressors** overlap. Sources of information and approaches to help you explore these issues include:

- a.** USDA Food Access Research Atlas<sup>38</sup> identifies where low-income areas overlap with low access to food at the census tract level.
- b.** EPA EJScreen combines census-based demographic data with data on environmental **hazards** to help identify areas where low-income individuals and communities of color face higher pollution burdens.
- c.** Kirwan Institute's Opportunity Mapping approach<sup>39</sup> identifies differences in "access to infrastructure and services that create high-opportunity" within a region through the use of education, economic, housing, transportation, and health indicators.
- d.** CDC Social Vulnerability Index (SVI) calculated at the census tract level combines 15 census variables to help identify communities that may need support before, during, or after disasters.

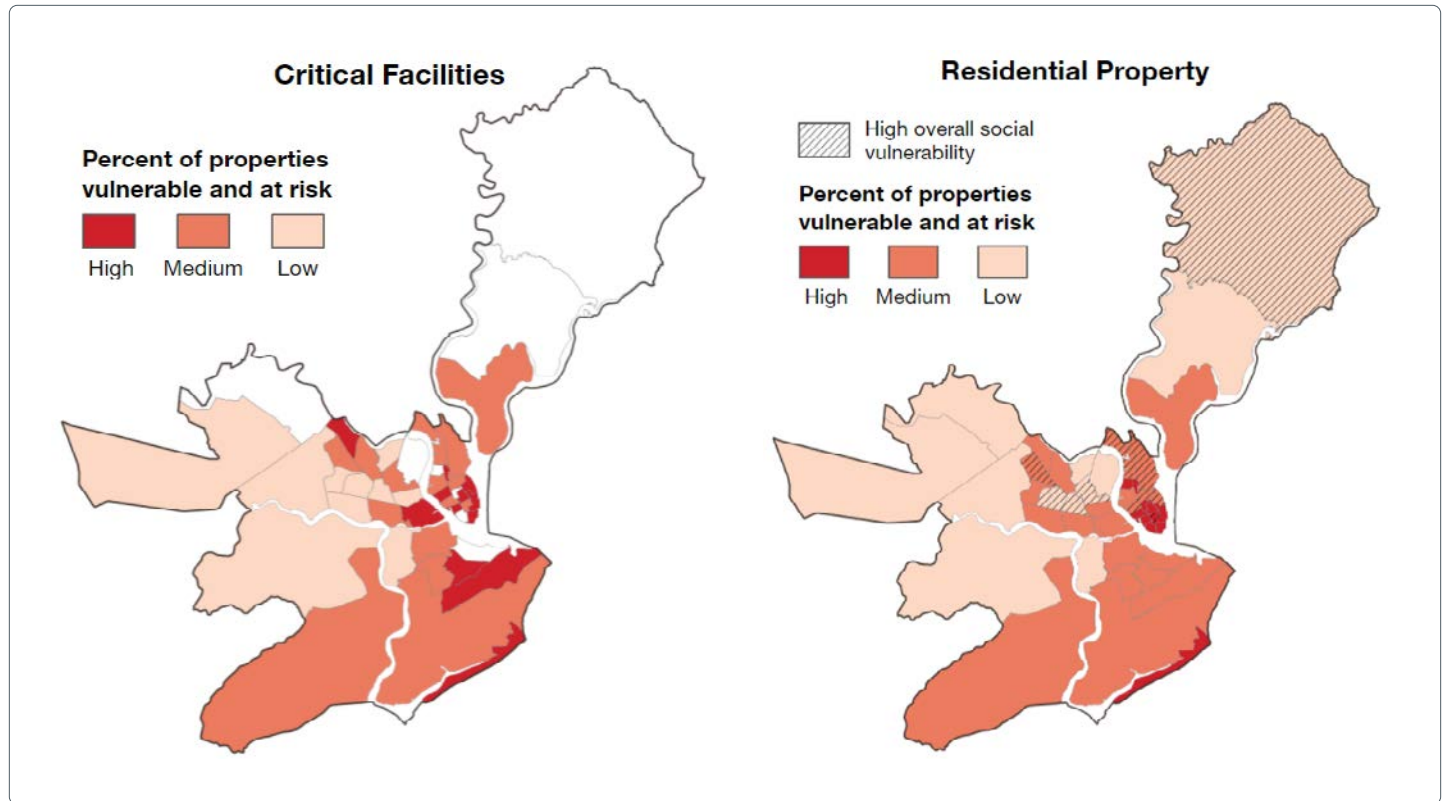


Figure 18. Example planning-level maps for combined vulnerability and risk showing commercial properties (left) and residential property (right). Source: Fernleaf, Charleston, SC.

In the map on the left (Figure 18), areas shaded in dark red represent neighborhoods where 100% of the critical facilities (including schools, community centers, and medical facilities) are vulnerable and at-risk to flooding.

The map on the right (Figure 18) shows neighborhood areas where a high percentage of residential properties that are vulnerable to flooding (darker red) overlap with areas that have relatively high overall social vulnerability (hatching), based on CDC's Social Vulnerability Index.

The Social Vulnerability Indicators and Spatial Data resource [2.11 Social Vulnerability Indicators and Spatial Data - Worksheet](#) includes links with descriptions for several of these resources.

### **Collaborative analyses with community leaders and community-based organizations**

Community partners rooted in [frontline communities](#) often have knowledge and expertise that can inform your assessment. They can help fill in gaps where data representing community experiences are not available, and assist in interpreting quantitative data on pre-existing [stressors](#) and social vulnerabilities. The [practitioner](#) or a community partner may be able to facilitate an exercise to trace root causes of community [stressors](#).<sup>41</sup> Careful interpretation and analysis is essential for identifying and prioritizing solutions that address causes of disproportionate impacts rather than just the symptoms.

### **Other community asset vulnerability and risk assessments**

[Vulnerability](#) and [risk assessments](#) may help community members understand the impacts of climate-related [hazards](#) on people, especially when they pertain to affordable housing and community services such as community centers and food infrastructure. As an example, the maps on the preceding page (Figure 17) show vulnerable community assets and how aggregate-level information can be used with assessment results to understand co-occurrences of physical and social [vulnerability](#).

## Generate assessment outputs

### Summary Tables

You can develop a table that summarizes the assessment results for the planning team and community. Table 12 provides a quick overview of vulnerabilities for four asset themes assessed in the project. Keep in mind that people are most interested in the results for where they live and where they work; they will usually look at a neighborhood-scale product before checking results for the entire community.

Theme and Asset	Asset Total	Floodplain Inundation (FEMA)	Storm Surge		Tidal Flooding and SLR (vulnerability)		
			Cat 3-5	Cat 3-5	2 ft + MHHW	3 ft + MHHW	4 ft + MHHW
<b>Critical Services &amp; Community Facilities</b>							
Critical Facilities & Govt-Owned	137	77 (56%)	16 (12%)	97 (71%)	1 (1%)	2 (1%)	17 (12%)
Parks, Cultural, & Entertainment	53	25 (47%)	9 (17%)	30 (57%)	NA	2 (4%)	7 (13%)
<b>Residential &amp; Commercial Properties</b>							
Residential	9,645	4,736 (49%)	1,093 (11%)	5,498 (57%)	48 (<1%)	160 (2%)	845 (9%)
Commercial & Industrial	516	299 (58%)	33 (6%)	350 (68%)	4 (1%)	7 (1%)	42 (8%)

**Table 12.** Summary table of total number of community assets and the number and percent of assets with medium or high combined vulnerability and risk for six hazard assessments. Source: Fernleaf.

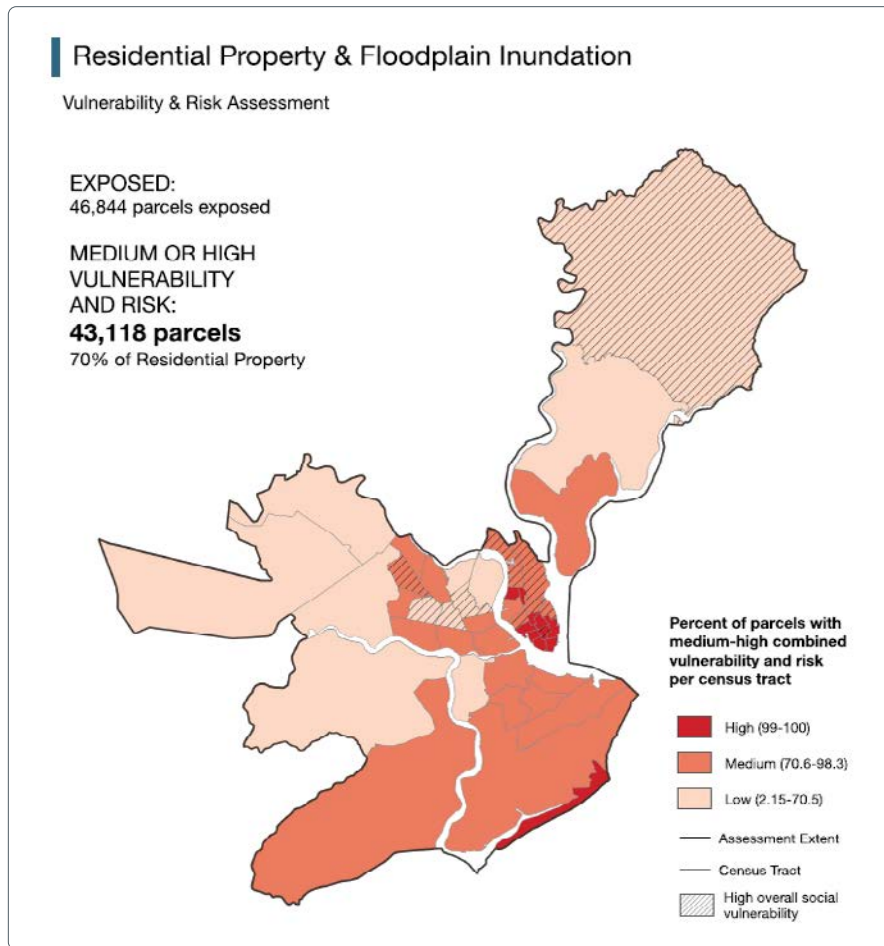


Figure 19. Map of census tracts with higher levels of combined vulnerability and risk in darker red. Source: Fernleaf.

Figure 20. (right) Community asset-level map with higher levels of combined vulnerability and risk for parcels in darker red. Source: Fernleaf.

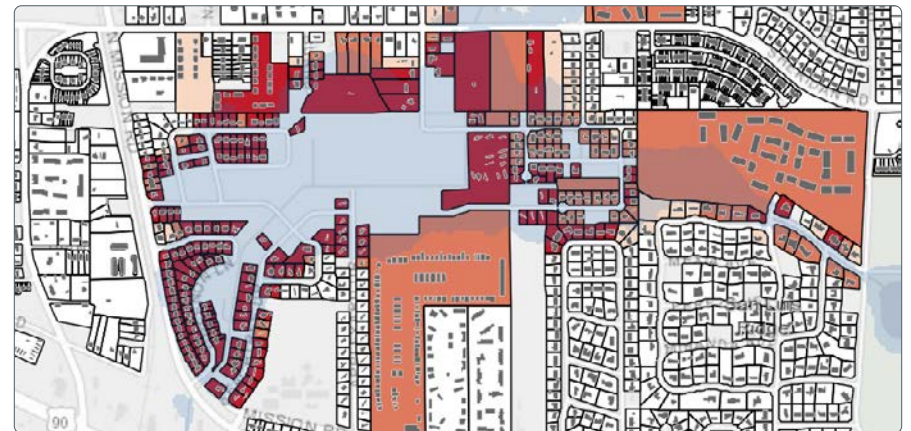
### Planning-level Maps

Planning-level maps display results for the entire study area. The example at left (Figure 19) aggregates property data within census tracts, a spatial unit that many planners use for evaluating socioeconomic trends. Such maps can help in comparing results with social **vulnerability** metrics collected at the same scale.

### Community asset-level Maps

Asset-level maps can display the analysis results for each **potential impact** and can be used to identify specific properties in the study area.

In addition to displaying the combined **vulnerability** and **risk** results (Figure 20), the maps can also display any of the component metrics (**sensitivity**, **adaptive capacity**, **probability**, **magnitude of impact**) to elucidate which factors underlie the **vulnerability** and **risk** of classes of a given property.





## Quality control preliminary assessment results

After completing the spatial assessment, you will likely need to put the results through several rounds of quality control (QC). This process is essential for ensuring the data outputs are spatially accurate and the [rulesets](#) have been applied correctly.

Use the Quality Control Checklist resource [3.6 Quality Control Checklist - Guidance](#) to keep track of and communicate the status of analysis and any issues identified during the quality control process.

## Review preliminary assessment with planning team

After the initial analysis is complete, meet with the planning team to share the preliminary results and receive feedback. Review the [rulesets](#), study area boundaries, and outputs as a group to ensure the assessment factors are being applied as expected. This is an opportunity to ensure transparency in the assessment approach and methods.

Use the Preliminary Results Meeting templates ([3.7 Preliminary Results Meeting Agenda - Template](#) and [3.8 Preliminary Results Meeting Slides - Template](#)) to plan the workshop. Make updates to the agenda and slides as needed.

During the meeting, you can encourage the planning team to begin thinking about any noticeable impacts and patterns in the results. This is also a great opportunity to ask for feedback. Even after detailed quality control of the results, team members who are most familiar with their community may notice something is missing or not quite right.

Use the Preliminary Results Feedback resource [3.9 Preliminary Results Feedback - Worksheet](#) to collect this feedback.

## Use assessment results to create impact statements

### *Identify major vulnerabilities and highlight drivers of vulnerability and risk*

In addition to understanding the challenges individuals and neighborhoods face from pre-existing **stressors**, the assessment can also help you identify how **hazards** exacerbate pre-existing **stressors**. One way to do this is by combining information about vulnerabilities in the built environment with information on pre-existing **stressors**. For example, is the limited affordable housing stock of a community at **risk** to severe coastal flooding? Another way to reveal where climate-related **hazards** may exacerbate pre-existing **stressors** is to identify areas where a high proportion of vulnerable community assets overlap with areas of concentrated poverty, people of color, or “at-risk” individuals. This information can help identify priority neighborhoods for strategies where that may be a relevant consideration.

## Nature-based Solutions Consideration:

Consider the geographic context of nature-based solution projects with regard to highly vulnerable neighborhoods and populations.

Certain factors, such as the ecological significance of the system, the magnitude and likelihood of climate impact, and the conservation and societal goals of the community influence a community's risk and consequences faced by hazards. The consequences of climate impacts are not felt equally by all groups, therefore identifying a range of stakeholders involved is crucial.<sup>41</sup>

“Factors such as the ecological significance of the system, the magnitude and likelihood of climate impact, and the conservation and societal goals of the community influence a community's risk and consequences faced by hazards. Since the consequences of climate impacts are not felt equally by all groups, involving a range of stakeholders is crucial to ensuring multiple and diverse viewpoints are included in the decisions.”<sup>42</sup>

### *Understand consequences and develop impact statements*

For each of the potential climate-related impacts, discuss the potential range of consequences that might occur in the event of a **hazard**. Impact statements can articulate major vulnerabilities, their drivers, and their logical consequences in ways that point to potential **options** for addressing them. Impact statements contain three key ingredients:

- summary of assessment findings;
- **potential impacts** in light of vulnerabilities;
- causes of vulnerabilities.

The Develop Impact Statements resource [3.10 Develop Impact Statements - Worksheet](#) provides an overview and guiding questions for the practitioner and planning team to develop impact statements.

## Finalize assessment and synthesize findings

### *Integrate feedback from planning team*

Use results from the Preliminary Results Feedback resource [3.9 Preliminary Results Feedback - Worksheet](#) to further refine and finalize the assessment.

Feedback on [rulesets](#) may be the most common type of feedback provided. For example, determining if the [rulesets](#) were applied appropriately or if a particular type of asset should have been considered high criticality was overlooked. Incorporate any changes needing to be made and adjust the results accordingly.

### **QC final assessment results**

Now that any changes to the assessment have been configured and new results are in-hand, another round of quality control should be completed to ensure accuracy.

As was done previously, use the Quality Control Checklist resource [3.6 Quality Control Checklist - Guidance](#) to track the quality control process and note any issues. Ideally, these will be the final results. However, the assessment may need to be adjusted again if there are errors and another round of quality control will be needed.

### **Prepare synthesis and share**

Results can be shared with the project team through a summary table, planning-level maps, and or asset-level maps. Select among these [options](#) to highlight the impacts numerically and visually at the entire community-level and at the individual property-level.

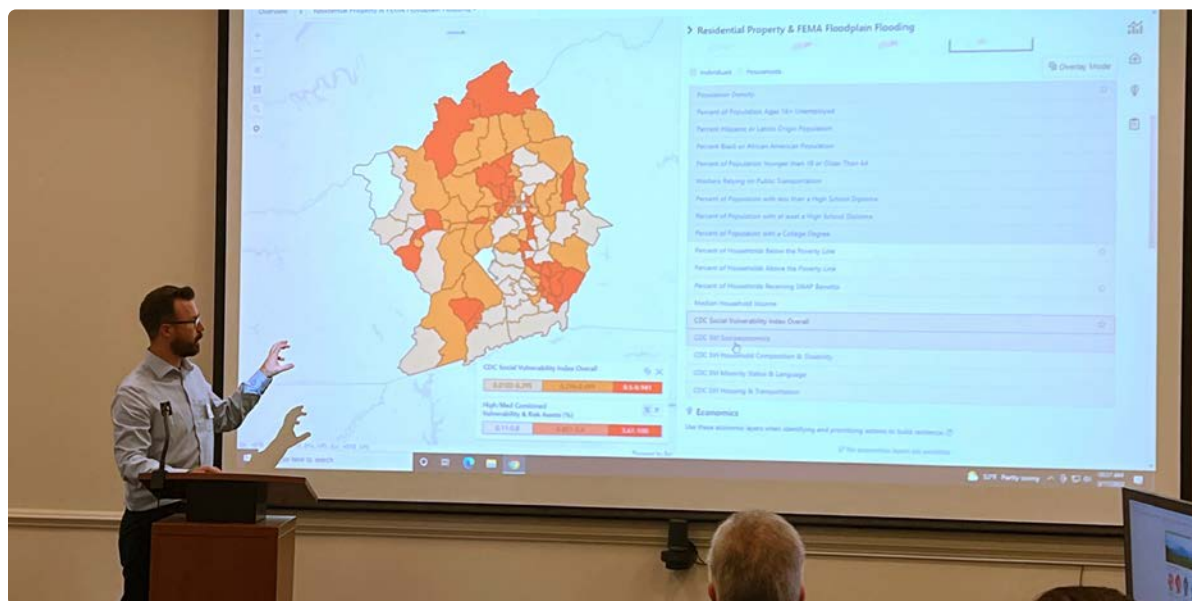
Finally, compile the assessment results and impact statements into a short progress report and share it with the planning team and community. This report will serve as a valuable reference going forward. In addition to summarizing what has been assessed thus far, consider the following questions for any insights they may inspire:

- Are there geographic areas with concentrated **vulnerability** and **risk**?
- What are the drivers of **vulnerability** and **risk**?
- What are the primary types of vulnerabilities?
- How are vulnerabilities expected to change in the future?
- Are there any issues the community has raised that were not covered in the assessment results?

You can use a template [3.11 Vulnerability and Risk Synthesis Report - Template](#) to capture all relevant information thus far.

In addition to the impact statement worksheets collected from the planning team, a variety of the previous resources will also be referenced to help fill in this template. The template is designed to address a single **hazard**; use it as is or change it to fit the unique needs of the project.

Matt Hutchins reviews region-wide vulnerability and risk assessment results and socioeconomic metrics with the planning team. Source: Fernleaf.



