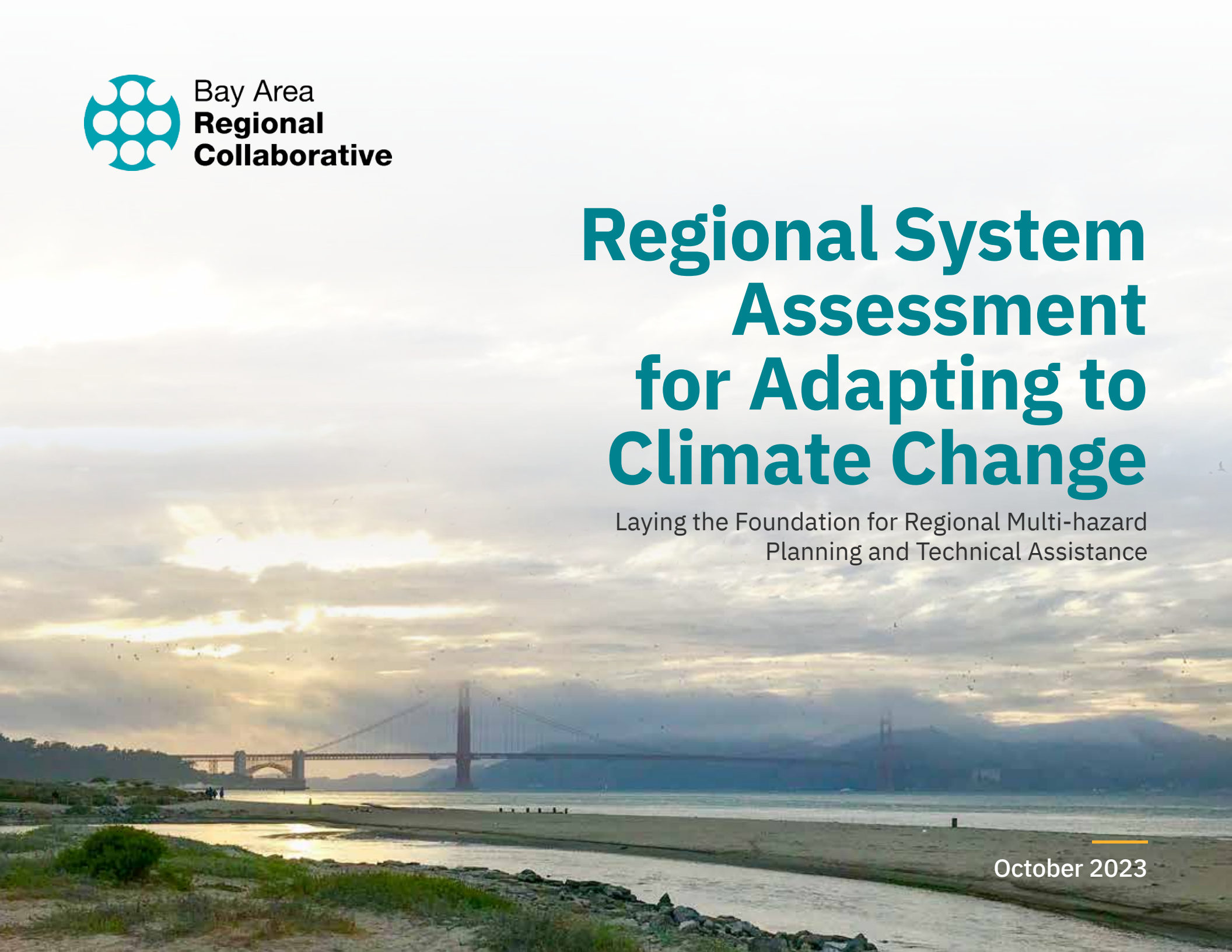
Bay Area
Regional
Collaborative

Regional System Assessment for Adapting to Climate Change

Laying the Foundation for Regional Multi-hazard Planning and Technical Assistance



October 2023

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Contents

Executive Summary

The **Bay Area Regional Collaborative (BARC)** is a consortium of regional and regionally oriented state agencies working together to address shared challenges in the San Francisco Bay Area. BARC's voting members include:

- **Association of Bay Area Governments (ABAG)**
- **Bay Area Air Quality Management District (BAAQMD)**
- **Metropolitan Transportation Commission (MTC)**
- **San Francisco Bay Conservation and Development Commission (BCDC)**

BARC also includes the following non-voting members:

- **California Department of Transportation District 4 (Caltrans D4)**
- **San Francisco Bay Regional Water Quality Control Board (SF Bay Water Board)**
- **State Coastal Conservancy (SCC)**

Introduction

Adapting to and adequately preparing for changing climate conditions is a complex challenge, requiring jurisdictions and agencies to coordinate a collective response to a wide array of climate hazards including sea level rise, inland flooding, water quality, drought, extreme heat, and wildfire and air quality. Intergovernmental coordination is particularly critical in a region as interconnected as the San Francisco Bay Area. Recognizing the scale of this work, the Bay Area Regional Collaborative (BARC) commissioned this report to better understand the existing climate adaptation activities and roles of its member agencies and their relationship to adaptation efforts at the local, state, and federal level.

This report documents how the overall climate adaptation system functions to inform BARC's next steps in exploring a regional and local response to climate adaptation. The report captures the existing baseline of adaptation activity in the Bay Area by mapping the programs, roles, authorities, partnerships, and responsibilities of Bay Area regional agencies. The report also assesses the current state of technical assistance related to climate adaptation.

By identifying gaps and opportunities, this report aims to lay the foundation for BARC and its member agencies to explore their respective roles in advancing adaptation through coordinated planning and technical assistance.

Our Process

The project team of AECOM, Nonlinear Ventures, and the Bay Area Climate Adaptation Network (BayCAN) worked collaboratively with BARC and its member agencies to document their adaptation activities, relationships, and resources. The project team also met with local, state, and federal agencies and community-based organizations (CBOs) through interviews and focus groups to understand the broader system of adaptation efforts and technical assistance.

A core part of the project was the development of systems maps to illustrate the components and relationships in the landscape of climate adaptation in the Bay Area. Using evidence-based methods, this process provides a common language for understanding complex systems by exploring the distinctions, stakeholders, relationships, and perspectives involved. The result is a visual model that builds shared understanding and creates a forum for collaboration.

BARC commissioned this report to better understand the existing climate adaptation activities and roles of its member agencies and their relationship to adaptation efforts at the local, state, and federal level.

Adaptation in the Bay: The Role of BARC Agencies

Across all climate hazards, BARC member agencies are active in adaptation planning, funding, and implementation, with varying levels of involvement by hazard. Table ES-1 summarizes the roles of BARC agencies by climate hazard and category of adaptation activity, with the following key themes noted below:

Table ES-1 This table shows the BARC member agencies active in each category of adaptation activity by hazard.

	Planning Coordination, collaboration, research, and planning	**Funding** Fundraising and fund allocation	**Implementation** Leading projects and programs, issuing permits and regulations, etc.
Sea Level Rise and Coastal Flooding	ABAG, MTC, BCDC, Caltrans D4	Caltrans D4, SCC	BCDC, Caltrans D4, SF Bay Water Board, SCC
Riverine and Inland Flooding	ABAG, MTC		Caltrans D4, SF Bay Water Board
Water Quality	SF Bay Water Board	SF Bay Water Board	SF Bay Water Board
Drought	ABAG, MTC	SCC	
Extreme Heat		ABAG, BAAQMD, MTC	ABAG, BAAQMD, MTC
Wildfire and Air Quality	ABAG, BAAQMD, MTC	BAAQMD, SCC	ABAG, BAAQMD, MTC, Caltrans D4

ABAG · Caltrans D4 · BAAQMD · SF Bay Water Board · MTC · SCC · BCDC

- Many BARC members are active in planning, funding, and implementing projects and programs related to sea level rise and coastal flooding, bringing a regional perspective to this Bay-wide issue. For example, BCDC has taken a lead role in addressing sea level rise, which has been integrated into its policies, guidance documents, strategies, and goals, and now is transitioning toward implementation.
- On the other hand, fewer BARC members are active in regional planning and coordination for riverine flooding, drought, extreme heat, and wildfire and air quality. These hazards are led by local and state agencies and special districts, with only moderate engagement with BARC members.
- For extreme heat and wildfire and air quality, BARC agencies are directly involved to reduce the public health impacts from these hazards but are less engaged in regional planning and coordination to mitigate the hazard itself. Particularly for extreme heat, regional and state agencies noted the lack of regional leadership and coordinated planning.
- Similarly, for riverine and inland flooding, BARC agencies are active in specific projects to reduce flood risk and address flood damage but have played a smaller role in regional planning and funding around this hazard.
- Water quality is the only hazard with a dedicated agency.[1] The SF Bay Water Board is charged with safeguarding water quality in the Bay Area and is actively incorporating climate adaptation into its programs and policies to reduce water pollution.