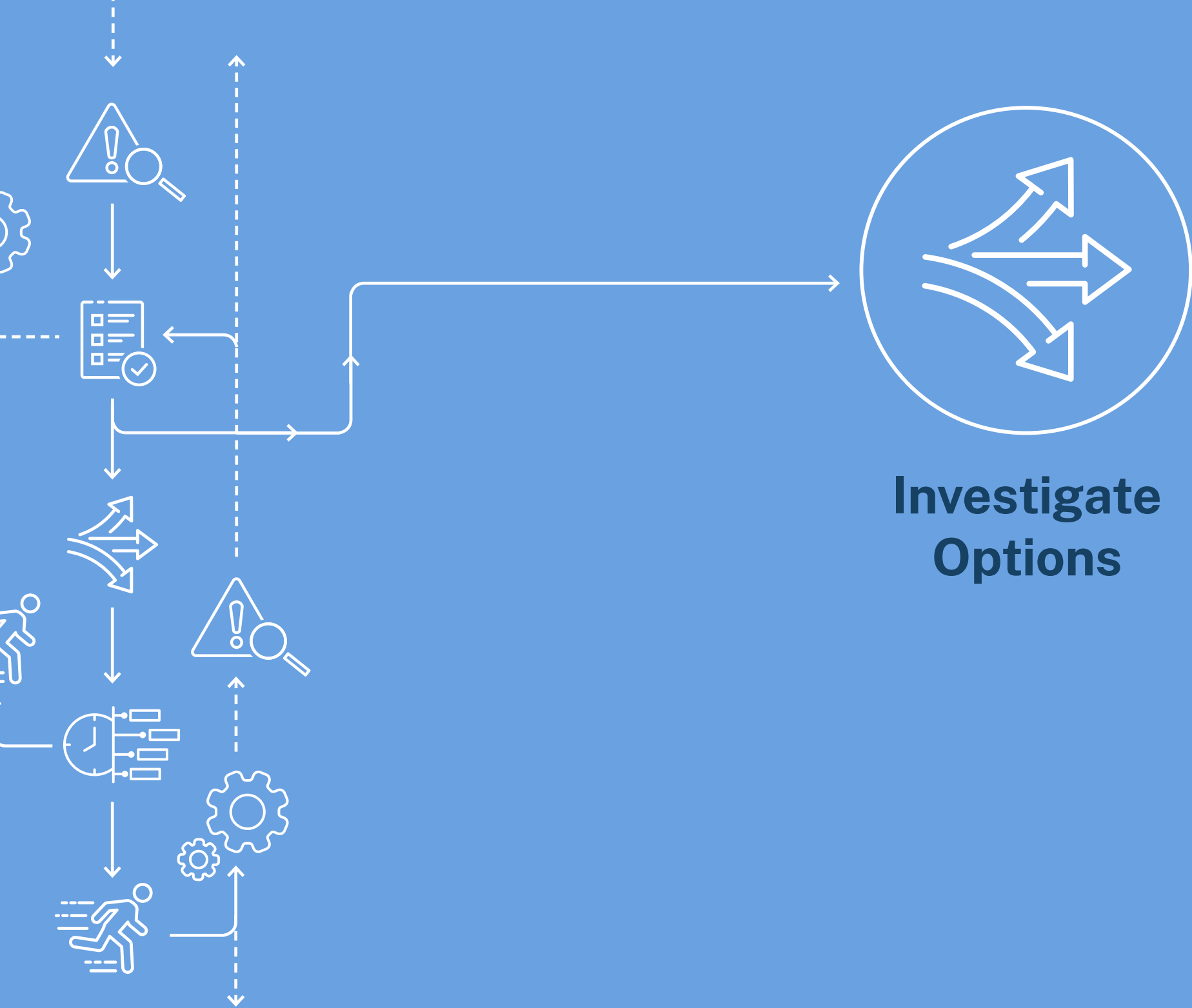
## Review assessment findings with planning team

A final meeting should be held with the full planning team to review the final assessment results and develop insights through the use of impact statements. The Government Champion and Planning Team should agree on the most important climate-related impacts to address in subsequent action steps. Be sure to address physical **vulnerability** (i.e., to buildings or infrastructure) as well as social **vulnerability**.

Use the Impact Statements Workshop templates [3.12 Impact Statements Workshop Agenda - Template](#) and [3.13 Impact Statements Workshop Slides - Template](#) to get started on planning the workshop. Make updates to the agenda and slides as needed.

## Endnotes

- 31 Section 3.1.1 of *Incorporating Nature-based Solutions into Community Climate Adaptation Planning* contains examples of quantitative and qualitative tools and approaches to assessing natural systems.
- 32 Section 3.2, “Approaches and Tools for Assessing Hazard Risks Due to Altered Natural Systems” in *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*
- 33 Georgetown Climate Center’s Equitable Adaptation Legal & Policy Toolkit.
- 34 National Academies of Sciences, Engineering, and Medicine 2017. *Communities in Action: Pathways to Health Equity*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/24624>
- 35 Thomas et al. 2018, Explaining differential vulnerability to climate change: a social science review. [doi.org/10.1002/wcc.565](https://doi.org/10.1002/wcc.565)
- 36 Yuen et al., 2017. *Guide to Equitable, Community-driven Climate Preparedness Planning*
- 37 EPA. 2021. *Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts*. U.S. Environmental Protection Agency, EPA 430-R-21-003.
- 38 <https://www.ers.usda.gov/data-products/food-access-research-atlas/>
- 39 Description of approach: [http://kirwaninstitute.osu.edu/wp-content/uploads/2013/09/FINAL\\_OM\\_9-5.pdf](http://kirwaninstitute.osu.edu/wp-content/uploads/2013/09/FINAL_OM_9-5.pdf); Information on metrics: [http://kirwaninstitute.osu.edu/docs/FINAL\\_2013%20Opp%20Metrics.pdf](http://kirwaninstitute.osu.edu/docs/FINAL_2013%20Opp%20Metrics.pdf)
- 40 “But Why” technique for analyzing root causes from the Center for Community Health and Development, <https://ctb.ku.edu/en/table-of-contents/analyze/analyze-community-problems-and-solutions/root-causes/main>
- 41 Section 3.4, “Consider Key Vulnerabilities and Hazard Risks” in *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*
- 42 Section 3.3, “Integrate Equity and Environmental Justice Concerns” in *Incorporating Nature-based Solutions in Community Climate Adaptation Planning*



**Investigate  
Options**





## Overview

Having identified the greatest **risks** in the previous step, the next step is to focus subsequent planning on the most urgent needs. Enumerate objectives and related **options**, strategies, and / or actions that can build **resilience** to high priority impacts. Ensure that **resilience** objectives are consistent with the vision and goals of the community. Define broad **resilience** objectives, then provide a template for refining **options** in subsequent steps.

The output from this step will be a list of options that can reduce the greatest climate-related **risks** to vulnerable populations and **community assets**.

### Objectives

- Review vulnerability and risk findings
- Refine resilience objectives
- Research and identify options
- Record options with supporting information
- Ensure options are acceptable in your community

## Resources

- ☰ 4.1 Facilitation Recommendations - Guidance
- ☰ 4.2 Develop Resilience Objectives - Worksheet
- ☰ 4.3 Inventory Options from Existing Plans - Worksheet
- ☰ 4.4 Integrating National Options into Community Inventory
- ☰ 4.5 Inventory of Community Options - Worksheet
- ☰ 4.6 Action Types and Subactions - Guidance

## Opportunities for community participation

- Gather input on potential [options](#) to check how they fit with community values.
- Align [resilience](#) actions with existing efforts such as grassroots and community-led efforts.
- Agree on resources needed for continued, equitable engagement in the future.

## Questions and metrics for assessing this step:

- Do proposed [options](#)
- Address community-defined, highest priority climate-related impacts?
- Are proposed [options](#) linked to the vulnerabilities they are meant to address?
- Are expected outcomes clearly identified and linked to those [options](#)?

## Key Concepts

### Objectives

**Resilience** objectives can be thought of as goals, but are different from the overarching goals for the project. These are objectives that help the community take targeted action to address key challenges. These objectives should align with the vision, values, and goals outlined at the outset of the project and may aim to address climate **resilience**, social equity, or both.

### Options

Ways of achieving objectives. **Options** consider objectives and encompass strategies and actions to build **resilience** that can include policies, programs, projects, systems, and technologies. **Options** require a subsequent decision about whether they will be enacted.

### Strategy

Strategies elaborate the way in which **resilience** objectives are going to be achieved. While a **strategy** describes how a **resilience** objective may be achieved, it may not have a specific geographic scale or timeframe for implementation. Most **options** published in **resilience** plans are strategies.

### Actions and projects

Actions and projects fit within a **strategy** and describe how a **strategy** will be carried out. Actions and projects have clear roles and responsibilities, timeframes, and geographic scale.

### Nature-based Solutions

Actions to protect, sustainably manage, and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and **biodiversity** benefits.

### Green Infrastructure

A term that historically has been used to refer to the value and role of open space and **ecosystem services** broadly, but is now often used in a narrower sense focusing on nature-based approaches to stormwater management.

### Maladaptation

Action taken ostensibly to avoid or reduce vulnerability to **climate change** that impacts adversely on, or increases the vulnerability of other systems, sectors, or social groups.

# Investigate Options Roles and Responsibilities

Government Champion	Climate Adaptation Practitioner
<ul style="list-style-type: none"> <li>• Work with members of government staff and community leaders to identify and highlight existing resilience building strategies and actions to be included in the plan.</li> <li>• Collaborate to flag the options, strategies, and actions from other communities they'd like to consider.</li> <li>• Collaborate to select strategies, actions, and potential projects that are most likely to address their primary concerns.</li> <li>• Consider opportunities within your selected strategies for explicitly advancing procedural, distributional, and structural equity.</li> <li>• Flexibly adapt to new information, resources, and situations and iterate.</li> </ul>	<ul style="list-style-type: none"> <li>• Iterate -work with the Government Champion and planning team to review the vision, values, and goals from Get Started and consider whether the list of climate-related impacts of greatest concern reflects the scope, objectives, and values of the community. Modify or edit as necessary.</li> <li>• Construct a table that shows relationships among each resilience objective, strategies that could address each such objective, and specific actions that align with each strategy. These terms will be defined through the exercises in this chapter.</li> </ul> <ul style="list-style-type: none"> <li>• Compile relevant options, strategies, and or actions from:             <ul style="list-style-type: none"> <li>• existing community plans;</li> <li>• National best practice options; and,</li> <li>• nature-based solutions.</li> </ul> </li> <li>• Ensure inclusion of equitable options.</li> <li>• Record options with supporting information.</li> <li>• Work with the Government Champion to ensure options are acceptable in the community.</li> </ul>

Table 13. Investigate Options roles and responsibilities of the government champion and climate adaptation practitioner.

# In Practice

## Review vulnerability and risk findings

Development of adaptation options usually occurs after a community (or facility, company, etc.) has determined their primary vulnerability and risks.

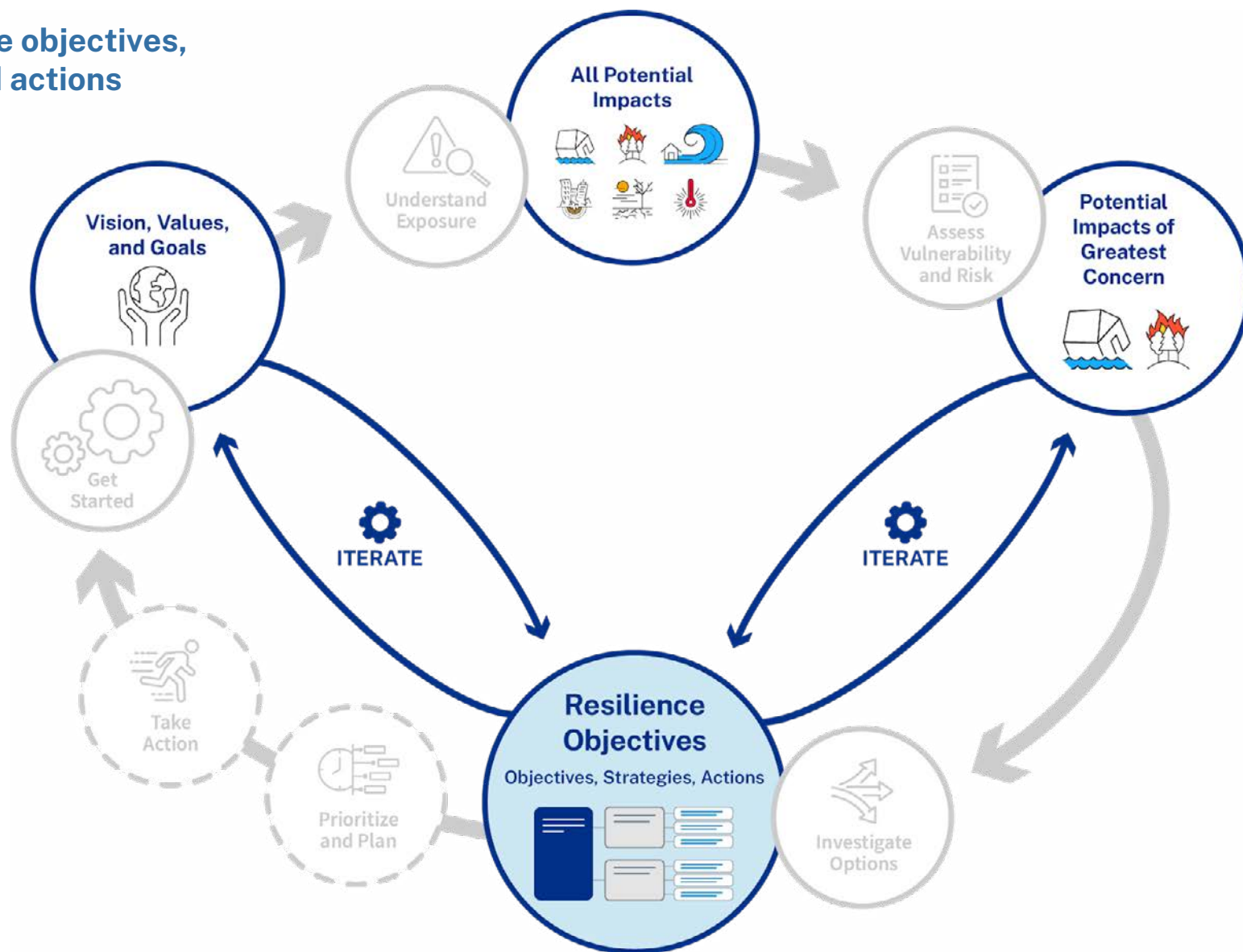
These risks were identified through impact statements and summarized as “Central Challenges” in the previous step (see [3.11 Vulnerability and Risk Synthesis Report - Template](#)).

The Government Champion and Planning Team agree on the most important climate-related impacts to address in developing solutions. In other words, they looked at the vulnerability and risk from specific hazards in identified areas in their community (neighborhoods, business districts) and compared them to the goals they set when beginning the resilience process.

The next question to answer is, “Now that we know what the most pressing problems are related to a changing climate, what can we do to build resilience and lower our risk?” To answer this question you’ll define some resilience objectives, and then generate a list of options, including strategies and actions, to consider.

## Iterate to refine objectives, strategies, and actions

Figure 21. Define options based on the impacts of greatest concern, and your team's overall vision, goals, and objectives.



**Team cohesion and buy-in are essential for the long-term success of resilience-building.** Figure 21 illustrates how the work completed in the previous steps can help you build and maintain cohesion as you begin this step.

The [Practitioner](#) and [Government Champion](#) can lead the Planning Team through a review of the vision, values, and goals (see [1.3 Vision, Values, and Goals - Worksheet](#)) outlined at the outset of the project.

Then, they can consider whether the list of climate-related impacts of greatest concern (see [3.11 Vulnerability and Risk Synthesis Report - Template](#)) truly reflects the values, scope, and interests of the community. Is there anything within the vision and or goals that should be added, modified, or emphasized at this point?

The Facilitation Recommendations resource [4.1 Facilitation Recommendations - Guidance](#) provides recommendations for carrying out this exercise with the team.

Following this review, the [Practitioner](#) and [Government Champion](#) can facilitate the development of [resilience](#) objectives. [Resilience](#) objectives should answer the question, “**In light of the challenges identified and the community’s long-term vision, what does the community want to achieve?**” [Resilience](#) objectives help organize and focus possible [options](#) to address the main issues. The objectives should address climate [resilience](#), social equity, or both. These objectives are the first step to help the community make important decisions and take targeted action to address primary challenges.

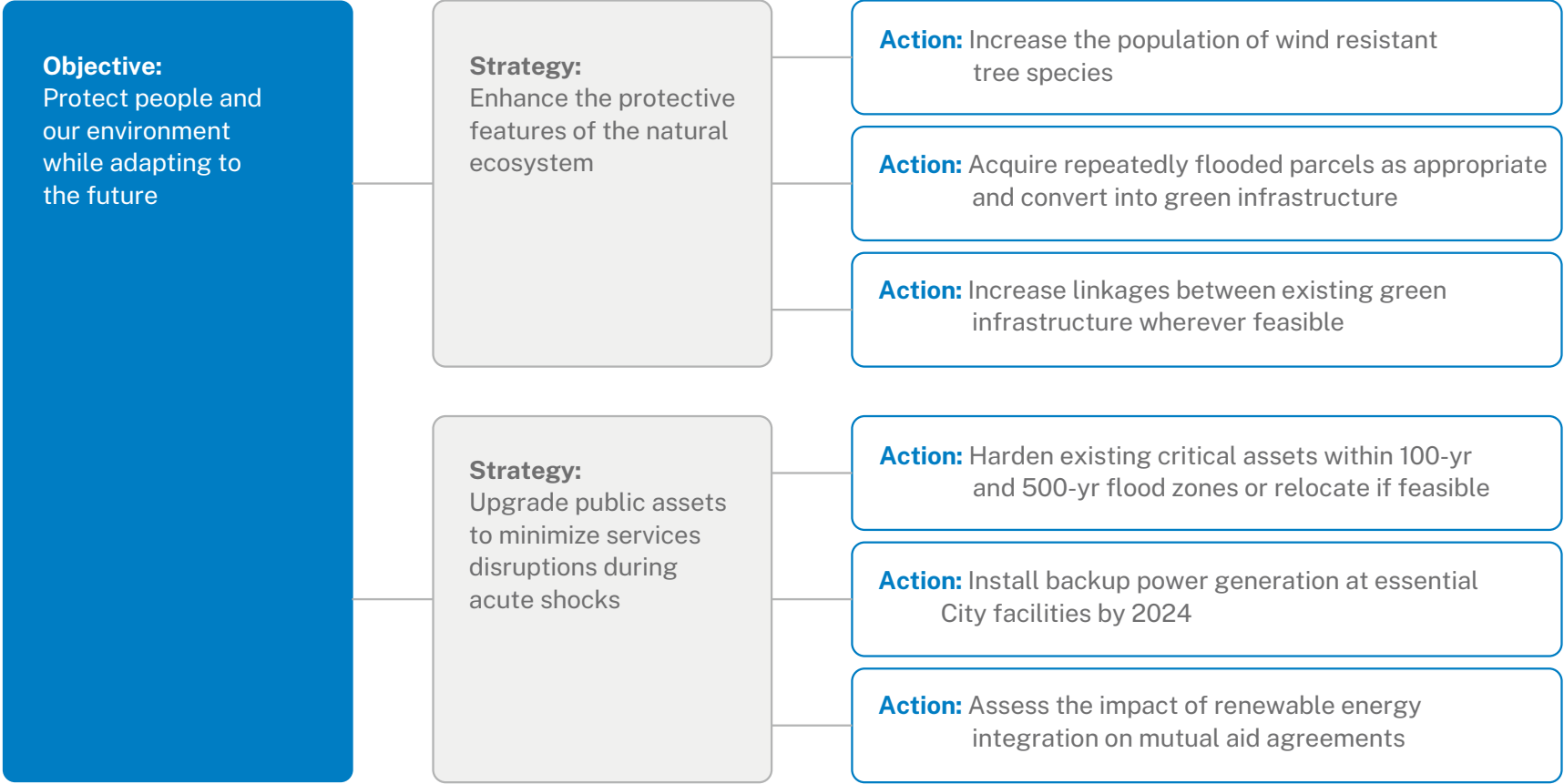


Figure 22. Example options showing the relationship between a resilience objective, strategies, and actions. Source: Fernleaf.



The components of every resilience objective are the key hazard and community assets impacted, the location in the community of these impacts, and the severity of the vulnerability and risk (see [4.2 Develop Resilience Objectives - Worksheet](#)).

Figure 22 shows the hierarchy of objectives, strategies, and actions, a sequence that goes from general to specific. Within a single objective, there are often multiple strategies that can help meet that objective. Strategies describe the way the **resilience** objectives are going to be achieved, though they may not have a specific geographic scale or timeframe for implementation. Within strategies, there are likely one or more specific actions that can be taken. Actions describe how a **strategy** will be carried out. **Actions and projects** should specify roles, responsibilities, timeframes, and geographic scale.

Objectives that directly address inequity (i.e., disparities in access to food, shelter, health, recreation, and economic opportunities) can reduce sensitivity of **frontline communities** by building capacity to adapt and thrive. Information for setting such objectives can come from data or from the needs identified by the community.

Take stock of what has been learned from involving the community so far. What resources, capacities, and capabilities can improve mutual engagement between community members and local government? Given the range of issues to be addressed, are additional experts needed to properly identify and scope **options** for building **resilience**? Such expertise may also be useful in subsequent prioritization, planning, and actions.

## Four ways to build resilience

### Most resilience-building falls within one of these methods:

- Build **adaptive capacity** (Example: fund community programs that provide meals and routine medical attention to people with limited mobility.)
- Reduce sensitivity (Example: ensure culturally sensitive artifacts in coastal areas are not stored in the wash zone.)
- Reduce **exposure** (Example: remove flammable material surrounding buildings, especially near ventilation systems.)
- Support better response and recovery (Example: conduct table-top exercises with emergency management personnel and community representatives focused on extreme heat.)

Most of the **options** will be linked to specific **hazards** (flooding, wildfire) and asset types (people, property), but some of them are overarching approaches. These **options** build **resilience** by increasing community capacity to deal with a multitude of **stressors**, both climate and non-climate.

## Develop a list of options

Focus on your primary **resilience** objectives and identify a list of **options** that could meet them. Try to come up with a manageable number of quality **options** rather than striving for a large quantity of **options**. Try to keep the total list to fewer than 50 **options**, and if possible just 20-25. This will make it easier for the Planning Team to prioritize and plan in follow-on activities.

Groups will often focus first on the **options** where they can take immediate action by leveraging internal resources. You can honor that inclination, but be sure to encourage the planning team to consider the benefits of a diverse portfolio across all types of

With a list of existing plans in hand, review and update your list of documents (see [1.2 Plans, Initiatives, and Context Inventory - Worksheet](#)).

Compile relevant recommendations (see [4.3 Inventory Options from Existing Plans - Worksheet](#)). As you review solutions from existing plans, watch for opportunities where existing projects, programs, and plans can be augmented, modified, or leveraged to achieve one or more of your [resilience objectives](#).

actions. Also, while adaptation strategies are emphasized in building [resilience](#), don't rule out the opportunity to address [mitigation](#) strategies as well. Combinations of adaptation, [mitigation](#), and capacity-building strategies are sometimes called transformative strategies, as they can help position the community for future success.

### **Gather Potential Solutions from Existing Community Plans**

Start by compiling relevant [options](#) from existing plans. Check your county or municipal comprehensive, emergency management, [hazard](#) mitigation, stormwater, sustainability, Capital Improvement Plan, and other plans for solutions that could address your [resilience](#) objectives. This is a task that can be delegated.

### **Gather Potential Solutions from the Options Database**

Building on the work of others can be an effective way to identify [options](#). You can see what other communities have considered or implemented to address similar challenges using the [Options Database](#) in the U.S. Climate Resilience Toolkit. This tool gives you a way to view [options](#) that communities facing similar issues listed in their climate adaptation plans. The tool also lets you select and save a list of the [options](#) that might work for your community.

In order to help [practitioners](#) implement the Steps to Resilience as a systematized process, the [options](#) database is structured around climate-related [hazards](#) that impact key [community assets](#).

**Hazards** listed in the tool are based on key terms and definitions from FEMA and NOAA. The hazards include the following.

- Air Quality (degradation)
- Changing Seasons
- Drought
- Erosion and Shoreline Recession
- Extreme Cold
- Extreme Heat
- Flooding - Coastal Inundation (includes tidal flooding, storm surge, and sea level rise)
- Flooding - General (when the type of flooding is unknown or not specific)
- Flooding - Rainfall-induced (inland flooding, riverine)
- High Winds (associated with tropical storms or severe storms)
- Landslides
- Multiple Hazards - All Hazards (see note below on this category)
- Severe Winter Weather
- Shifting Species, Habitats, and Ecosystems
- Vector-borne disease
- Water Quality (degradation)
- Wildfire

Potential actions usually fit within two main categories: options that address **multiple hazards** simultaneously or options that are more **hazard- or asset-specific**. Below are some examples:

- Characteristics of multi-hazard (all Hazards) options
  - Integrate resilience plans with hazard mitigation
  - Train staff in resilience techniques
  - Perform community outreach
- Hazard, Asset, and or Action Type options
  - Flooding: Harden existing critical assets within 100-yr and 500-yr flood zones or relocate if feasible
  - Extreme heat: Build cooling centers for underserved communities
- Drought: Add capacity to water supply reservoir and determine viability and cost effectiveness

**Assets** in the database represent a simplified list from the National Institute of Standards and Technology (NIST), U.S. Environmental Protection Agency (EPA), the American Planning Association (APA), and other sources.

- Agriculture / Food Supply
- Critical Facilities
- Economy
- Energy and Utilities
- Multiple Assets - All Assets
- Natural Areas / Wildlife
- People
- Property (residential, commercial, industrial)
- Stormwater Infrastructure
- Transportation and Mobility
- Tree Canopy
- Water Infrastructure - Drinking Water
- Water Infrastructure - General
- Water Infrastructure - Wastewater

View the [Action Types and Subactions resource \(4.6 Action Types and Subactions - Guidance\)](#) for more details and related subactions.

**Action Types - Options and Adaptation Strategies** - Because there is not a national model (at the current time) for these Action Types, this database proposes a first “best guess” with plans to iterate to improve. Based on user research, the title of the database is Action Types, even though it also includes strategies (which are not as detailed as actions).

To employ a complete toolbox for adaptation, strategies are categorized into distinct types.

- Capacity Building (Analysis and Research, Monitoring, Technology, Staff Capacity, Community Resources)
- Capital Improvements - Green and Gray Infrastructure
- Funding and Finance
- Health, Wellness, and Security
- Land Use, Land Conservation, and Zoning
- Managed Retreat, Relocation, and Buyout
- Partnerships and Collaboration
- Planning and Management (non-land use related)
- Policy, Codes, and Standards
- Preparedness and Response
- Public Education and Outreach

## Using the Options Database 4.6 Action Types and Subactions - Guidance

Access the [Options Database](#). Follow instructions on the page to filter the list for options that are relevant to your hazards and assets. Once you've narrowed the list, follow instructions to copy your selected options and paste them into a spreadsheet.

Figure 23. Screenshot of the Options Database.

Option	Hazards	Assets	Action Type	Sub-Action Type	Source Plan	Plan URL
72 hour resilience for all city infrastructure: generator, supplies and storage, points of relocation for ops and loc center, training for all city departments about our ...	Flooding – Rainfall-indu...	Critical Facilities	Capacity Building	Community Resources, Transformative Strat...	City of Asheville Planning for Climate Resilience	<a href="https://drive.google.com/file/d/1X_Gr4eUCmkXPOzAcyyxCe-uZPkX84Byz/view">https://drive.google.com/file/d/1X_Gr4eUCmkXPOzAcyyxCe-uZPkX84Byz/view</a>
Accelerate adoption of distributed renewable energy systems, electrification and microgrids.	Extreme Heat	Energy and Utili...	Capacity Building	Community Resources, Transformative Strat...	Missoula, MT Regional Adaptation Strategy	<a href="https://www.climateadaptymissoula.org/uploads/1/2/6/6/126687164/revisedclimatereadymissoula_2.22.20.pdf">https://www.climateadaptymissoula.org/uploads/1/2/6/6/126687164/revisedclimatereadymissoula_2.22.20.pdf</a>
Account for projected changes in precipitation and sea level rise in water and water infrastructure planning.	Flooding – Coastal Flooding – General	Water Infrastruc... Water Infrastruc... Water Infrastruc...	Planning & Manage...	Planning	Climate Resilient San Diego	<a href="https://www.sandiego.gov/sites/default/files/crsd_final_plan_with_appendices.pdf">https://www.sandiego.gov/sites/default/files/crsd_final_plan_with_appendices.pdf</a>
Acquire appropriate flood response assets for public safety.	Flooding – Rainfall-indu...	Critical Facilities	Preparedness & Res...	Emergency Management	Charleston, South Carolina All Hazards Vulnerability & Risk Assessment	<a href="https://www.charleston-sc.gov/1975/All-Hazards-Vulnerability-Risk-Assessment">https://www.charleston-sc.gov/1975/All-Hazards-Vulnerability-Risk-Assessment</a>

1 record selected

## Host a Detailed Review of Potential Options

Facilitate dialogue to ensure team members agree that the options, actions, and potential projects (see [4.5 Inventory of Community Options - Worksheet](#)) are likely to address their primary concerns.

### **Special Consideration: Nature-based Solutions**

[Nature-based solutions](#) approaches may be highlighted in sector-based plans, such as transportation, human health, and others. [Table 14](#) highlights conventional and nature-based approaches for different types of [hazards](#). Make note of which efforts may be well aligned with your [resilience](#) objectives and assessment findings.

Natural Hazard	Conventional Approaches	Natural or Nature-based Approaches	Examples
<b>Inland Flooding</b>	Dams, dikes, levees, stream channelization, stormwater sewers, combined sewers, pumps	<ul style="list-style-type: none"> <li>Floodplain and watershed restoration</li> <li>Green stormwater management</li> <li>Protecting floodplains from development</li> <li>Moving people and infrastructure away from high-risk areas (“managed retreat”)</li> </ul>	<ul style="list-style-type: none"> <li>Levee setbacks and dam removal; wetland restoration</li> <li>Rain gardens; permeable surfaces</li> <li>Local legislation limiting new development in floodplains/ high-risk areas</li> <li>Open space acquisition and protection; voluntary buyouts</li> </ul>
<b>Coastal hazards</b>	Seawalls, bulkheads, dikes, breakwaters, levees	<ul style="list-style-type: none"> <li>Coastal habitat protection and restoration</li> <li>Living shorelines</li> <li>Protecting coastal areas from development</li> <li>Moving people and infrastructure away from high-risk-areas (“managed retreat”)</li> </ul>	<ul style="list-style-type: none"> <li>Protecting and restoring coastal wetlands; beaches, dunes, and barrier islands; coral and oyster reefs</li> <li>Vegetation-only or combined vegetation and structural approaches (e.g., constructed marsh with sills or breakwater structures)</li> <li>Voluntary buyouts; coastal open space protection</li> </ul>
<b>Extreme heat and drought</b>	Dams and reservoirs, air conditioning	<ul style="list-style-type: none"> <li>Watershed restoration</li> <li>Urban green infrastructure</li> <li>Water conservation</li> </ul>	<ul style="list-style-type: none"> <li>Headwater stream and forest restoration; beaver restoration</li> <li>Urban forestry; green roofs; cool pavement</li> <li>Rainwater harvesting; xeriscaping; water-saving agricultural practices</li> </ul>
<b>Wildfires</b>	Wholesale suppression of wildfires	<ul style="list-style-type: none"> <li>Ecological forest management</li> <li>Learning to live with fire</li> <li>Reducing edge development in fire prone habitat</li> </ul>	<ul style="list-style-type: none"> <li>Fuel reduction treatments; prescribed fire; post-fire restoration</li> <li>Community planning and collaborative risk management; managed wildfire</li> <li>Update land use/zoning</li> </ul>

Table 14. Examples of Nature-based Solutions for Hazard Risk Reduction. Source: NWF.<sup>43</sup>



### Nature-based Solutions Consideration:<sup>44</sup>

Consider that nature-based solutions can address equity concerns and exacerbate them. Nature-based solutions, such as urban green space, offer broad health benefits, such as reducing chronic disease, promoting mental well-being, and providing safe places to exercise. These solutions improve mental and physical health outcomes for communities and support social and ecological community cohesion.

In addition to various benefits, nature-based solutions can also create challenges for socially vulnerable populations in the form of unintended consequences. One example is the creation of green spaces that can cause an increase in housing costs and property values, ultimately resulting in gentrification and displacement of the very residents these strategies intended to benefit. Building on awareness of existing inequities, consider concrete strategies centered on community members who are most affected by climate change as well as environmental and social injustices.

## Special Consideration: Equitable Solutions

### Understand opportunities and considerations for social equity

Some options may explicitly advance equity. Others may require additional considerations to avoid exacerbating equity concerns. Encourage the planning team to consider the following opportunities for explicitly advancing procedural, distributional, and structural equity.

- a. Options that take into account unique disaster preparedness and recovery needs of diverse individuals, households, and groups (short-term; *distributive equity*).
- b. Options that seek to reduce inequities in access to resources and opportunities within the community (i.e. *pre-existing stressors*) such as lack of affordable housing, food deserts, or affordable medical care (short or long term; *distributive equity*).

- c. Options that seek to improve local government and community capacity and capabilities to move towards more deliberative and participatory governance<sup>45</sup> (*procedural and structural equity*).
- d. Options that seek to address root causes of differential vulnerability (i.e. structural inequities including structural racism) such as changes in policies, law, governance, and culture that perpetuate systemic inequities, reparative actions, and actions that institutionalize accountability to frontline communities and support their leadership and voice in decision making.
- e. Lastly, for all other options, Table 12 provides a set of questions that are useful to consider for equity-related co-benefits or, at a minimum, to avoid exacerbating equity concerns and unintended consequences such as gentrification.

Georgetown Climate Center Equitable Adaptation Legal and Policy Toolkit<sup>46</sup> provides case studies of strategies that have been used by communities in the U.S. to ensure resilience efforts are equitable. The toolkit includes emerging practices in economic, housing, public health, energy, water, disaster, and natural infrastructure sectors as well as policies that enable robust community involvement in resilience decision-making.

<b>Shared Benefits</b>	Can the benefits of action reduce historical or current disparities?
<b>Engagement</b>	Can the action engage and empower in a meaningful, authentic, and culturally appropriate manner?
<b>Capacity Building</b>	Can the action help build community capacity through funding, and expanded knowledge base or other resources?
<b>Alignment &amp; Partnership</b>	Can the action align with and support priorities of frontline communities, create an opportunity to leverage resources, and build collaborative partnerships?
<b>Relationship Building</b>	Can the action help foster the building of effective, long-term relationships and trust between diverse communities and local government?
<b>Economic Opportunity &amp; Staff Diversity</b>	Does the option support frontline communities through workforce development, contracting opportunities, or increased diversity of city and county staff?
<b>Accountability</b>	Does the option have accountability mechanisms to ensure frontline communities will equitably benefit and not be disproportionately harmed?
<b>Disproportionate Impacts (of actions)</b>	Does the action generate burdens to frontline and marginalized communities?
<b>Accessibility</b>	Are the benefits of the action broadly accessible to households and businesses throughout the community – particularly, communities of color, low-income individuals, and emerging small businesses?

Table 15. Equity Considerations from Williams-Rajee, D. Used with permission<sup>47</sup>

## Co-develop climate resilience projects with community residents<sup>48</sup>

A platform for community co-development helps shift funding and finance resources to communities most in need. This platform may:

- Enhance community trust and buy-in around a project, a key prerequisite for funder interest.
- Better identify and prioritize the funding ‘ask.’
- Increase eligibility for funding opportunities that include a robust vulnerability assessment and community engagement as part of the funding criteria.
- Ensure accountability to outcomes that reflect community needs and assets rather than those reflecting a predetermined view of what resilience should look like.
- Grow investor support by establishing community buy-in.
- Maximize project design, readiness for funding, and outcomes by supplementing content expertise (city planners and engineers) with context expertise (community residents).

## Incentivize climate resilience action

Embedding resilience into local government policies and creating new policies to support the climate resilience agenda can:

- Increase certainty for investors.
- Reduce transaction costs.
- Incentivize resilience.
- Mitigate risk and avoid losses.
- Enhance transparency.
- Set a framework for data collection and ongoing monitoring and maintenance.
- Mandate best practice.
- Increase eligibility for funding.
- Unlock additional funding streams.
- Increase local government creditworthiness and, therefore, fundability.
- Ensure more equitable outcomes.
- Improve efficiency.

### How:

- a. Reassess how community needs and assets are understood via more human-centric vulnerability assessments.
- b. Establish a platform for project co-development alongside community residents.
- c. Ensure accessibility.

### How:

- a. Bake risks into institutional framework and policies.
- b. Establish equitable resilience standards and incentives.
- c. Support Structural Shifts.

For additional details see: [Ready-to-Fund Resilience Guidebook Toolkit](#)

## Record information about each option

The options inventory (see [4.5 Inventory of Community Options - Worksheet](#)) represents the synthesis of all prior work: resilience objectives, research about options to consider, and basic notes from Planning Team discussions. For continuity and ease of discussion, the worksheet is designed to group options by their primary resilience objectives.

Once grouped, you may find it useful to re-sort the options by more granular categories (see [4.6 Action Types and Subactions - Guidance](#)).

Assigning Action Types and SubAction Types to your locally sourced options will let you sort into new groupings that can help you see if you are missing any “types” of actions or whether some of the options could be combined.

Apply a logical labeling or numbering system to individual options in the list so team members can refer to and find specific options as they are discussed.

As part of the review, consider each of the following questions for every potential option.

- How is social equity addressed?
- How is vulnerability and risk reduced?
- What is the timescale for implementation? near-term, mid-term, or long-term.
- Which agency would lead? Which partners would be responsible?
- What is the estimated cost?

Gather other notes on efficacy, feasibility, capacity, potential partners, perceived obstacles, and community strengths that can be leveraged.

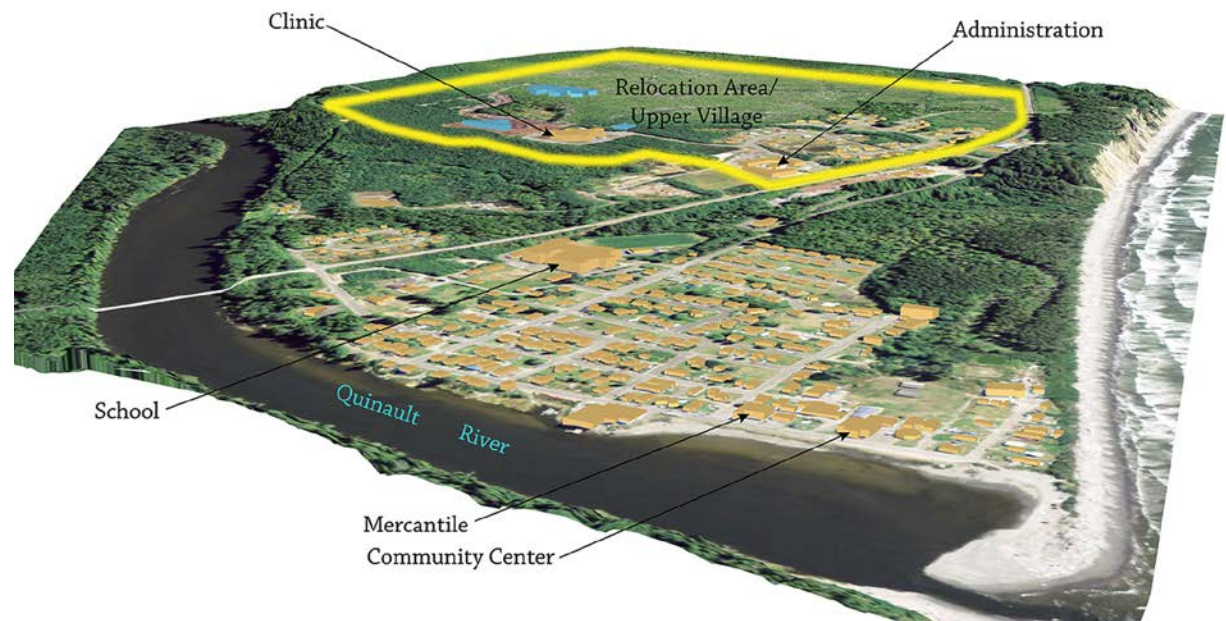


**Iterate!** This planning stage involves evaluating actions (projects) based on a variety of factors. Many communities iterate between the Investigate Options step and Prioritize and Plan step before implementing any resilience actions.