[1] Note that BAAQMD is also dedicated to addressing a single hazard, air quality, but this report evaluates wildfire risk and air quality together as one hazard.

Gaps and Opportunities

As illustrated in Table ES-1, responsibility for adaptation is dispersed across multiple agencies across multiple hazards. No single agency at the federal, state, regional, or local level has primary responsibility for preparing for or coordinating the response to the multiple hazards associated with climate change. The sections below summarize gaps and opportunities for a cross-border approach to climate adaptation, as well as technical assistance and capacity building, based on conversations with regional and state agencies, local governments, and CBOs.

A Cross-Border Climate Adaptation Approach

Across conversations with regional agencies, there was broad agreement that adaptation projects are often most effective when implemented along natural landscape features, such as watersheds and shorelines, not jurisdictional boundaries. These cross-border, sub-regional projects can respond holistically to multiple hazards, rise above a single local perspective, and deliver multiple community benefits. For example, the Resilient State Route 37 project brings stakeholders from four counties to address sea level rise resilience, ecosystem health, mobility, public access, recreation, and equity.

Yet cross-border adaptation planning brings a unique set of challenges. Planning, designing, funding, and implementing multi-benefit adaptation projects demand a high level of effort and coordination between agencies, across disciplines and sectors, including those that may not typically collaborate. However, this approach can ultimately deliver significant time and cost savings.

Narrow regulatory authorities can also limit agencies' ability to plan and implement holistic projects that address multiple hazards and benefit overall community well-being. For example, Caltrans D4's jurisdiction is generally limited to its right-of-way, and while MTC/ABAG allocates substantial transportation funding it can only influence local land use planning decisions through voluntary incentive programs. These limitations in authority may reduce agencies' ability to partner on projects outside their jurisdiction that would nonetheless benefit their assets or mission.

Cross-jurisdictional projects also require engaging multiple permitting and resource agencies to work through questions of funding, governance, and implementation. For projects touching the San Francisco Bay, project applicants must untangle various layers of regulatory requirements and seek multiple permits from state and federal agencies. Fortunately, agencies have recognized this challenge and formed the Bay Restoration Regulatory Integration Team to provide a cross-agency permitting team to support certain Bay restoration projects.

Despite the challenges of coordination, Bay Area stakeholders are starting to come together around cross-border sea level rise adaptation projects, including in the San Francisquito Creek and the Alameda-San Leandro sub-regions. However, fewer examples of cross-regional approaches exist for other hazards, with extreme heat noted as one hazard lacking regional leadership and coordination. As more partnerships and projects develop, agencies can learn a great deal from the impacts, co-benefits, challenges, and opportunities of adaptation projects that have been already implemented. This is especially important for emerging solutions, such as nature-based solutions (e.g., horizontal levees) or cool pavements, which are often perceived to be riskier for funders due to the lack real-world test case data. In some cases, existing regulations or permit requirements can make nature-based solutions challenging and expensive. For the region to advance on climate adaptation, greater collaboration across borders can remove barriers and increase knowledge-sharing and innovation.

Capacity and Technical Assistance

Technical assistance is seen as critical to levelling the playing field between less-resourced jurisdictions, agencies, CBOs, and their wealthier counterparts. Technical assistance can enable organizations to understand the implications of climate change for their work, begin incorporating adaptation into programs and policies, and apply for funding. Yet with most adaptation funding provided via grant competitions, many less-resourced communities risk being left behind. Without technical assistance, disadvantaged communities face challenges in competing for funding with better-resourced communities, who often have access to staff capacity, technical expertise, funding, and consultants – all of which can support obtaining more funding. Although the total amount of available funding for adaptation is growing, the entire process to secure a single grant can be daunting and expensive, especially as federal, state, and regional funding programs each have their own set of requirements for applications, documentation, contracting, and reporting. The necessary level of effort can effectively exclude less-resourced jurisdictions and CBOs from applying.