## Ensure options are acceptable in your community

Given limited resources for implementation, you may want to filter out options that are clearly infeasible or not directly relevant. This is a key task for the Planning Team. This is also a good time to have discussions with **Community Champions**.

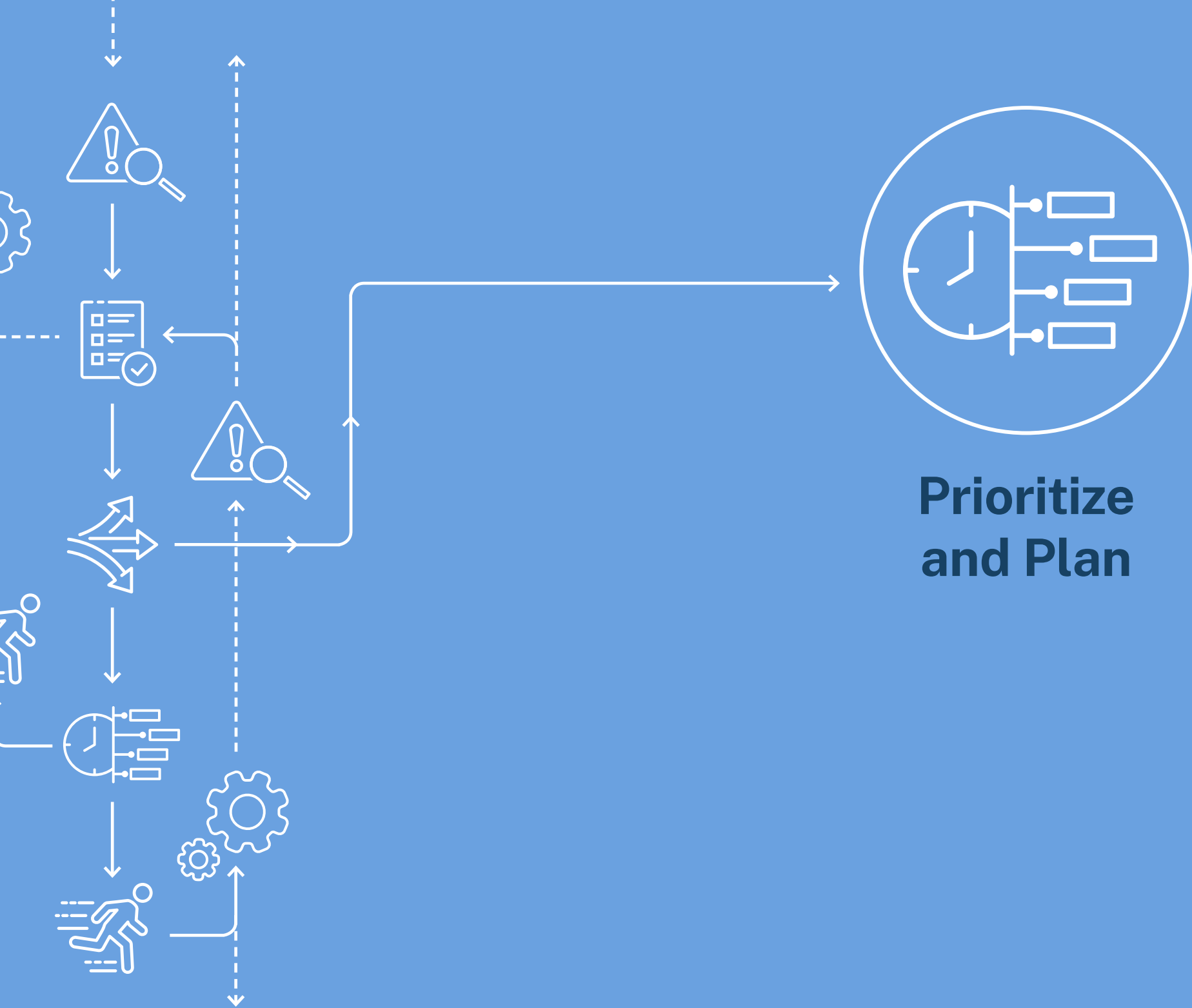
Start these discussions with a review of the **resilience objectives** (see **4.2 Develop Resilience Objectives - Worksheet**) to ensure that the potential options adequately address the highest vulnerabilities and risks.



The visualization shows the existing village of Taholah, with the higher elevation area for relocation outlined in yellow. Source: Quinault Indian Nation Department of Planning, Community & Economic Development

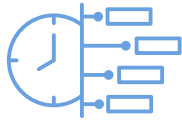
## Endnotes

- 43 From section 4 in *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*. For more on NbS related to specific sectors, see section 4.2, “Nature-based Solutions for Other Key Sectors/Concerns”.
- 44 Refer to the section “Diversity, equity, and inclusion” on page 44 and section 3.3, “Integrate Equity and Environmental Justice Concerns” in *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*.
- 45 For identifying potential strategies, see the discussion of ‘Essential Conditions for Collaborative Governance’ in *From Community Engagement to Ownership: Tools for the Field with Case Studies of Four Municipal Community-Driven Environmental and Racial Equity Committees*. [https://www.usdn.org/uploads/cms/documents/community\\_engagement\\_to\\_ownership\\_-\\_tools\\_and\\_case\\_studies\\_final.pdf](https://www.usdn.org/uploads/cms/documents/community_engagement_to_ownership_-_tools_and_case_studies_final.pdf)
- 46 Georgetown Climate Center’s Equitable Adaptation Toolkit, <https://www.georgetownclimate.org/articles/equitable-adaptation-toolkit-release.html>
- 47 Chapter 7, “Resources for Implementing Nature-based Solutions” in *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*.
- 48 See Characteristic 4 in *The Ready-to-Fund Resilience Guidebook*



**Prioritize  
and Plan**





## Prioritize and Plan

### Overview

The goal of prioritization is to rank order the achievable **options** and actions based on their ability to address the most concerning vulnerabilities and **risks**, meet the **resilience** objectives, and garner the support of community stakeholders.

The goal of planning is to find synergies and cost savings by combining or sequencing actions that reduce **risk** while avoiding unwanted, unintended consequences.

This chapter provides tools for assessing project **feasibility** and removing barriers to implementation. Seek efficiency by selecting **options** that can protect several assets. Sequence actions to reduce **risk** across a range of priorities.

Responsibility for much of the work in this step will shift from the **Practitioner** and Planning Team to the **Government Champion** or others with decision-making authority. Be aware that the skills and experience needed for success in this step are different from previous steps, so maintaining forward momentum may require a different person to complete the tasks.

#### Objectives

- Prioritize resilience options (strategies and actions)
- Planning – Acquire Funding
- Planning – Deal with Uncertainty
- Write the Resilience Plan

### Resources

- ☰ 5.1 Criteria for Evaluating Options - Worksheet
- ☰ 5.2 Community Options Prioritization Table - Worksheet
- ☰ 5.3 STAPLEE Descriptions and Guiding Questions - Guidance
- ☰ 5.4 STAPLEE Score Sheet - Worksheet
- ☰ 5.5 Considerations for Benefit-Cost Analysis - Guidance
- ☰ 5.6 Comparing Financing Tools - Guidance
- ☰ 5.7 Barriers to Resilience Funding and Finance - Guidance
- ☰ 5.8 Resilience Plan Outline and Guiding Questions

### Additional Resources

- ☰ Grant Proposal Development Resources (PDFs)

### Opportunities for community participation

- Community input about priorities for strategies and actions

### Questions and metrics for assessing this step:

- Are there easily available, understandable, and transparent prioritization criteria?
- Does the plan address the highest priorities for [exposure](#), [vulnerability](#), and [risk](#) to climate-related [hazards](#)?
- Will outcomes of each action reduce [vulnerability](#) and [risk](#)?
- Does the community have the technical capacity to continue [resilience](#) work into the foreseeable future?

## Key Concepts

### Feasibility

Also referred to as the “Ability to Implement”; the degree to which climate goals and response [options](#) are considered possible and/or desirable.

### Resilience planning

The process by which assets and [hazards](#) are defined within a community and a [vulnerability](#) and [risk assessment](#) is performed to help identify and prioritize [resilience](#)-building actions.

### Scenario planning

A method for exploring multiple possible (hypothetical) futures that allows decision makers to discuss and understand complex systems while also acknowledging their inherent uncertainty.

# Prioritize and Plan Roles and Responsibilities

Government Champion	Climate Adaptation Practitioner
<ul style="list-style-type: none"> <li>• Develop 3-5 criteria for evaluating Options. Include criteria that reflect stakeholder values and consider both Benefits and Feasibility.</li> <li>• Assemble a portfolio of prioritized strategies.</li> <li>• Evaluate projects and actions. Consider the need for benefit cost analysis and or expected value analysis.</li> <li>• Determine the best way to address uncertainty in the community.</li> <li>• Build on the planning team’s efforts to develop an implementation plan.</li> <li>• Collaborate with the Practitioner to explore opportunities to fund or finance priorities and determine which to pursue.</li> <li>• Flexibly adapt to new information, resources, and situations. Iterate as needed.</li> </ul>	<ul style="list-style-type: none"> <li>• Assist the Government Champion in developing 3-5 criteria for evaluating options.</li> <li>• Assist the Government Champion facilitate discussions for evaluating options.</li> <li>• Iterate as necessary to help the Government Champion assemble a portfolio of prioritized options.</li> <li>• Perform Benefit Cost Analysis and Expected Values Analysis as required by the Government Champion.</li> <li>• Advise the Government Champion on potential methods to address uncertainty, e.g., scenario planning or dynamic adaptive policy pathways.</li> <li>• As required by the Government Champion, write the Resilience Implementation Plan.</li> <li>• Collaborate with the Government Champion to explore opportunities to fund or finance priorities and determine which to pursue.</li> </ul>

**Table 14.** Prioritize and Plan roles and responsibilities of the government champion and climate adaptation practitioner.



The image at top shows the restoration of dunes in progress on the North Shore of O’ahu; at bottom are the newly restored dunes that will protect homes from high waves. Source: Hawai’i Sea Grant.

## In practice

### Prioritize resilience options

Enhance the Inventory of Community Options resource ([4.5 Inventory of Community Options - Worksheet](#)) by focusing on what must be done and in what order.

### Determine Evaluation Criteria

The team will evaluate the collection of feasible **options** against criteria which reflect stakeholder values. As you develop the evaluation criteria, take care to ensure they are explicit, understandable, and easily judged. This will help stakeholders see how their concerns are included in the prioritization process, and reveal the necessity of tradeoffs. Clear evaluation criteria will also make it clear how “success” is defined.<sup>49</sup>

Use the Criteria for Evaluating Strategy resource ([5.1 Criteria for Evaluating Options - Worksheet](#)) to establish three to five criteria within the two primary categories of “Reduction of Vulnerability and Risk” and “Ability to Implement.”

## **Reduction of Vulnerability and Risk**

**Options** have already been filtered for their ability to reduce **vulnerability** and **risk**. The following considerations can help you judge how the option could build **resilience**.

### *Long-Term Sustainability*

In addition to promoting **resilience** today, does the option or **strategy** increase the ability to withstand expected future change related to the particular **hazard**?

### *Alignment with social equity goals*

Does the option or **strategy** promote fairness, equity, and social responsibility to all people in the community?

### *Co-benefits*

Will this option or **strategy** serve any additional benefit other than what it is intended for? Will it address multiple threats? Multiple assets? Or other issues of value (i.e. environmental issues, social **justice** issues)?

## **Feasibility**

### *Political will*

**Feasibility** encompasses many factors: Does this option or **strategy** have public support? Is there political will to implement it? Inadequate information and concerns over the effectiveness of a given solution may render a given solution unpopular.<sup>50</sup> Public support, including community receptivity to a planning team's recommendations, will be important for the ultimate efficacy of a **strategy**. Communities that value local ecosystems and public space may be more inclined to embrace **nature-based solutions**.

### *Funding and finance*

Will this option or [strategy](#) be financially feasible with current resources? Are funds available? Can state and federal resources be applied? What opportunities exist to find [funding](#) or [finance options](#) or innovative financial mechanisms? Two related questions: “Does this option align with existing grant [funding](#) opportunities?” Does this option meet the criteria for existing grant programs such as FEMA BRIC, HMGP, FMA, HUD, or others?

### *Staff capacity*

Is staff capacity a barrier to implementation? Even with [funding](#), does the community have the requisite staffing, expertise, or other capacity to implement this option? Many projects require additional expertise, studies, or planning before getting to the actual project. Additionally, most large projects require additional expertise if they want to secure [funding](#) from a federal source. Recognizing the expertise required to identify the next steps is critical to keep projects moving forward.

### *Identified in existing plans?*

If an option is already in a community plan, it is more likely to be approved and implemented. Check for similar [options](#) in the following plans:

- Capital Improvement Plan
- [Hazard Mitigation](#) Plan
- Comprehensive Plan

### *Finally, can you form a connection from an option or action to an existing government program?*

If an option accelerates, supports, or complements an existing effort, it may be feasible to assign it a higher priority.

## Evaluate options using selected criteria

Use the criteria you developed or the examples in the Criteria for Evaluating Options resource (see [5.1 Criteria for Evaluating Options - Worksheet](#)), to evaluate each option.

Assign an identification code or number to each option in the Identify Acceptable Options resource (see [5.2 Community Options Prioritization Table - Worksheet](#)), and fill in responses to the criteria under Reduction of Vulnerability and Risk and Ability to Implement columns.

Consider organizing the Planning Team and community members into working groups by [hazard](#) or type of option for the evaluation discussion. This will let individuals with subject matter expertise or strong interests contribute accordingly.



		Criteria <i>(examples shown below)</i>				
		Reduction of Vulnerability and Risk		Ability to Implement		
ID	Option (Strategy or Action)	Co-benefits?	Does it meet social equity goals?	Is there staff capacity?	Is there political will?	Is funding available (now or future)?
ST-001	Incentivize private property owners to implement green infrastructure through zoning					
ST-002	Implement the stormwater response plan to clear inlets and outlets, including teams on stand-by, before and during events					
ST-003	Evaluate streets for accessibility for various levels of service given sea level rise to promote best routes					
ST-004	Evaluate and implement tree planting recommendations in public areas					

Table 15. Example traffic light evaluation of strategies. Source: Fernleaf.

## **Check team agreement on options**

Table 15 offers a three-category system based on an intuitive “traffic light” visual to get a quick snapshot of the level of team agreement on each option.

## **Classify options into tiers based on benefits and feasibility**

Considering the specifics of each option, [strategy](#), or action may help you see opportunities for improving it. Categorizing [options](#) into the following four tiers may help you identify ways to overcome barriers to implementation.

**Tier 1** – Options that reduce Vulnerability and Risk that are able to be implemented (feasible).

**Tier 2** – Options that reduce Vulnerability and Risk but have barriers to implementation. For these, identify perceived barriers such as funding, staff capacity, or others.

**Tier 3** – Options that have issues with reduction of Vulnerability and Risk, but are implementable.

**Tier 4** – Options that have issues with reduction of Vulnerability and Risk that also have barriers to implementation.



**Iterate!** For options in **Tier 2**, determine the specific issue that is blocking the option's **feasibility**. Return to the Inventory of Community Options resource (**5.2 Community Options Prioritization Table - Worksheet**) and consider what **options** could be added to remove blockages and move them into **Tier 1**.

Identify which **tier** each strategy fits within in the Inventory of Community Options resource (**5.2 Community Options Prioritization Table - Worksheet**).

### **Identify additional options that target barriers to feasibility**

Look at all **Tier 2 options** and consider how impediments could be removed. For example, an action that builds staff capacity could remove barriers for multiple beneficial **options**. Consider how prioritizing a new option such as building staff capacity could improve the **feasibility** of **options**.

### **Gap analysis: potential impacts**

For the **options** in **Tiers 1** through **3**, consider if and how they address vulnerabilities across all **community asset themes** and community values. It is important that strategies fit together to comprehensively address the team's **resilience** priorities.

Look at the **5.2 Community Options Prioritization Table - Worksheet** to determine if there are any major gaps within the full range of activities. Address those gaps.

### **Reconsider timescale for implementation**

Consider if the timescale of each option is near-term, mid-term, or long-term.

Record that in Column I in the Inventory of Community Options resource (☰ 5.2 Community Options Prioritization Table - Worksheet). Sort Tier 1 to 3 options by “timescales,” i.e., the time needed for implementation.

Will the vulnerabilities and risks identified in the Assess Vulnerability and Risk step impact your community before implementation of each option is likely to be complete?

Nature-based solutions require special considerations with respect to the time needed for both implementation and efficacy.<sup>51</sup> The phenology of plants, for example, can influence plant transpiration and therefore efficacy in regulating soil moisture. Establishing a nature-based solution may require a longer period of time than some other options.

### Assemble a portfolio of prioritized strategies

Identify the options within each tier that

- Address your central challenges as defined in your resilience objectives)
- Are explicitly equitable because they address one or more of the dimensions of equity and or target a root cause of inequity;
- Are options that remove a barrier to implementation for a Tier 2 option;
- Address an acceptable range of vulnerabilities, community values, and timescales.

### Nature-based solutions consideration:

A well-known and significant barrier to nature-based solutions is the limited financial resources for their implementation. The federal government is incentivizing these actions through grants such as BRIC (Building Resilient Infrastructure and Communities). While these grant programs can help accelerate nature-based solutions, upscaling and maintaining these solutions will require a continuous funding stream with targeted investments in disadvantaged communities.

The prioritization work done to this point will reveal the highest ranking options within each option type. One may then compare feasibility and benefits across different types of options. For example, the vulnerability and risk reduction, co-benefits, and equity outcomes of a natural infrastructure option compared to a gray infrastructure option can and should be compared to identify priorities across types.

## Planning

### Determine ability to fund or finance priorities

Public and private funds can both support government projects. Public funds come from revenue generation, including municipal, agency, state, and federal government taxes, fees, and charges. Private funds come from the capital markets, including bonds, bank loans, and even direct equity investments. Philanthropic funding is also part of private financing. In the context of local government financial dealings, funding is generally understood to mean money that does not need to be repaid, such as grants. On the other hand, finance is understood to mean money that must be repaid, such as a loan or debt service on a municipal bond.<sup>52</sup> Funding and financing for resilience projects can be obtained through a variety of institutions, including non-profits and educational institutions, public sector institutions, and private sector institutions.

Guidance for funding or financing can be found in the Comparing Financing Tools resource ([5.6 Comparing Financing Tools - Guidance](#)).

Review the [5.7 Barriers to Resilience Funding and Finance - Guidance](#) for details on these barriers and the characteristics that can be used to address them.

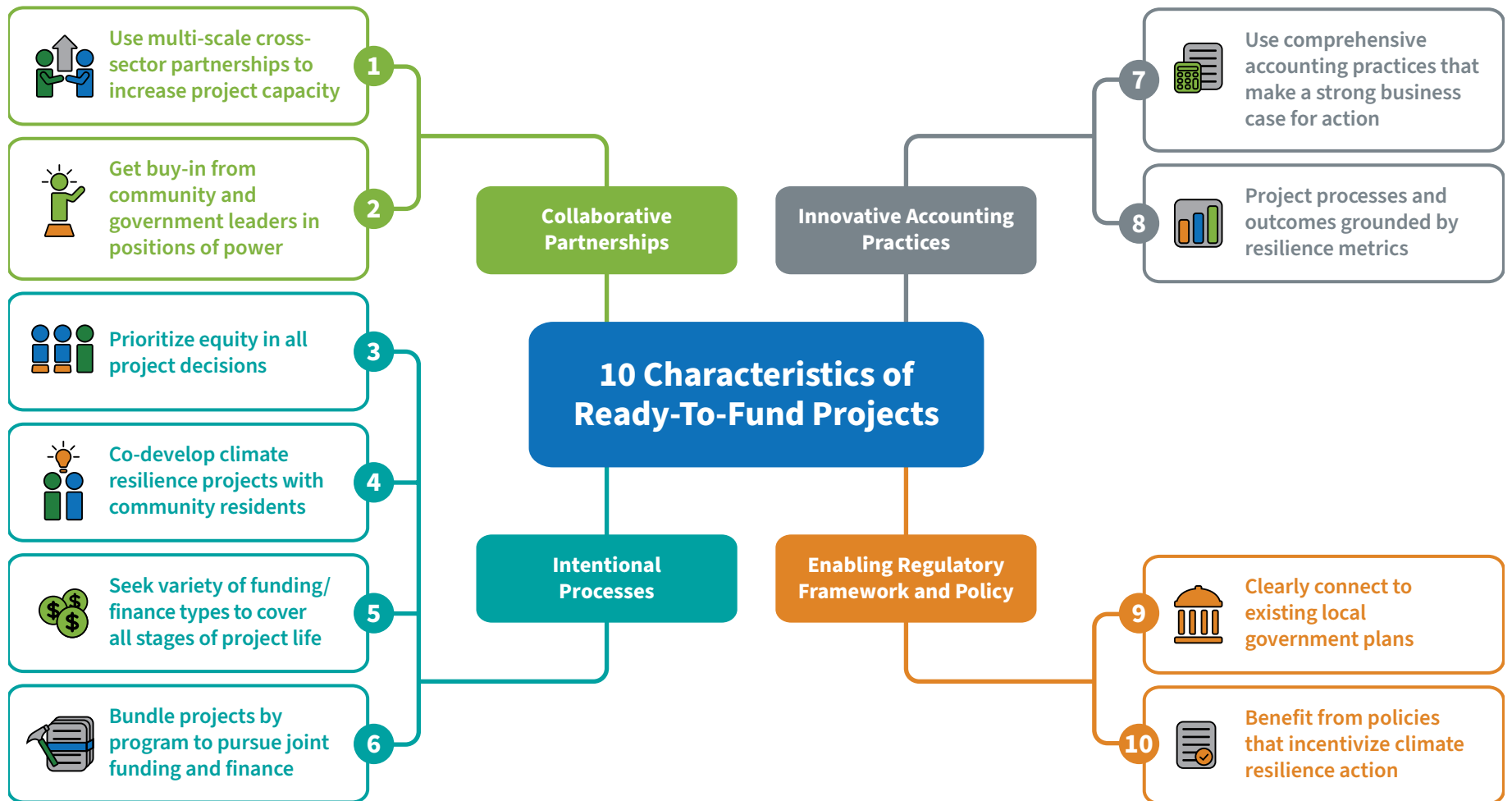


Figure 24. Ten characteristics of ready-to-fund resilience projects in four categories.

## Barriers to Resilience Funding and Finance

Federal and private sector climate [resilience](#) set the tone for climate [resilience](#)'s [financing](#) landscape writ large.<sup>54</sup> Understanding the barriers to securing funding and finance at a more granular level informs planners about what is possible.

For local governments, major barriers to [resilience](#) funding include lack of capacity to generate competitive grant proposals, intense competition for scarce resources, lack of political will among elected officials to allocate resources to projects that accrue benefits beyond an election cycle, leadership and or community resistance to transformative change that increases social equity, the absence of a [resilience](#) leader or lead agency within a local government, competing priorities, differing timeframes and visions between municipal government and communities, the inability of a municipal government to hear and act on community needs, and a dearth of funds for the convening, planning, and design often required to initiate funding or [financing](#).

The [Ready-to-Fund Resilience Guidebook](#) addresses these barriers through 10 characteristics (Figure 22) across four areas.

- **Economic:** Relating to project accounting and bankability.
- **Capacity:** Relating to the ability to meet the demands required of systemic transitions.
- **Cultural:** Relating to internal processes, partnerships, and communications.
- **Regulatory:** Relating to the planning and policy environment at a local, regional, and national level.

For a particular project or [strategy](#), a variety of [funding](#) and [financing](#) mechanisms may ultimately be needed. For example, the distinctive characteristics of nature-based solution [funding](#) and [finance](#) are discussed in “Resources for Implementing Nature-based Solutions.” Identify any sources that have been obtained and any that are possible or needed for the future.<sup>53</sup>

## Nature-based Solutions Consideration:

A well-known and significant barrier to [nature-based solutions](#) is the limited financial resources for their implementation. The federal government is incentivizing these actions through grants such as BRIC (Building Resilient Infrastructure and Communities). While these grant programs can help accelerate [nature-based solutions](#), upscaling and maintaining these solutions will require a continuous funding stream with targeted investments in disadvantaged communities.<sup>55</sup>

## Qualifying for Federal Funding

### Consider Evaluating projects and actions using STAPLEE

If you are looking to qualify for FEMA funding, The Federal Emergency Management Agency (FEMA) provides a standardized and systematic method you can use to evaluate project-level actions. The method uses a set of criteria that fall into seven categories: **S**ocial, **T**echnical, **A**dministrative, **P**olitical, **L**egal, **E**conomic, and **E**nvironment (STAPLEE).

Use the STAPLEE Descriptions and Guiding Questions resource [5.3 STAPLEE Descriptions and Guiding Questions - Guidance](#) to review guidance for each of the STAPLEE categories. Modify the STAPLEE criteria after reviewing the goals, vision, and values developed for the project to determine if anything needs to be altered or added.

Use the STAPLEE Score Sheet [5.4 STAPLEE Score Sheet - Worksheet](#) to evaluate each category. Review and update any of the criteria as needed by the Planning Team.

### Consider the need for benefit-cost and expected value analysis

To qualify for FEMA, U.S. Army Corps of Engineers, and some other funding, a benefit-cost analysis (BCA) is required.<sup>56</sup> A benefit-cost analysis (BCA) helps you determine whether an action is a worthwhile investment by comparing the cost to implement it to the expected value of the benefit it will provide. If the total value of reduced [risk](#), increased [resilience](#), and co-benefits are expected to have a comparable or higher value



than the cost of implementing the project, expected value is positive. FEMA offers three elements to make the business case for implementing projects: the efficacy of [hazard mitigation](#) benefits, community co-benefits, and community cost savings.<sup>57</sup> These include the [hazard mitigation](#) benefits as well as community co-benefits and cost savings.<sup>58</sup>

There are caveats to consider with a benefit-cost analysis. [Practitioners](#) have found three major limitations to using a benefit-cost analysis: (1) exacerbating inequities, (2) inability to capture the full range of value provided by natural systems, and (3) uncertainty in future conditions. A benefit-cost analysis can undervalue the benefits of [mitigation](#) projects in lower-capacity and lower-income communities. A major pitfall of benefit-cost analysis in this context is that it singles out the economic value of property protected, resulting in an inequitable distribution of funds to those people whose property is of greatest value. Addressing the number of people impacted or services they require would require a non-monetary approach to assessing benefits and costs.<sup>59</sup>

Always consider the cost and benefits of [nature-based solution](#) alternatives. Estimating the potential financial benefit of intangible things such as [eco-system services](#) can lead to a broad range of expected values. [Nature-based solutions](#) are dynamic systems that provide a multitude of benefits in addition to [hazard risk](#) reduction.

The benefit-cost analysis requirement itself can be a barrier to implementation for many communities because of the staff capacity needed to carry out the accounting process. Some groups choose to engage [risk management](#) consultants to help produce a benefit-cost analysis. It is also important to check if your state requires that such assessments are completed by registered engineers.

The Considerations for Benefit-Cost Analysis resource (5.5 Considerations for Benefit-Cost Analysis - Guidance) expands on each of these issues, provides additional considerations, and suggests alternatives for improving traditional benefit-cost analysis methods.

Table 14 also lends insight into how to improve a benefit-cost analysis.

Another federal resource for guidance on grants and successful grant applications are NOAA's Office for Coastal Management's Grant Proposal Development Resources:

[coast.noaa.gov/digitalcoast/training/grant-proposal.html](https://coast.noaa.gov/digitalcoast/training/grant-proposal.html)

The simple equation of expected benefits accrued from the investment divided by the sum of all necessary costs incurred does not address uncertainties such as the rate of increase in **risk** over time due to **climate change**. Non-stationarity in the climate system is not considered within a standard benefit-cost analysis. Immediate needs tend to outweigh longer-term considerations when conducting a benefit-cost analysis.<sup>45</sup>

FEMA continues to update its guidance on benefit-cost analysis to address these shortfalls. In early 2004, FEMA updated their BCA guidance to address these challenges. They did several things:

- FEMA no longer requires a full BCA for projects being funded through its Hazard Mitigation Assistance grant programs with a total cost of less than \$1 million.
- FEMA lowered their discount rate to make the funding more available for underserved communities.
- Distributional weights can now be applied. These weights will automatically adjust the BCA by increasing the build replacement values for properties in areas with household incomes below the national median. In disadvantaged communities, this will make it easier for projects to be eligible for **mitigation** grant funding.
- FEMA will continue to offer BCA assistance to disadvantaged communities and Tribal Nations to determine **hazard mitigation** project cost-effectiveness.

The Ready-to-Fund Resilience Guidebook and Headwaters Economics “Improving Benefit-Cost Analyses” are both good resources full of practical advice on how communities are applying these concepts. The table on the following page summarizes some of the points in these resources.

### **Internalize project co-benefits to conduct a triple bottom line cost benefit analysis.<sup>60</sup>**

The triple bottom line (sometimes called TBL or 3BL) is an accounting framework with three parts: social, environmental (or ecological), and economic. These assessments consider [green infrastructure](#) projects, such as wetlands restoration, brownfield remediation, or urban reforestation, that involve a network of “ingredients” for solving urban and climatic challenges by building with nature. In addition to maintaining water quality and mitigating flooding, such installations can clear and cool the atmosphere. This improves public health and lessens basement flooding. This improves property values and saves owners and renters money. It boosts tourism, attracts business, produces tax revenue, and reduces stormwater to treat lowering public utility costs.

The dialogue around climate [resilience](#) investment often only weighs avoided losses against the physical costs of a gray infrastructural investment. This conversation usually occurs after disaster strikes. While much work remains to be done to account more effectively for these sorts of hard cost savings, resources invested in the quantification of more holistic costs and benefits can move the field forward. Proactively highlighting investments that yield a triple dividend can shift the focus from the solely upfront financial project costs to include the cascading benefits over time.

### Three considerations for improving your benefit-cost analysis

	What is being valued?	What is the Accounting Timeframe?	Who receives benefits and who bears costs?
Considerations	<ul style="list-style-type: none"> <li>Are we creating a business case that includes upfront capital costs and longer-term savings in maintenance and operations that are benefits related to increased health and safety? Do we consider how it stabilizes and/or increases the tax base, economic position, and community livability aspects, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Have benefits and costs that accrue beyond a construction timeframe been considered?</li> <li>Has the project’s real useful life been explained and accounted for in decision-making?</li> <li>For additional information around alternative discounting practices, consider Appendix B.</li> </ul>	<ul style="list-style-type: none"> <li>Who judges the project to be worthwhile from the standpoint of the use of local government resources? Are those who rate it highly in traditional positions of power, from the community, or who are historic beneficiaries of adequate public services? Who pays and who benefits from this work? Compared to other government-funded local projects, will this fund provide more or fewer resources to LMI and BIPOC communities?</li> </ul>
How to	<ul style="list-style-type: none"> <li>Internalize project co-benefits to conduct a triple bottom line (social, environmental, and financial) cost-benefit analysis.</li> <li>Pursue innovative strategies to monetize the “intangible” benefits.</li> </ul>	<ul style="list-style-type: none"> <li>Correct the misaligned planning horizon of climate resilience investments by using alternative discount rates.</li> <li>Engage your CFO to discuss an alternative BCA.</li> </ul>	<ul style="list-style-type: none"> <li>Wherever possible, set investment priorities for LMI and BIPOC communities.</li> <li>Establish a platform for community and codevelopment (see Characteristic 4).</li> <li>Value qualitative community data in addition to quantitative indicators. Cite the considerations described above within project discussions.</li> </ul>

**Table 16.** Considerations for improving a cost-benefit analysis over more traditional methods. Source: Ready-to-Fund Resilience Guidebook.

## Planning under uncertainty

Decisions to build **resilience** must consider not only the current **vulnerability** and **risk**, but also future **risk** due to a changing climate. Four principles can help mitigate the downside **risk** of decisions made in the face of deep uncertainty (DMDU).<sup>61</sup>

**First**, consider multiple futures, not one single future, in your planning. Choose these futures to stress test your plans. It is better to have a range of scenarios and a plan that can adapt based on what is known and anticipated at the present.

**Second**, seek robust plans that perform well over many futures, not optimal plans designed for a single, best-estimate future. Such a plan will be responsive to what is experienced and learned as the future unfolds.

**Third**, make plans flexible and adaptive. This **strategy** often makes them more robust. Such plans contain a strategic vision of the future, commit to short-term actions, and establish a framework to guide future actions.

**Fourth**, use analytics to explore many futures and **options**. Strive for correctability of decisions, extensive monitoring, and flexibility.

Multiple tools and processes are available for planning under uncertainty. The two methods described below have proven to be successful when working with communities.

### *Scenario Planning*

**Scenario planning** is a widely used method of envisioning possible future conditions by understanding the primary driving forces that might shape alternative futures.<sup>62</sup> The process typically involves identifying a decision challenge, enumerating the factors that

are beyond one's control or that increase uncertainty, developing narratives describing distinct scenarios, and developing a plan that could address each scenario.

Scenario-based planning allows the community to evaluate a suite of **options** that are robust under various plausible outcomes.<sup>63</sup>

#### *Dynamic Adaptive Policy Pathways*

Dynamic adaptation policy pathways is a decision-support framework for **options** that adjust over time and are therefore able to handle uncertainties both in the present-day and in the face of changing conditions.<sup>64</sup> Users construct a framework comprising times when conditions are evaluated (open circles, Figure 25), tipping points (conditions which, when met, necessitate that a strategy or action should be abandoned), Adaptation Pathways (Figure 25; strategies that are pursued as long as they provide adaptation and resilience benefits. By continually evaluating real-world conditions, decision makers remain aware of triggers that necessitate the re-evaluation of decisions (Figure 25).

Based on the best available information, responsible parties decide (open circle, Figure 25) to implement a policy or strategy (horizontal line, Figure 25). External conditions, such as sea level rise having reached a given elevation or extreme rainfall having increased in intensity and frequency by a given amount, may necessitate future decision points (depicted by circles that appear to the right of any other circle on a given "Adaptation Pathway," or horizontal line. At that decision point, the team chooses alternate pathways, depicted by vertical lines.

The open circles connected by vertical lines are alternative options based on information available at that time. A decision is made in light of that information, leading to the need to follow one or another horizontal line until the next trigger and decision point. By representing each pathway, decision point, and alternative in a single visualization, dynamic adaptation policy pathways can be made explicit to decision makers throughout the adaptation process.

# Pathways to different futures

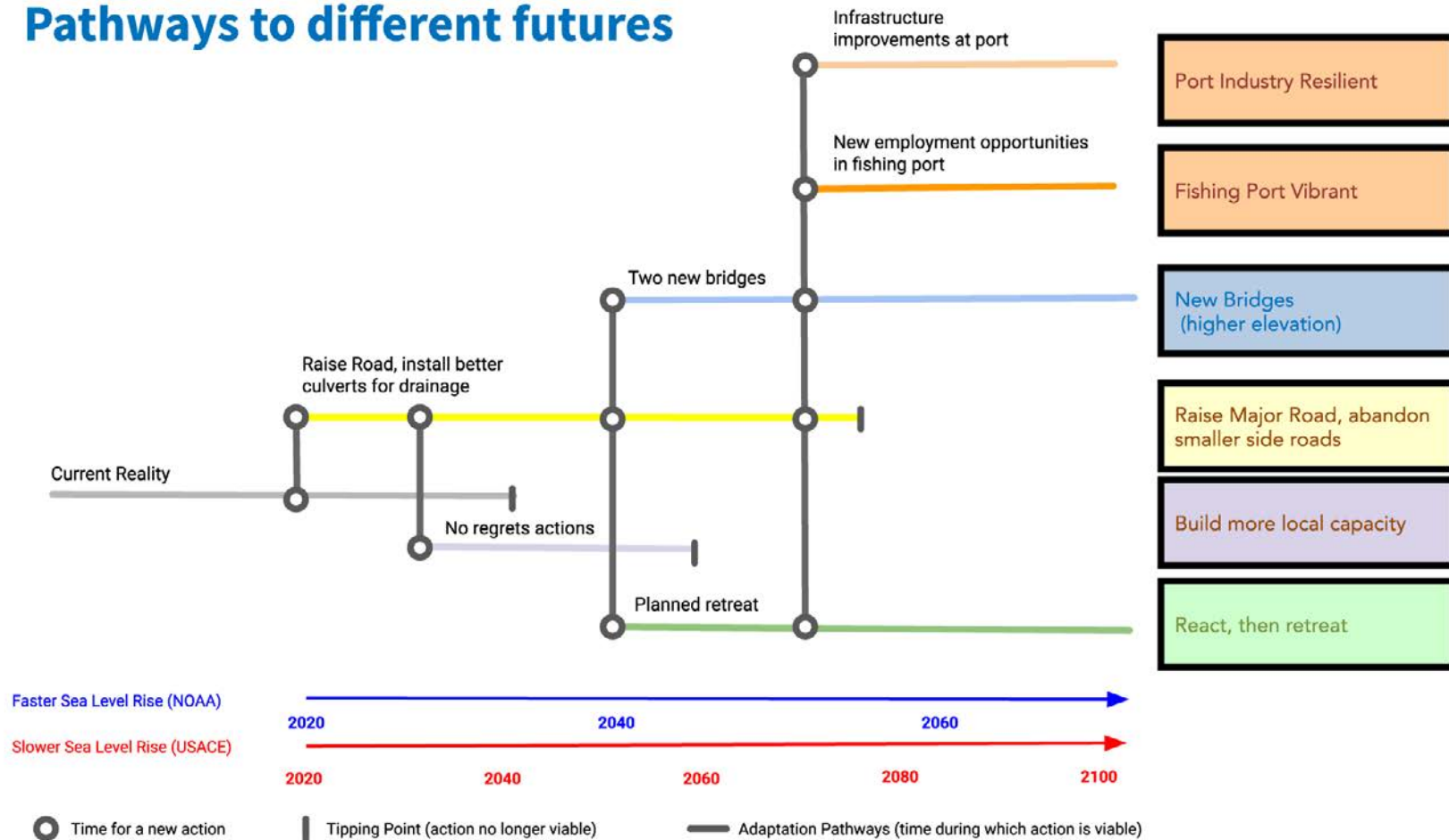


Figure 25. This diagram outlines adaptation strategies for a fictitious coastal community facing increasing flood risks, from 2020 to 2100. It shows three main approaches – protect, accommodate, and retreat – with decision points for strategy adjustments based on observed climate impacts.

A climate resilience planning team may put its own prioritized options into a dynamic adaptation pathways framework and visualization.<sup>65</sup> Figure 25 illustrates a simple example of adaptation pathways.

First, identify thresholds for potential climate-related impacts in your area of interest (see summary of central challenges in [3.11 Vulnerability and Risk Synthesis Report - Template](#)). For instance, some threshold amount of sea level rise would impact a set of assets in many geographical settings.