Recognizing this need, state and regional agencies have begun to offer technical assistance programs, both in conjunction with their grant programs and standalone. However, during focus groups for this project, CBOs observed that it is the complexity of government programs that creates its own demand for technical assistance. Dense, technical language and application processes create a need for assistance to interpret requirements and assemble applications. Some CBOs shared that assistance is needed to even apply for or access technical assistance itself, noting that technical assistance is a bandage for a broken system.

More broadly, CBOs and local agencies noted that most available technical assistance was too generalized and broad to be useful. Instead, they most valued one-on-one assistance and tailored support for specific needs. However, this type of assistance is difficult to scale for providers, who may also face their own capacity constraints. Similarly, the volume and complexity of adaptation programs can also make it difficult for technical assistance providers to stay fully updated and informed on adaptation policies, programs, funding, and research, especially for cross-hazard opportunities.

Finally, there is still work to do to build trust between technical assistance providers and CBOs. Many providers report that they integrate equity, such as by prioritizing or tailoring TA to underserved communities and CBOs. However, CBOs engaged in this project said they have low trust in regional agency-provided technical assistance and prefer to seek assistance from other CBOs first. Notably, CBOs participants recommend that agencies recognize the expertise of CBOs and partner with them to implement TA.

Questions for Further Exploration

Across the Bay Area, there is an urgent need for adaptation to the impacts of climate change. This report provides the groundwork to support and inform BARC regional agencies as they work together to explore a regional approach to adaptation and technical assistance. As they do so, potential questions to consider include:

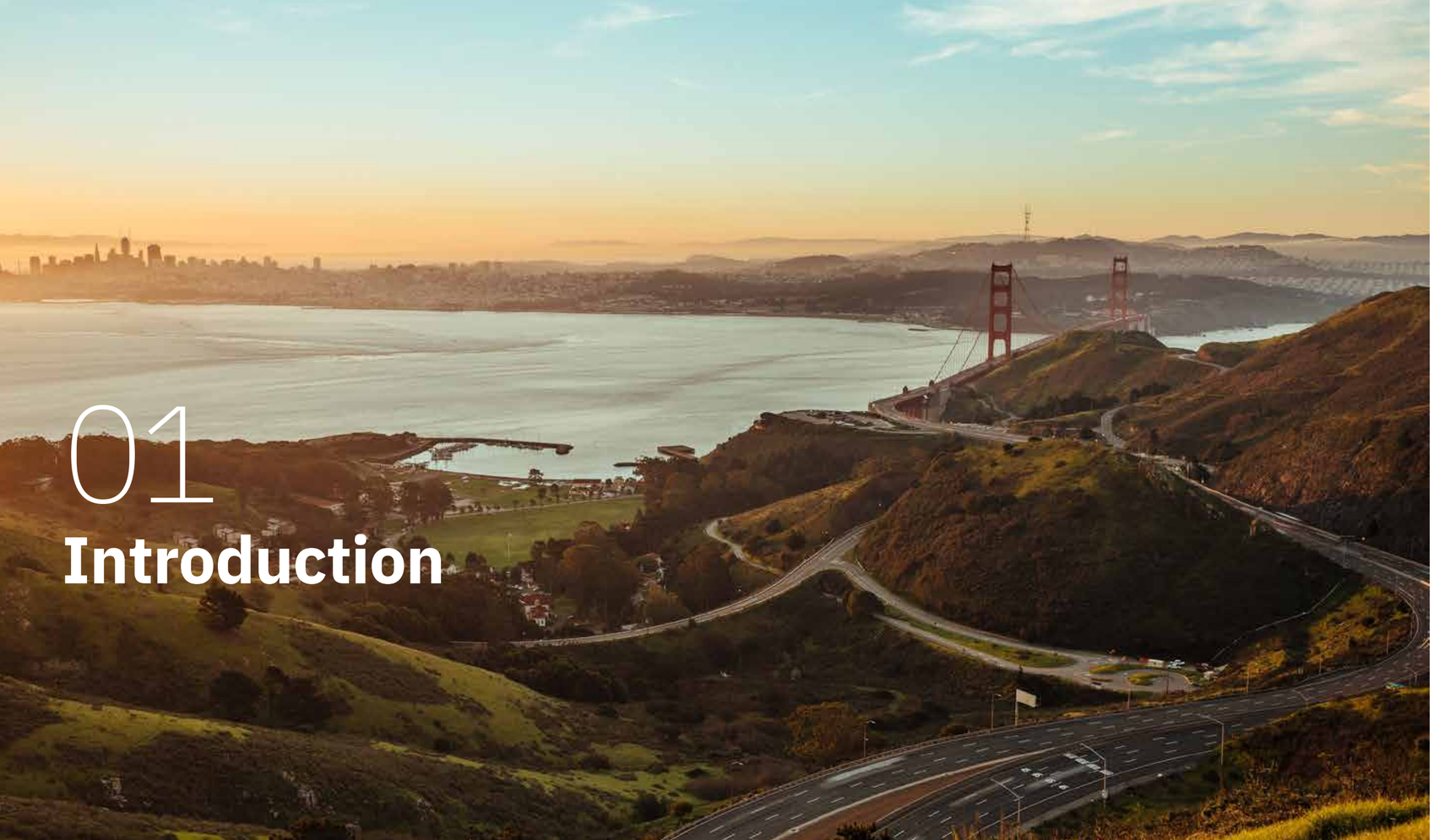
What should the role of BARC member agencies be in addressing each climate hazard?