Determine **the year that threshold might be reached** or exceeded while considering the team's *risk* tolerance. In the example shown, two different sea level rise scenarios are shown in the timelines at the bottom of the diagram, one in blue and the other in red. Most *climate change* projection datasets provide a set of trajectories representing plausible outcomes based on possible future greenhouse gas emissions, *sensitivity* of the climate system, and the local manifestations of global *climate change*. The time when a threshold is exceeded is an **adaptation tipping point**. These **adaptation tipping points** are shown as vertical black bars in the diagram and indicate times by which decisions need to have been made.

This planning framework emphasizes the value of monitoring weather and climate conditions in order to anticipate **adaptation tipping points**. Use monitoring data to justify decisions to move from one **adaptation** pathway to another. The different pathways are shown in different colors, and the colors relate to different future goals related to the community's vision. Those decision points are referred to as **sign posts**. The **adaptation** plan should articulate what actions are to be taken in association with **tipping points** and sign posts.



## Consider trade-offs

Climate [adaptation](#) and [resilience](#) are not the only factors that enter into community planning. Trade-offs often involve balancing [adaptation](#) actions with sustainability, greenhouse gas [mitigation](#), and efforts to decrease social inequalities.<sup>66</sup> The downside to focusing on a single [hazard](#) and its [potential impacts](#) is that one might lose perspective and miss the potential for unintended consequences or fail to recognize co-benefits. When developing a final implementation plan, [practitioners](#) can help the community check that a proposed option will not create a bigger issue somewhere else or for other community assets.<sup>67</sup> Gentrification, community isolation, and ecosystem degradation from civil engineering projects are examples of [maladaptation](#) and unintended consequences associated with nature-based solution implementation.<sup>68</sup> Think broadly about unintended consequences and focus design efforts to reduce or eliminate them.<sup>69, 70</sup>

Conflicts across different community departments and stakeholder groups may become apparent when assigning limited resources to prioritized [options](#). Trade-offs would manifest at some future date or would be more viable at a later time or after specific conditions come around. Stakeholders may not show value for future benefits compared to current necessities. Facilitated dialog can acknowledge and address these conflicts. Discuss trade-offs, and find ways to find agreement.<sup>71</sup> Communicate the trade-offs among economic benefits, [equity](#) issues, “green vs. gray” solutions, and other community value drivers.

## Write the Plan

### Write project plans for highest priority projects

Create project plans for implementing each of the highest priority projects. Implementing these projects is dependent on several factors related to the project and community.



Members of the planning team gather to develop the implementation plan using information from the previous steps. Source: Whitney Hansen, Fernleaf.

Some guiding principles to consider for developing these plans include the following ideas taken from the Ready-to-Fund Resilience Guidebook,<sup>72</sup> unless otherwise noted.

**Be explicit about the future risk scenarios the project must address.** For **nature-based solutions**, consider how climate will affect organisms and ecosystem processes in the near to long-term.<sup>73</sup>

**Define project requirements** Consider the **scope, design, budget, community engagement, and long-term monitoring and maintenance of each project**. If a project requires the cooperation of multiple departments (e.g., planning, sustainability, emergency management, and housing), begin the necessary collaboration. Communities already engage in several types of planning processes. Nature-based solution projects will likely require a paradigm shift from business-as-usual planning to improve internal cooperation and intersection among various departments and agencies.<sup>74</sup> However, mainstreaming and integrating **nature-based solutions** into existing policy and planning processes may ensure action.

For each component of the project, **consider the contingencies and legal viability of each project element. Demonstrate capacity to obtain any necessary consent or permits, meet regulations, or honor land rights prior to project implementation.**

Prepare a full funding and finance plan for prospective investors. This may include several aspects of the plan for implementing the project. In order to maintain momentum for the **resilience** team, some funding or **financing** may need to be identified.

## Develop a timeline and milestones

Work with the Planning Team to document the plan. Include a narrative summarizing (a) the vulnerabilities that will be addressed; (b) the potentially exacerbating climate and non-climate-related **stressors** the team identified; (c) actions that were considered and the ones selected, and why; (d) the anticipated costs, benefits, and outcomes of the plan; (e) an implementation timeline with phases of work and estimated completion times clearly identified.

Referring to the **Tiers** identified above, justify the prioritization process, and mention how barriers were identified as well as how those might be overcome. Discuss the timescale for emerging problems as well as concomitant actions to address those issues. Community members must take note if there is a phase difference between when a problem will emerge and when **resilience** action can be accomplished.

## Write the Resilience Plan

Up to this point, the **Practitioner**, Planning Team, and **Government Champion** have worked through the Steps to Resilience to create a list of **adaptation options** that when implemented as actions create a more resilient community. The **adaptation** actions by themselves may lack the context of why and how they were developed and the challenges they were selected to address. Putting it into a written plan for the community, possible funders, and others is important for gaining support for the individual actions or projects and for the plan overall. The key is to write the plan outlining the **options** that could be implemented through the execution of **adaptation** actions, policy initiatives, and fundable projects. Depending on the size of the community and resources available, implementation plans may look very different as they may serve many different audiences and purposes.

The **Government Champion** begins to play a much larger role as the Resilience Plan is written and support is gained. An effective internal communication effort will ensure government leaders and key community leaders are aware of the plan and its recommendations. These leaders are the key decision makers and they will need to accept responsibility for taking action and finding resources to assist in the plan development and approval. Some suggested topics to be covered in the plan are as follows.

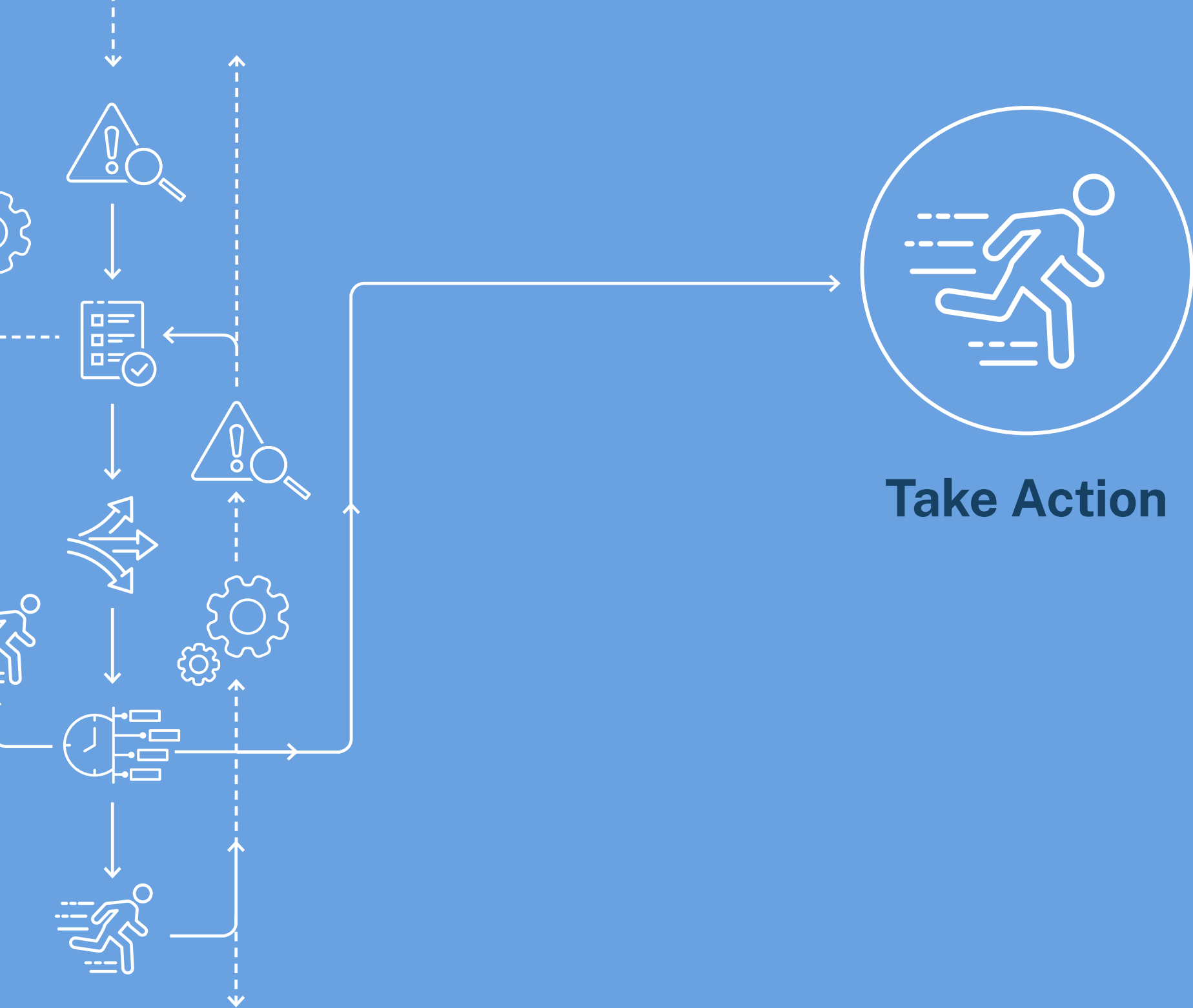
 **Resource 5.8** can be helpful in crafting the Resilience Plan.

- a. Background information:** why was this resilience effort started? Was it a single event or was it chronic symptoms caused by changing climate and weather or other **non-climate stressors**?
- b. Who was involved:** list the planning team members, the **Government Champion**, community champions, and stakeholders that participated. Detail any public meetings, feedback received, and action taken from that feedback.
- c. Vision, values, and goals:** how they were used in each of the steps to make sure efforts focused on what was important to the community. Likewise, what community assets were evaluated, and what **hazards** and **stressors** were considered? The community will want to see their interests represented in the document.
- d. Science:** what science was used to document and project **hazards**, current and future? It is critically important for the community to have confidence in the science serving as the foundation for the plan. Make it easy to understand and provide references so community members can spend time looking at the science for themselves and follow the trends and events.
- e. Prioritized Actions:** what actions does the plan recommend the community take to be more resilient? How were they prioritized? What were the criteria?
- f. Funding and Finance options:** although it is too early to settle on any one specific source or sources for any particular project, describe the broad overview of funding and **financing options** that were considered and discussed during the prioritization and planning step. It is important the community realizes there are many **options** to fund and finance these actions. It is also important to lay out the timeline for available grant programs to help manage expectations and frustrations.
- g. Accountability and Transparency:** how can the community track the progress of the larger plan and individual projects and actions? What mechanism has been established to report on progress for implementing the actions but also on the impact the actions are having on creating a more resilient community?

## Endnotes

- 49 Additional discussion on these topics is available in Hoffman and Hansen, 2022.
- 50 Section 5.3.2, “Enabling Conditions,” and section 6.4.1, “Social and Cultural Context,” in *Incorporating Nature-based Solutions into Community Climate Adaptation Planning* go into more detail about these feasibility concepts in the context of natural systems.
- 51 Read more about this in the context of Nature-based Solutions in section 5.3.1, “When to Act” in *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*.
- 52 From *Ready-to-Fund Resilience Guidebook*
- 53 Chapter 7, “Resources for Implementing Nature-based Solutions” in *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*.
- 54 This section is from *Ready-to-Fund Resilience Toolkit*
- 55 From *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*, section 6.4.3: Financial and Regulatory Context.
- 56 <https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis>
- 57 This concept and others related are covered in section 5.2.1, “Limited Resources,” in *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*.
- 58 For more details related to NbS and FEMA funding, refer to section 6.4.3 “Financial and Regulatory Context” in *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*
- 59 Headwaters Economics, <https://headwaterseconomics.org/equity/improving-benefit-cost-analyses/#point2>
- 60 Read more about Characteristic 7 in *Ready to Fund Resilience Guidebook*.
- 61 See the Implementation Examples resource for a recorded presentation delivered in May 2019 as part of a two-day technical training course held by the Water Utility Climate Alliance (WUCA) in Tampa, Florida, <https://toolkit.climate.gov/course-lessons/decision-making-under-deep-uncertainty-dmdu>
- 62 Scenario planning processes were pioneered by Schwartz and van der Heijden
- 63 From *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*, Section 3.1.1.
- 64 Haasnoot et al. 2013
- 65 These are based on a synthesis of Haasnoot 2013 approach for pathways
- 66 Chelleri et al., 2015.
- 67 Charleston Medical District Lowcountry Oases
- 68 Seddon, N., A. Chausson, P. Berry, C.A.J. Girardin, A. Smith and B. Turner. 2020. Understanding the value and limits of nature-based solutions to climate change and other global challenges. *Philosophical Transactions of the Royal Society B* 375:20190120.

- 69 From *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*, section 5.2: Trade-offs.
- 70 For more on climate gentrification, see Anguelovski et al. 2019.
- 71 Richters et al. 2015.
- 72 Guiding principles are from the *Ready-to-Fund Resilience Guidebook*
- 73 From *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*, section 2.3 “Determine Geographic and Temporal Scale”.
- 74 From *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*: Section 6.4.2, Barrier 3: Institutional Fragmentation.
- 75 <https://www.cakex.org>
- 76 This section and the following questions are from Hoffman and Hansen 2022





## Take Action

## Overview

Implementing a [resilience](#) plan requires active leadership by the [Government Champion\(s\)](#) and a commitment to building capacity among local groups to support the effort over time. In addition to the technical capacity for any construction or project management activities, ongoing community engagement is crucial for buy-in and support. Having a well-constructed Communications Plan is critical to ensure the community knows about the plan, what it contains, and how it will affect them now and in the future. Having transparent measures to monitor and evaluate progress will assist with ongoing funding and finance efforts. Communicate project progress and results with other communities who are engaged in similar efforts. Monitoring and evaluation are important for internal success: when done well, these efforts can help build [resilience](#) capacity on a national level. Data collection will support iterative, persistent [adaptation](#) efforts. Focus data collection on ways to improve project goals and implementation strategies.

### Objectives

- Implement the plan
- Identify and seek opportunities for funding
- Monitor, evaluate, and share lessons learned
- Iterate: plan for persistent adaptation



### **Practitioner's Guide Resources**

[6.1 Communications Plan - Guidance](#)

[6.2 Measuring Success - Guidance](#)

### **Additional Resources**

- [Preparing for Effective Risk Communication](#) (Asynchronous Online Course)
- [Moving from Faith-based to Tested Adaptation Process and Approach: How Will We Know We're Adapting?](#) (PDF)
- [Resilience Metrics: Exploring and Identifying Indicators](#)
- [Long-Term Community Resilience Exercise Resource Guide](#)

### **Opportunities for community participation**

- The community can help with communication and outreach. Ideally, community members will be informed and involved throughout the process of implementation.
- The community can help with monitoring.
- Community partners help determine funding and finance as well as project timelines.
- Ensure actions are addressing needs in the community.
- Because “Take Action” is part of an iterative cycle, community participation should be maintained over time.

### Questions and metrics for assessing this step:

- Has the action been implemented?
- Has a plan for monitoring and evaluation been adopted and implemented?
- Have the vulnerabilities been reduced by the actions? Is there evidence of having reduced impacts?
- Implement a monitoring plan to measure the function of social, built, or natural systems aligned with objectives of the action plan.

## Key Concepts

### Monitoring and evaluation indicator

A quality or trait of effectiveness, progress, or success.

### Indicator

A quality or trait suggesting (indicates) effectiveness, progress, or success.

### Bankable

Projects possessing an attractive economic profile that appear likely to deliver high enough **risk**-adjusted returns to attract private sector **equity** or debt.

### Financing

Obtaining money for a project that must be repaid eventually.

### Sensitivity

Money available on a one-time or limited-time basis (e.g., a grant) or over time (e.g., taxes or fees) that does not need to be repaid.

## Take Action Roles and Responsibilities

**Table 17.** Take Action roles and responsibilities of the government champion and climate adaptation practitioner.

Government Champion	Climate Adaptation Practitioner
<ul style="list-style-type: none"> <li>• Collaborate to develop communication plans, presentations, and job-aids.</li> <li>• Garner political support at the local, regional, and state level.</li> <li>• Work with the planning team to convene workshops/ training opportunities to socialize resilience efforts within the community’s social systems.</li> <li>• Work with other government entities to take steps to systematically integrate the resilience plans into governance systems.</li> <li>• Identify and pursue funding opportunities.</li> <li>• Collaborate with the planning team to develop metrics that can be used to monitor success of resilience priorities. Advertise and share results of the adaptation planning process with community stakeholders.</li> <li>• Flexibly adapt to new information, resources, and situations and iterate.</li> </ul>	<ul style="list-style-type: none"> <li>• Do not plan to play an active role in this step unless contracted to do so.</li> <li>• If you are a permanent employee of the city or community team, work closely with the Government Champion on all aspects of this step.</li> </ul>

# In practice

## Implement the plan

### Government Champion Takes Action

Take Action is where the [Government Champion](#)(s) steps up to take the lead role. The [Practitioner](#) and Planning Team, including [community champions](#), play a supporting role in assisting the [Government Champion](#). To successfully implement the plan the [Government Champion](#) must be well prepared to communicate the plan to a wide audience of stakeholders. They'll need to work inside and outside of government to build a strong coalition of support for the plan and actions. The [Practitioner](#) and Planning Team may play a critical role in providing technical expertise. They can be essential in helping to activate the different levels of community engagement (e.g., informing, consulting, involving, collaborating, and deferring to).

Taking action is the longest part of the building [resilience](#) journey within the Steps to Resilience. This step really never ends but is refreshed with new information, updated with new [options](#), and may be energized with every federal grant and budget cycle, potentially bringing opportunities for new [funding](#) to make meaningful investments. During this step, the [Government Champion](#) will need to navigate and adjust to numerous political and administrative changes that will require additional education, one on one discussions, and being open and responsive to changes about the plan and priorities.

An important component of the Take Action step is the monitoring and evaluation of adaptation actions to see if they are having the desired results. It is much easier to maintain public and political support when you can share success and show that important [indicators](#) of [resilience](#) are improving.

Finally, the [Government Champion](#) must always be willing to iterate and adapt as things change. Updating the plan is a must to keep it fresh and responsive to the current realities the community is facing. Being open to adjusting priorities, whether from a recent hazardous event, changing political input, updated science information, or information from the evaluations of existing measures makes the plan relevant and responsive.

## **Actions for Success**

### **Communicate the Plan**

The Steps to Resilience processes, actions, and outcomes should all be shared with and beyond the community to broaden understanding of what has taken place, if it is working, and to support neighboring jurisdictions that may be at an earlier phase of the adaptation process. Consider communication with peers in other communities through professional societies, regional government working groups, and online tools used for adaptation (e.g., [Climate Adaptation Knowledge Exchange](#)<sup>75</sup>).

A Climate Adaptation Communications Plan can support monitoring and evaluation.<sup>76</sup> Key questions to ask may include the following.

- Are stakeholders aware of the current and projected effects of [climate change](#)?
- Are they aware of the associated [risk](#) for [community assets](#) and how the implemented actions reduce that [risk](#)?

The Communications Plan resource (📖 **6.1 Communications Plan - Guidance**) can be used to help formulate your communication with various groups. Customize it as needed for intended audiences.

Likewise, NOAA's Digital Coast (<https://coast.noaa.gov/digitalcoast/training/home.html>) provides a suite of training tools and job-aids on topics such as risk communication, facilitation, funding and financing coastal resilience, nature-based solutions, and economic guidance. These resources serve as an excellent resource to refer to and use as you craft your message and develop your plan.

- Were stakeholders included in the process of identifying **risks** and solutions?
- Can stakeholders track progress toward meeting adaptation goals and the effectiveness of those actions?
- How can you use follow-up surveys, social media, the web, and other relevant outreach mechanisms to evaluate awareness and participation in the plan using?
- What can local partners contribute to gauge inclusion, awareness, and sharing?
- What methods of tracking adaptation or **risk** reduction progress will work best?

To help build national capacity for climate adaptation, consider sharing lessons learned and best practices with your peers. Professional organizations such as the American Society of Adaptation Professionals (ASAP) and the U.S. Sustainability Directors Network (USDN) support these types of conversations. Many states offer regular **resilience** forums. The semi-annual National Adaptation Forum (<https://www.nationaladaptationforum.org/>) is also an important assembly of adaptation professionals.