What should the role of BARC member agencies be in addressing the pressing need for adaptation funding?

How can BARC member agencies help improve resource-intensive processes like community engagement and technical assistance?

What hazards or situations benefit most from a regional approach, and when is a localized strategy more effective?

How can regional agencies work together to scale adaptation efforts quickly and effectively, while remaining inclusive and respecting local control and community-driven initiatives?



01 Introduction

As climate change intensifies over the coming decades, the Bay Area is preparing for longer, more intense fire seasons, more days with extreme heat, rising seas, extended drought, and increased incidents of flooding. In light of this growing challenge, the Bay Area Regional Collaborative (BARC) commissioned this report to better understand the existing climate adaptation activities and roles of its member agencies, both individually and in relationship to the full suite of adaptation activities occurring at the local, state, and federal level.

This report came out of a shared desire among regional agencies to proactively and effectively address the effects of climate change and understand how they can better serve Bay Area communities. By mapping the landscape of climate adaptation activities of its member agencies, BARC aims to identify how agencies can move forward together to adapt to climate change while advancing on their legislative mandates on transportation, housing, air and water quality, conservation of the San Francisco Bay, and social and racial justice.

BARC is a consortium of regional and regionally oriented state agencies working together to address issues facing the San Francisco Bay Area. BARC was established by state legislation to coordinate the policy and planning work of its agencies.

BARC provides a forum for its member agencies to coordinate on cross-cutting challenges facing the nine-county Bay Area[2], with a shared goal of improving quality life for all residents. To achieve this, BARC brings together its member agencies and other stakeholders to advance collaborative, interdisciplinary work on a range of regional issues that cannot be fully addressed by any one agency alone.

The report is intended to inform this ongoing dialogue to advance regional collaboration for climate resilience. Understanding how the overall climate adaption "system" is currently functioning is a necessary precursor to identifying how best to work together to improve and strengthen it so that the Bay Area region is adequately managing and adapting to climate hazards and their impacts.

[2] The nine counties of the Bay Area are Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma.

Voting Members - Regional Government Agencies

ABAG
Association of Bay Area Governments
ABAG was created by local governments to meet their planning and research needs related to land use, environmental and water resource protection, disaster resilience, energy efficiency and hazardous waste mitigation. ABAG also provides financial services to local counties, cities and towns.

BAAQMD
Bay Area Air Quality Management District
The Air District monitors air quality and regulates stationary sources of air pollution - including factories, refineries, boilers, and power plants - in the nine Bay Area counties. It also works with local governments on climate action planning and greenhouse gas reductions.

BCDC
The San Francisco Bay Conservation & Development Commission

BCDC has regional authority over the Bay, the Bay's shoreline band and the Suisun Marsh. Its mission is to protect these areas for future generations and address the impacts of rising sea levels on our communities.

MTC
Metropolitan Transportation Commission
MTC is the transportation planning, financing and coordinating agency for the nine-county San Francisco Bay Area. MTC supports our streets, roads, highways, transit systems and other transportation resources.

Non-Voting Members

Caltrans
Caltrans manages more than 50,000 miles of California's highway and freeway lanes, provides inter-city rail services, permits more than 400 public-use airports and special-use hospital heliports, and works with local agencies. Caltrans's mission is to provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability.

San Francisco Bay Regional Water Quality Control Board (Water Board)
The Water Board is a state agency whose mandate is to protect water quality in the San Francisco Bay Area. To accomplish this, the Water Board regulates discharge of dredge and fill materials, wastewater, and stormwater.

California State Coastal Conservancy
The Coastal Conservancy is a state agency whose mission is to protect and improve natural lands and waterways, to help people get to and enjoy the outdoors, and to sustain local economies along California's coast. The Conservancy is a non-regulatory agency that supports projects to protect coastal resources and increase opportunities for the public to enjoy the coast.

Impetus for this Report

BARC recognizes that resilience to the complex, intersectional hazards of climate change requires a collaborative regional and local response. To effectively address climate vulnerabilities in the Bay Area's unique geography, communities must think regionally and consider cross-cutting issues such as housing affordability, transportation, economic inequalities, displacement, and racial justice. As part of its coordinating mission, BARC plays a critical role in convening regional agencies to collaborate on these interrelated challenges. As a result, in September 2021, BARC's Governing Board approved a Joint Resolution to Address Climate Change. The resolution called for the creation of a Shared Work Plan to better align regional authorities, capacities, and expertise in the ongoing effort to mitigate climate change and advance effective climate adaption planning to manage the multiple, urgent risks of climate change.

In May 2022, the BARC Governing Board adopted a Shared Work Plan that outlines three initiatives to equitably advance a strategic approach to climate adaptation and greenhouse gas (GHG) reduction. The Plan's objective is to amplify the work of its member agencies to support cities, counties, special districts, and community leaders to build resilience in an equitable way. The work plan also recognizes the importance of federal and state agencies and programs that provide funding, technical support, and regulatory oversight in the Bay Area.

As part of the work plan's Resilient Bay Area component, BARC is exploring the development of a multi-hazard adaptation plan and a regional technical assistance program, both of which can support effective, multi-benefit project deployment.

BARC commissioned this report to provide a starting point for both these activities by describing the current baseline of the structure and status of adaptation activities around the Bay. The report outlines the activities, roles, authorities, and responsibilities of Bay Area regional agencies to understand the landscape of adaptation in the Bay. It identifies the factors, opportunities and barriers that can shape the development of an effective regional multi-hazard plan and technical assistance program.

Report Goals & Objectives

Unlike the more-established field of practice for reducing GHG emissions, the field of practice for climate adaptation is still taking shape. To support BARC's Resilient Bay Area work plan, the first need is to understand adaptation activities that BARC member agencies are undertaking today and how they fit into the greater context of adaptation activities throughout the region as a whole. Capturing the existing baseline of activity can help inform future planning and technical assistance by identifying overlooked barriers and needs, as well as areas for more detailed research. To achieve this goal, this analysis pursued the following objectives:

- **Clearly define adaptation activities and delineate climate impacts**
  Simple models of adaptation activities and climate impacts in the Bay Area will help inform future planning and program development.

- **Document existing adaptation activities of BARC members**
  The information will provide a baseline to support cross-agency discussions about agency roles and responsibilities.

- **Place regional adaptation activities into a larger context**
  Regional agency activities occur within the larger ecosystem of adaptation planning, funding, and implementation led by federal, state, regional, and local entities. Though at a higher level of detail than the regional analysis, capturing key connections among these agencies provides additional insight into the regional work needed over the coming decades.

- **Assess the current state of technical assistance related to adaptation**
  The analysis included stakeholder outreach to identify immediate, actionable ways that technical assistance programs can be improved.

- **Identify themes for discussion and further analysis**
  Identifying opportunities and barriers for existing adaptation efforts can expand the scale and effectiveness of future climate adaptation actions, support equitable adaptation efforts, and mitigate multiple hazards. Findings and considerations can inform the planning of BARC's adaptation initiatives, including the likely form and functions of a potential regional multi-hazard adaptation plan and an effective technical assistance program serving local communities and agencies.