As climate **resilience** is still a relatively new services sector, vocabulary and metrics are not yet used in standard ways. Such standards, as well as measurements that establish efficacy of tested practices, will reveal opportunities for improvement in subsequent planning efforts.

Centering equity within climate **resilience planning** is contingent on active community participation throughout the Steps to Resilience. Reaching a variety of stakeholders and audiences requires multiple strategies and styles of communication. The Climate Adaptation Communications Plan Template,<sup>77</sup> includes a sample plan template that can be used for communicating with a range of audiences. Watch for opportunities to enable the conditions for higher levels of community engagement, involvement, and ownership based on the goals and needs of the community.

## Get buy-in from community and elected leaders<sup>78</sup>

Buy-in from community and government leaders in positions of power may increase the priority of resilience projects.

- Grow untapped support for resilience funding and finance.
- Counter pushback from individuals or departments with veto power that resist resilience investment.
- Ensure longevity of in-progress resilience projects beyond election cycles.
- Generate broader buy-in to increase investment opportunities.
- Align cross-sector departments and resources toward a common guiding vision to create project efficiencies and mutual benefits.
- Help to prioritize climate resilience projects within a competitive funding environment.
- Increase accountability for achieving resilience project impacts.

### How?

1. Refine the value proposition of climate resilience.
2. Identify people in power and develop strategic messaging to attract them.

### Strategic Message Examples

- The cost of inaction exceeds the up-front investment in resilience.
- Check how our goals and agendas overlap.
- Consider the long-term costs and the headaches the next generation can avoid.
- Recognize that these actions will position us as a regional hub for economic success into the future.

## Build Synergy with Existing Projects

Grounding climate **resilience** projects within existing community plans can help secure **funding** and **finance**. Such coordination provides clarity to investors since a wider range of funds can be tapped and set aside for the climate **resilience** agenda. Coordination among local government leaders and partners builds synergy among projects (e.g., pooling resources and sharing costs). Actively mitigating **risk** is an enticement to investors in its own right.<sup>79</sup>

**Internal government staff.** Training and educating staff about **resilience** can lower resistance to subsequent planning and implementation. Communicate the project plan in multiple phases. This is accomplished by involving key staff at first and then pulling in every department to discuss the results and mainstreaming concepts. Workshops can be held to review and discuss the assessment results, actions identified, and the implementation plan(s) for taking action. The audience for this will be familiar with past and current initiatives, as well as the inner workings of the government process. Communicating the process and results may get detailed but may open the opportunity for additional areas for synergy with existing projects and efforts.

**Elected and appointed officials** may not have time to dedicate to a workshop or understanding the details of each assessment. Some may have limited interest in climate adaptation or a predilection for greenhouse gas emissions reduction over adaptation. However, plans will likely require approval by city councils, mayors, managers, or others, in accordance with local legal requirements. An efficient summary of the process behind a plan, the plan itself, and expected outcomes will be essential. Find the best ways to gain support (e.g., budget savings or co-benefits) in order to garner support from stakeholders such as elected and appointed officials. Highlight how each action within the plan will benefit the constituents of an elected official's area. This may include direct support to neighborhoods and homes or perhaps more broad benefits to



critical infrastructure or economic infrastructure benefiting the entire community. **Coordinate efforts among partners across scales.** Partners comprise different individuals and groups in each community. Community-based organizations, academic institutions, and nonprofits can assist in local projects, outreach, and advocacy. Councils of Governments (COGs) generally operate at a regional scale and support public services such as supply chains, regional transportation, housing, and economic development. Some may already have part-time or dedicated staff addressing regional greenhouse gas emissions and or regional climate preparedness. State agencies, such as state departments of transportation or natural resources may have a role, provide **funding**, or be impacted by local projects. Federal partners, even if they are providing pass-through funds, may need to be involved in the project. All partners must be aware of your efforts and understand the costs, benefits, and their role in the proposed actions within the plan.

**Community members.** Community-based organizations and other nonprofits may be able to help with communication and outreach. Ideally, community members will have been informed and involved throughout the process. However, details of the plan still need to be communicated so the community knows what to expect. Homeowners associations and issue-specific advocacy groups (e.g., historical preservation groups) can help spread the message to their members and show how specific actions will support their neighborhoods and issues directly. Failure to communicate the plan can also impact public support and long-term success of **options**, particularly those with less public buy-in.<sup>80</sup>



Jim Fox from UNC Asheville's NEMAC leads participants from the City of Asheville during a climate resilience planning workshop held in December 2016. Source: Karin Rogers, UNC Asheville's NEMAC.

## Mainstream and integrate with planning initiatives

One of the ways to ensure action on projects is to mainstream and integrate them into policy and planning processes of existing departments. Mainstreaming takes advantage of pre-existing decision-making structures and **funding** streams within a community. Coordination across multiple agencies and planning sectors, as well as collaboration with a diversity of stakeholders, will be essential to ensure the project will be as effective as possible in reducing **risks** and enhancing co-benefits. Important connections exist between various types of land use planning and **resilience** outcomes, where failure to coordinate across different planning efforts could lead to maladaptive outcomes.<sup>81</sup> Mainstreaming may involve modifying current practices or creating new processes within municipal planning activities. A few examples of how to work with typical government departments are given below.

**Comprehensive and Land Use Planning.** Use elements of the assessment to identify current and future challenges to provide recommendations related to land use decisions. These types of plans provide an avenue to embed **nature-based solutions**, particularly **green infrastructure** concepts, in the local policy instructions and implementation ordinances.<sup>82</sup> The team can refer to the Measuring Success resource (6.2 Measuring Success - Guidance) for guiding questions for each step pertinent to comprehensive plan updates.<sup>83</sup> Comprehensive plans are sometimes combined with or include elements of economic development or redevelopment plans. These also provide an opportunity to tie in **resilience**-building projects and initiatives.

**Public Safety, Emergency Management, and Public Works Planning.** Identify specific opportunities to perform community outreach. This is particularly important for vulnerable populations and neighborhoods that face disproportionate **risk** or may not be equipped to prepare for climate-related **hazards** without significant assistance. Portions of the **resilience** plan may be incorporated into a community's Hazard Mitigation Plan.

Actions in the Hazard Mitigation Plan will likely appear in the [Resilience Plan](#). To receive [funding](#) from FEMA's [hazard mitigation](#) assistance grant programs, such as the BRIC program, proposed activities or projects must be consistent with a state's Hazard Mitigation Planning guidance. Ensuring [nature-based solutions](#) and other [resilience-building options](#) are incorporated into state or community plans is important for pre-disaster [mitigation](#) funds.<sup>84</sup> Similarly, stormwater master planning may use information from this assessment to help inform high-level strategies and investments. This is an opportunity to address multiple [hazards](#) and co-benefits between stormwater and other [resilience](#) strategies. Consider using the resource [FEMA's Long Term Community Resilience Exercise Resource Guide](#) to organize whole community exercises to evaluate readiness in a structured and recognized process. [Sustainability and Climate Action Plans](#) may be updated by adding elements of [resilience](#), recognition of social [vulnerability](#), and alignment of co-benefits, especially around buildings and transportation.

Keep in mind that some of these plans are updated periodically, with comprehensive plans being updated every five to ten years. It may be necessary to consider a phased approach to the project, and especially to implementing full strategies.

### **Identify and seek opportunities for [funding](#) or [finance](#)**

Bundling projects within an existing (non-climate) program can provide a fast path to implementation.<sup>85</sup> Consider the type of program and who the best partners will be. The type of program may drive where to look for [funding](#) and [finance](#) opportunities.<sup>86</sup> Partners could include different government departments, academic institutions, or special interest organizations.



### Opportunity for iteration

As necessary, return to the funding and financing mechanisms to seek additional resources and ensure the full project can be carried out. Revisit the Comparing Financing Tools resource [5.5 Comparing Financing Tools - Guidance](#).

### Seek a variety of funding and finance types to cover all stages of project life.<sup>87</sup>

Combine funding and finance from a variety of funding sources, a strategy referred to as 'blended finance', to cover all stages of resilience building from community co-development and project design to execution and longer-term monitoring and performance measurement. Blended finance may include commercial debt and equity, grants, concessional loans, subsidies, and other public support.

#### Why? Blended finance can

- Support funding of climate resilience proactively in the wake of disruption
- Expedite the funding process
- Ensure all components of the climate resilience-building process are covered, including grant writing, project planning and design, and execution components
- Cater to the development and application of climate adaptation plans with a longer-range timeline
- Open up opportunities for new sources to cover grant match requirements

#### How?

1. Stack a variety of funding and finance sources
2. Incorporate innovative funding mechanisms such as social impact bonds, parametric insurance, and loans from community development finance institutions
3. Work with partners on strategies about the types of funding or finance to pursue and at what time for types of projects
4. Fight the urge to shy away from debt financing



Jennifer Hanlon, Environmental Coordinator for the Central Council Tlingit and Haida Indian Tribes of Alaska, uses a microscope to identify phytoplankton and algal species. Source: Chis Whitehead, Sitka Tribe of Alaska.

## Monitor, Evaluate, and Share Lessons Learned

### Monitoring and Evaluation

Monitoring and evaluation of an [adaptation](#) action should begin at project launch. Done correctly, monitoring and evaluation will help build public trust and support for additional funding and [adaptation](#) actions. It can even build opportunities for public participation, especially for [nature-based solutions](#).

Residents who participated in the Indian River Lagoon estuary restoration efforts in Florida regularly checked on progress (plant growth and other performance metrics), tracked site success via social media, and returned with fellow restoration volunteers for recreational activities.<sup>88</sup>

Establishing a baseline and measuring improvement will help facilitate scaling up what works.<sup>89</sup>

Actively seek input and feedback to check if the actions you take are yielding the benefits you envisioned. Watch for any less-than-optimal results and address them as soon as possible. The team may find that additional resources are needed for the project, or they may find it could be easily implemented in other areas of the community. Review and use the findings to inform next steps in the process. Watch for early wins you can use to show the community at-large and other stakeholders the efficacy of building [resilience](#). Celebrate these successes and recognize stakeholders. You can leverage these successes to gain funding and support for larger initiatives. Measure the effectiveness of each step, within an action, and adjustments as necessary before moving to the next phase.

Evaluation of [nature-based solutions](#) can be carried out quantitatively or qualitatively by comparing case studies, laboratory studies, and systematic literature reviews. In communities with access to data, [indicators](#) may be quantitative. Other communities can incorporate a collaborative [indicator](#) approach of metrics such as integrated environmental performance, human health and well-being, citizen involvement, and transferability. When deciding nature-based solution [indicators](#) for a specific community, the exact choice will rely on their particular location, climate [risks](#), and availability of existing resources.<sup>90</sup>

Monitoring and evaluation is a very important component for building [resilience](#). It can be challenging to establish an effective monitoring and evaluation effort, but there are many good resources to help get you started. The resource “How Will We Know We’re Adapting? Moving from Faith-based to Tested Adaptation Process and Approach” is an excellent resource to reference before beginning your Steps to Resilience journey. The resource outlines a process for evaluating and measuring the progress of your community throughout the Steps to Resilience process to build local community expertise and capacity and test your efforts against values and goals expressed by the community.

The Measuring Success resource ([6.2 Measuring Success - Guidance](#)) provides ideas and guidance as you move through the Steps to Resilience and begin to take action. Encouraging community involvement and sharing your results will help make your plan a success.

## **Iterate and plan for persistent adaptation**

Watch for opportunities to improve or recover from missteps. If your actions are not producing the desired outcome, consider modifying your approach or making course corrections to your plan. As necessary, revisit your deliberations in each of the previous

## Nature-based Solutions

### Consideration:<sup>91</sup>

Using the correct metrics of success will, ideally, yield answers to these questions.

**Will the action need to be modified if conditions change?** Either establish sign posts for modifying an action plan or establish monitoring and evaluation procedures to instigate a new action plan. Events that cause measurable impact in the near term (e.g., seasonal flooding, wildfires, near-term sea level rise), can be used as decision points for adaptive management decisions.

**How can you adjust course if the action is not working?** When a measure indicates the action is not delivering the intended benefit or the ecosystem is being adversely impacted, it may be time to adjust course. A **resilience plan** should include a suite of actions that are appropriate at different points along a trajectory of change.

steps. With *hindsight*, you may be able to spot a previous *oversight*. If so, review **options**, re-evaluate **risks** and costs, and then decide what additional or different actions will help. Persist through setbacks to reach your goals.

## Approaches to Iteration

Decisions are constrained by imperfect knowledge and cognitive biases. Cycles of revision are necessary to improve the performance of strategies and actions. Once the team accepts uncertainty about what the future holds, it is essential that the **Government Champion** and Planning Team be flexible about when and how to respond. Building **resilience** depends on learning and responding effectively to lessons learned and outcomes, as well as determining how to incorporate new information, opportunities, and experiences. Iteration does not mean starting from scratch. Iteration means using new information, circumstances, and resources to inform, refine, and improve an existing plan or process.

In addition to monitoring and evaluating ongoing projects, revisit Pathways and Adaptive Management. The process of iteration recognizes that decision makers are making choices and decisions with the best information available at the time and can pivot as needs change or as new resources become available.

Adaptive management can be used to take small stepwise actions to implement strategies rapidly and as needed. This approach is useful for addressing multiple impacts across a system and at a variety of scales while addressing intended or unintended side effects of an action. Because natural systems change over time, **nature-based solutions** are nearly always managed adaptively. Monitoring and evaluation can help drive iteration. Adaptive design recognizes that needs of today may be different from what they will be in 50 years.

## **Indicators: When is it time to iterate?**

The need for iteration may be triggered by an extreme event, the crossing of a threshold, or if new information on a particular **hazard** becomes available. In these cases, the assessment and plan may need to be updated. Or, new funding may have been identified that makes a particular action feasible. Another possibility is the opportunity to engage new and different stakeholder or community groups that bring in different perspectives. Below are some **indicators** to consider for determining when it is appropriate to iterate.

- When new information becomes available, such as new data or regulations that could inform the assessment of **vulnerability** and **risk**
- As new planning or community engagement opportunities arise or when previously unavailable resources become available
- As **hazard** events transpire, they could bring to light new priorities or information throughout the process
- When considering that multiple actions and strategies will be needed to address long-term vulnerabilities
- As new **options** become available due to changes in ability to implement
- As priorities or needs change for the community
- As resources, stakeholders, or partnerships create new opportunities, such as the ability to include others who were not previously included

Refer to your team's measures of success, goals and vision. If actions are not producing the desired outcome, consider modifying your approach or making course corrections to your plan. Re-evaluate **risks** and costs, if needed, and then decide what additional or different actions will help correct your course.

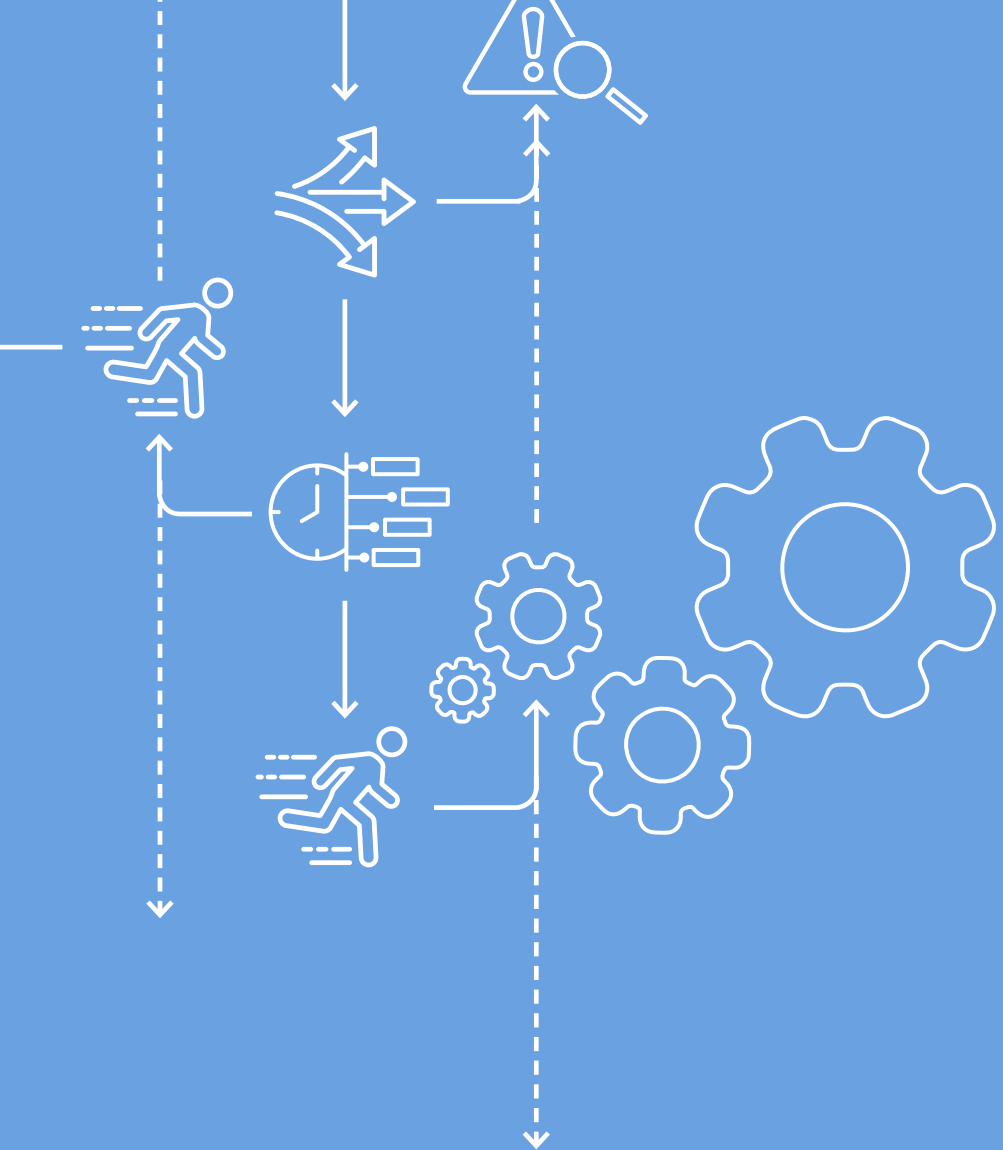


## Alignment with Vision, Values, and Goals

Throughout the Take Action step, refer to earlier steps to ensure the actions taken acknowledge and reflect the work and efforts of the community and Planning Team. In particular, the work accomplished in the Get Started step to identify Vision, Values, and Goals for the community is very important for continued public support of proposed actions. The common themes reflected in the visioning statements represent a shared set of goals and values; what the community values, what they were hoping this plan would address, and how it is addressing it. Refer back to those values when moving forward in the Take Action step. For example, in a coastal community that values its connection to the natural environment, a proposed action to protect against storm surge such as a seawall that separates people from the natural environment can be very contentious and it needs to be thought through carefully. Incorporate [nature-based solutions](#) where possible and if not feasible seek additional community input around design and multi-benefit use before proceeding. These types of considerations were considered during the Investigate Options and Prioritize and Plan steps. Ensuring those considerations remain front and center is key to success. Over time, it may be necessary to re-engage the community to ensure the same Vision, Values, and Goals are still relevant. As you proceed through various iterations, monitor changes in updated scientific information or community priorities, update the plan with new information and proceed accordingly.

## Endnotes

- 76 Hoffman and Hansen 2022, Appendix A
- 77 For additional details and strategic messaging examples see Coffee et al. 2022
- 78 For additional details see: Ready-to-Fund Resilience Toolkit
- 79 From Pathak et al. Section 6.4.1, Barrier 1: Public participation and acceptance.
- 80 From Pathak et al., section 6.1: Mainstream Nature-based Solutions Within Existing Planning Processes, and section 6.2: Coordinate Across Planning Efforts.
- 81 From Pathak et al., Section 6.1.2: Comprehensive Land Use Plans.
- 82 From Hoffman and Hansen, Table 2
- 83 From Pathak et al., Section 6.1.1: Hazard Mitigation Plans.
- 84 See Ready-to-Fund Resilience Characteristic 6.
- 85 Chapter 7 in *Incorporating Nature-based Solutions into Community Climate Adaptation Planning* provides a detailed discussion on funding and finance mechanisms specific to Nature-based Solutions.
- 86 For additional details see: Ready-to-Fund Resilience Toolkit
- 87 Kibler, K., G. Cook, L. Chambers, et al. 2018. Integrating sense of place into ecosystem restoration: a novel approach to achieve synergistic social-ecological impact. *Ecology and Society*, 23(4) cited in Pathak et al. 2022.
- 88 From Pathak et al., section 6.3: Implement and Monitor.
- 89 Pathak et al., Section 6.3.
- 90 Pathak et al., Section 5.4, “Decision Points,” which suggests questions for evaluation and adjusting course if the action is (or isn’t) working and if conditions change and modifications are needed.
- 91 <https://toolkit.climate.gov/#steps>



**Conclusion**

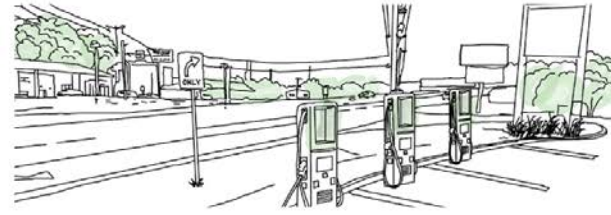
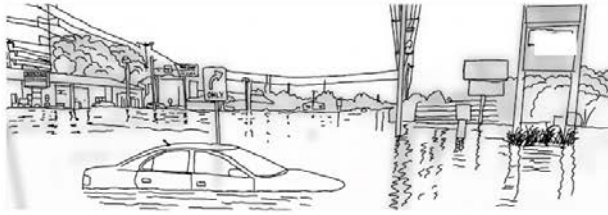
## Conclusion

This guidebook provides procedures, guidance, and customizable resources for climate [adaptation practitioners](#) who are working to enhance climate [resilience](#) in communities across the United States. By consolidating this guidance, tailored to the Steps to Resilience,<sup>92</sup> the NOAA Climate Program Office is shining light on its own strategic path to scaling up and accelerating climate [adaptation](#) and [resilience planning](#) throughout the nation's counties, communities, and neighboring tribal nations. The guidance presented here is offered as a resource for [adaptation](#) and [resilience](#)-building to all who are working in or alongside this sector.

Because extreme weather-related events are always a possibility, building [resilience](#) does not end with publication of a plan, securing funding, or even implementing a project. It is our hope that the procedures outlined herein will support ongoing efforts to continually adapt to ever-changing climatic conditions.

*We invite your feedback. Visit the [Climate Resilience Toolkit](#) for case studies, action plans, and more resources. Please send thoughts or comments to [noaa.toolkit@noaa.gov](mailto:noaa.toolkit@noaa.gov).*

**FLOODING**



**HEAT & HEALTH**



**AIR QUALITY**



**DROUGHT & WATER SUPPLY**



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# Glossary

The following definitions are those that are used throughout the Guide and Steps to Resilience framework. Some, but not all, of these terms can be found in the [U.S. Climate Resilience Toolkit Glossary](#). Many of these definitions are adapted from the U.S. Global Change Research Program (USGCRP), Intergovernmental Panel on Climate Change (IPCC), and other sources, as indicated in the footnotes.

**Actions and projects:** Actions and projects fit within a strategy and describe how a strategy will be carried out. Actions and projects have clear roles and responsibilities, timeframes, and geographic scale.

**Adaptation:** The process of adjusting to new (climate) conditions in order to reduce risks to valued assets or to take advantage of beneficial opportunities. A community’s “resilience journey” can be enabled by an adaptation plan.<sup>93, 94</sup>

**Adaptive capacity:** The ability of a person, asset, or system to withstand and adjust to a hazard, take advantage of new opportunities, or cope with change.<sup>95</sup>

**Assets:** see [People and Community Assets](#).

**Bankable:** Projects that possess an attractive economic profile that appears likely to deliver high enough risk-adjusted returns to attract private sector equity or debt.<sup>96</sup>

**Biodiversity:** The variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part. This includes variation in genetic, phenotypic, phylogenetic, and functional attributes, as well as changes in abundance and distribution over time and space within and among species, biological communities and ecosystems.<sup>97,98</sup>

**Climate Change:** changes in average weather conditions that persist over multiple decades or longer. Climate change encompasses both increases and decreases in temperature, as well as shifts in precipitation, changing risk of certain types of severe weather events, and changes to other features of the climate system.<sup>99</sup>

**Climate gentrification:** the process of wealthier, often whiter populations moving to areas less exposed to the effects of climate change that were previously occupied by lower-income residents and communities of color, thus exacerbating displacement and disparities.<sup>100</sup>

**Climate Adaptation Practitioner (Practitioner):** An individual working with a Community and **Government Champion** on implementing the Steps to Resilience. This individual is a climate adaptation and resilience-building professional skilled at building local capacity for climate resilience analysis, facilitation, and guidance. The Climate Adaptation Practitioner could have a range of experiences and is trained to work with a community to evaluate climate risks and develop resilience strategies.

**Climate stressor:** A condition, event, or trend related to climate variability and change that can exacerbate hazards.

**Co-creation:** People from different departments, backgrounds, or disciplines joining efforts to learn something new.

**Community:** A state, regional, county, local municipal, or tribal government entity; as well as community members or non-governmental groups working with one of these entities that are willing to be active stakeholders in building resilience.

**Community Assets:** resources, ecosystems, infrastructure, and the services they provide. Assets are the tangible and intangible things people or communities value.<sup>101</sup>

**Community Based Organizations (CBOs):** trusted public or private entities that are a resource to and/or provide specific services to a community or targeted population within a community based on a shared understanding of trust, awareness, and connection to its people.

**CRT:** the U.S. Climate Resilience Toolkit ([toolkit.climate.gov](https://www.toolkit.climate.gov)),

**Cultural equity:** A commitment to undoing racism through an intentional deconstruction of White supremacist assumptions and behaviors and the concurrent construction of equitable multicultural norms. The fourth aspect is overarching and integrates with the previous three (also see **Equity** below).

**Distributional equity:** Ensuring the resources or benefits and burdens of a policy or program are distributed fairly, prioritizing those with highest need first (also see [Equity](#) below).

**Ecosystem-based adaptation:** refers to the role of biodiversity and ecosystems in addressing climate-related vulnerabilities and risks to people and livelihoods.<sup>102</sup>

**Ecosystem services:** Benefits humans receive from ecosystems,<sup>103</sup> or simply “nature’s contributions to people”.<sup>104</sup>

**Equity:** The consistent and systematic fair, just, and impartial treatment of all individuals.<sup>105, 106</sup> Four components of equity are frequently cited and incorporated into community resilience.<sup>107</sup>

**Procedural equity:** Ensuring that processes are fair and inclusive in the development and implementation of any program or policy.

**Distributional equity:** Ensuring the resources or benefits and burdens of a policy or program are distributed fairly, prioritizing those with highest need first.

**Structural (intergenerational) equity:** A commitment and action to correct past harms and prevent future negative consequences by institutionalizing accountability and decision-making structures that aim to sustain positive outcomes.

**Cultural equity:** A commitment to undoing racism through an intentional deconstruction of White supremacist assumptions and behaviors and the concurrent construction of equitable multicultural norms. The fourth aspect is overarching and integrates with the previous three.

**Exposure:** The presence of [People and Community Assets](#) in places where they could be adversely affected by [Hazards](#).<sup>108</sup>

**Feasibility:** The degree to which climate goals and response options are considered possible and/or desirable. Feasibility depends on geophysical, ecological, technological, economic, social and institutional conditions for change. Conditions underpinning feasibility are dynamic, spatially variable, and may vary between different groups.<sup>109</sup>

**Financing:** obtaining money for a project that must be repaid eventually.<sup>110</sup>

**Frontline Communities:** Frontline communities are groups of people who are directly affected by climate change and inequity in society at higher rates than people who have more power in society.

**Funding:** money available on a one-time or limited time basis (e.g., a grant) or over time (e.g., taxes or fees) that does not need to be repaid.<sup>111</sup>

**Government Champion:** An individual accepting responsibility to bring members from the Community together as a team to implement the Steps to Resilience. This individual is usually someone from a government entity, but could be from a community-based organization, or another community stakeholder group. The Government Champion also serves as the point person to work with Climate Adaptation Practitioners and Decision Makers and is someone willing to be conversant in the concepts of community and climate resilience.

**Green Infrastructure:** a term that historically has been used to refer to the value and role of open space and ecosystem services broadly (e.g., Benedict and McMahon 2006), but is now often used in a narrower sense focusing on nature-based approaches to stormwater management (see [Nature-based Solutions](#)).<sup>112</sup>

**Hazard:** An event or condition that may cause injury, illness, or death to people or damage to assets.

**Hazard Mitigation:** The capabilities necessary to reduce loss of life and property by lessening the impact of disasters. Mitigation is used interchangeably with hazard mitigation in the emergency management field.<sup>113</sup>

**Indicator:** a quality or trait that suggests (“indicates”) effectiveness, progress, or success.<sup>114</sup>

**Justice:** The process of acquiring equal access to rights, resources, opportunities, and power, as well as remedy of past harms. Achieving justice involves dismantling systems of oppression and privilege that create systemic disadvantages and barriers for certain individuals and groups.<sup>115</sup>

**Maladaptation:** action taken ostensibly to avoid or reduce vulnerability to climate change that impacts adversely on, or increases the vulnerability of other systems, sectors, or social groups.<sup>116</sup>

**Magnitude of impact:** A subsequent negative result that follows from damage to or loss of an asset. Quantifying potential consequences is an important part of determining risk.

**Mitigation:** Processes that can reduce the amount and speed of future climate change by reducing emissions of heat-trapping gasses or by removing them from the atmosphere.

**Monitoring and evaluation indicator:** A quality or trait of effectiveness, progress, or success.<sup>117</sup>

**Natural Capital:** the world’s stocks of natural assets (see [People and Community Assets](#)), including geology, soil, air, water, and all living things.<sup>118</sup>

**Nature-based Solutions (NbS):** actions to protect, sustainably manage, and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and biodiversity benefits (see [Green Infrastructure](#)).<sup>119</sup>

**Nature-based Thinking:** The concept calls for a paradigm shift in the existing anthropocentric and solutions-based approaches for managing nature to a broader nature-based, social-ecological (inclusive) approach. NBT is rooted in a) acknowledging the value of nature beyond solutions and services (recognizing nature’s intrinsic value; ‘nature for nature’s sake’), while at the same time b) inclusivity of culturally diverse and community-centered ways of thinking about and relating to nature.<sup>120</sup>

**Natural Infrastructure:** a term that refers to the services that natural systems (see [Ecosystem Services](#)) provide to people, and is used especially to contrast with traditional conceptions of infrastructure as consisting only of engineered or hard structures. In particular, the term refers to infrastructure that either uses, restores, or emulates natural ecological, geological, or physical processes.<sup>121</sup>

**Natural and Nature-based Features:** a concept used by the U.S. Army Corps of Engineers and more broadly within the environmental engineering community; defined as landscape features that are used to provide engineering functions relevant to flood risk management and other hazard mitigation efforts. Importantly, this concept incorporates both the role of intact or restored natural features, as well as of engineered solutions that emulate natural functions or processes.<sup>122</sup>

**Nature-based Solutions:** Actions to protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and biodiversity benefits.

**Non-climate stressor:** A change or trend unrelated to climate that can exacerbate hazards.

**Options:** Ways of achieving objectives. Options might be policies, programs, projects, schemes, systems, technologies, or anything else presenting a choice which itself requires a decision. Options may be mutually exclusive (A or B), or could be implemented individually or in combination (A and B).<sup>123</sup>

**People and Community Assets:** people, resources, ecosystems, infrastructure, and the services they provide. Assets are the tangible and intangible things people or communities value.<sup>124</sup>

**Potential Impact:** Effects on community assets, including both natural and human systems, that result from hazards. A potential impact is considered for every applicable community asset/hazard combination (e.g., residential property and flooding). Evaluating specific potential impacts is a critical step in assessing vulnerability and risk.

**Practitioner:** see [Climate Service Practitioner](#).

**Probability:** The likelihood of hazard events occurring, traditionally determined from the historic frequency of events. With changing climate and the introduction of non-climate stressors, the probability of hazard events also changes.

**Procedural Equity:** Ensuring that processes are fair and inclusive in the development and implementation of any program or policy (also see [Equity](#), above).

**Projections:** Potential future climate conditions calculated by computer-based models of the Earth system. Projections are based on sets of assumptions about the future (scenarios) that may or may not be realized.

**Resilience:** The capacity of a community, business, or natural environment to prevent, withstand, respond to, and recover from a disruption.<sup>125, 126</sup>

**Resilience Planning:** the process by which assets and hazards are defined within a community and a vulnerability and risk assessment is performed to help identify and prioritize resilience-building actions.

**Risk:** The potential for negative consequences where something of value is at stake. In the context of the assessment of climate impacts, the term risk is often used to refer to the potential for adverse consequences of a climate-related hazard. Risk can be assessed by multiplying the probability of a hazard by the magnitude of the potential loss.<sup>127</sup>

**Risk Assessment:** a qualitative or quantitative study that estimates the combination of the likelihood of specific sets of events occurring and their potential positive or negative consequences.<sup>128</sup>

**Risk Management:** Plans, actions, strategies, or policies to reduce the likelihood and/or consequences of risks, or to respond to consequences.<sup>129</sup>

**Ruleset(s):** Semantic rule(s) based on attributes of populations or community assets used to define criteria for establishing low, medium, or high vulnerability or risk classifications.

**Scenario Planning:** A method for exploring multiple possible (hypothetical) futures that allows decision makers to explore and understand complex systems while also acknowledging their inherent uncertainty.

**Sensitivity:** The degree to which a system, population, or resource is or might be affected by a given hazard.

**StR:** The Steps to Resilience (StR) framework described throughout this document was formulated based on tested practices drawn from diverse disciplines and regions, all concerned with how to use climate information to inform actions that prevent loss of life, property, and essential functions in the natural and built environment.<sup>130</sup>

**Strategy:** Strategies elaborate the way in which resilience objectives are going to be achieved. While a strategy describes how a resilience objective may be achieved, it may not have a specific geographic scale or timeframe for implementation. Most options published in resilience plans are strategies.

**Stressors:** A condition, event, or trend that can exacerbate hazards. See [Climate Stressors](#) and [Non-Climate Stressors](#).

**Structural (intergenerational) equity:** A commitment and action to correct past harms and prevent future negative consequences by institutionalizing accountability and decision-making structures that aim to sustain positive outcomes (also see [Equity](#) above).

**Systems Thinking:** A holistic approach to analysis that requires the capacity to solve problems at a complex, systems-level scale where many interrelated and interdependent parts interact within the whole system. Systems thinking requires the ability to understand system structure, recognize interconnections, identify feedback loops, understand non-linear relationships, and adjust to dynamic conditions and behavior.<sup>131</sup>

**Tipping Point:** A level of change in system properties beyond which a system reorganizes, often abruptly, and does not return to the initial state even if the drivers of the change are abated. For the climate system, it refers to a critical threshold when global or regional climate changes from one stable state to another stable state.

**Transformational Change:** irreversible, persistent adjustment in societal values, outlooks and behaviors of sufficient width and depth to alter any preceding situation. A structural change that alters the interplay of institutional, cultural, technological, economic and ecological dimensions of a given system.<sup>132</sup>

**Vulnerability:** The propensity or predisposition of People and Community Assets to be adversely affected by hazards. Vulnerability encompasses exposure to potential impacts, sensitivity, and adaptive capacity.

## Endnotes

- 92 Adds to the definition in the US Climate Resilience Toolkit by incorporating “to take advantage of beneficial opportunities” as reflected in IPCC and UKCIP documents.
- 93 In natural systems, adaptation is the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate. From IPCC SREX, cited in Pathak et al.
- 94 Adapted from USGCRP and IPCC.
- 95 From Coffee et al.
- 96 IPBES Core Glossary, <https://ipbes.net/glossary/biodiversity>
- 97 Although often associated with the variety of species inhabiting a given place, biodiversity encompasses multiple levels of biological organization, from genes and species to ecosystems. In turn, each level of organization can be viewed as consisting of three major components: composition, structure, and function (Noss 1990 cited in Pathak et al.).
- 98 USGCRP
- 99 Environmental Law Institute, 2019.
- 100 NIST and FEMA commonly refer to distinct “Community Capitals.” Enderami and Sutley (2021) provide seven such metrics; financial, political, social, human, cultural, natural, and built.
- 101 Colls et al. 2009 cited in Pathak et al. Although the phrase may suggest that ecosystems are the intended beneficiaries of the adaptation, instead they are the means for achieving human-oriented adaptation outcomes.
- 102 MEA 2005, cited in Pathak et al.
- 103 IPBES 2019, cited in Pathak et al.
- 104 FEMA Press Release 2021
- 105 Financial Equity is a developer’s potential contributions toward project financing in terms of cash or land, or other assets. This can be calculated by subtracting any financial commitments from the value of any cash, land, or other assets (AECOM cited in Coffee et al. 2022).
- 106 Kapwa Consulting, 2020.
- 107 Adapted from IPCC.
- 108 IPCC.
- 109 AECOM 2018 cited in Coffee et al. 2022.
- 110 AECOM 2018 cited in Coffee et al. 2022.
- 111 U.S. EPA as cited in Pathak et al. 2022.
- 112 Mitigation Framework Leadership Group 2019.
- 113 Arnott et al. 2016, cited in Hoffman and Hansen 2022.
- 114 *Sensu* Avarna Group [https:// theavarnagroup.com/wp-content/uploads/2016/01/ Vocab-Sheet-v6.pdf](https://theavarnagroup.com/wp-content/uploads/2016/01/Vocab-Sheet-v6.pdf)
- 115 Barnett and O’Neill 2013



- 116 Arnott et al. 2016, cited in Hoffman and Hansen 2022.
- 117 Pathak et al. 2022.
- 118 Cohen-Shacham et al. 2016 cited in Pathak et al. 2022.
- 119 Randrup et al. 2020, cited in Pathak et al. 2022.
- 120 Pathak et al. 2022.
- 121 Bridges et al. 2015, cited in Pathak et al. 2022.
- 122 *Sensu* <https://www.ukcip.org.uk/>
- 123 NIST and FEMA commonly refer to distinct “Community Capitals.” Enderami and Sutley (2021) provide seven such metrics; financial, political, social, human, cultural, natural, and built.
- 124 The USGCRP uses the definition, “a capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social well-being, the economy, and the environment.”
- 125 “The ability of communities to anticipate, accommodate, and adapt positively to or thrive amid changing climate conditions or hazard events, and also to enhance quality of life, reliable systems, economic vitality, and conservation of resources for present and future generations. Resilience differs by facility, community, and setting.” (USDN, cited in Coffee et al. 2022)
- 126 Note the linkage of negative consequence to something of value, which is defined by People and Community Assets. “The potential for adverse consequences where something of value is at stake and where the occurrence and degree of an outcome is uncertain. In the context of the assessment of climate impacts, the term risk is often used to refer to the potential for adverse consequences of a climate-related hazard, or of adaptation or mitigation response to such a hazard, on lives, livelihoods, health and wellbeing, ecosystems and species, economic, social and cultural assets, services (including ecosystem services), and infrastructure. Risk results from the interaction of vulnerability (of the affected system), its exposure over time (to the hazard), as well as the (climate-related) hazard and likelihood of its occurrence” (Matthews 2018).
- 127 Adapted from USGCRP and Matthews 2018.
- 128 Matthews 2018.
- 129 Gardiner et al. 2019
- 131 Arnold and Wade 2015.
- 132 See Coffee et al. 2022.