This report aims provides suggested questions for future focused conversations to address, but it purposefully does not provide specific programmatic adaptation recommendations and approaches. These planning activities and discussions will occur in following phases in BARC's work plan. The report aims to lay a foundation for future work by BARC to explore the roles its member agencies could play to advance adaptation activity across the region.

02 Climate Adaptation: Background and Context

Climate Change & Adaptation

Climate change is already impacting the Bay Area, and additional changes in temperature, precipitation, and sea level are projected to occur over the coming decades.[3] Some of the key climate hazards that present critical concerns for public health and safety, regional infrastructure, and natural resources include:

- Coastal flooding from sea level rise
- Inland flooding from high-intensity precipitation
- Extreme heat
- Wildfire and air quality
- Water quality
- Drought

These six climate hazards affect everything from utilities and government services, to agricultural production, built infrastructure, and public health. The full range of the potential impacts of climate change is shown on the next page (Figure 1) – and nearly every system and community are affected. Many critical systems, such as water supply and transportation, are vulnerable to multiple hazards. Bay Area ecosystems are also affected in multiple ways, from habitat disruption due to flooding and wildfire to reduced species health from extreme heat and drought. The consequences of these hazards are compounded by cascading impacts.[4] However, this report focuses on adaptation to the six primary hazards listed above.

Adaptation can encompass many forms, depending on the hazard and the vulnerabilities and needs of a particular ecosystem or community. Protecting against potential hazard impacts, increasing the resilience of infrastructure and communities, retreating or relocating from hazards, and changing behaviors—all are types of adaptation activity.

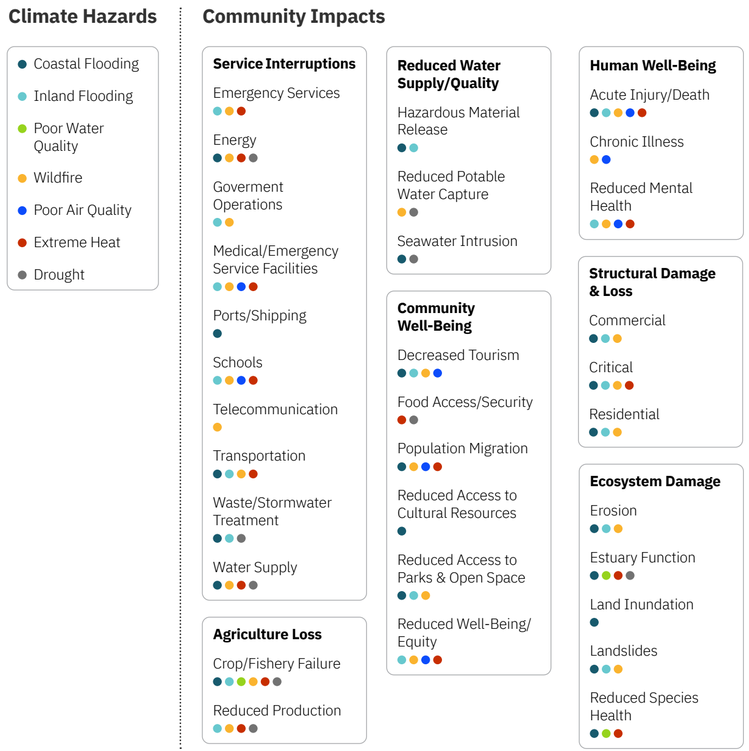
Examples include regulations implementing fire breaks around buildings in wildfire zones, elevating highways at risk of sea level rise, switching to drought-resistant crops, and establishing cooling centers for people vulnerable to heat waves.

Across all adaptation activities, it is critical to lead with equity and follow a participatory, transparent approach. Centering adaptation activities around the needs of vulnerable communities can help to deliver equitable outcomes for those disproportionately affected by climate change and historically left out of decision-making processes. Vulnerable and disadvantaged communities are more likely to work and live in locations affected by extreme heat and wildfire smoke, face exposure to industrial pollutants that can be reactivated by rising seas, and lack the resources to evacuate, recover, and rebuild from floods and wildfires. In response, many Bay Area local and regional governments seek to develop adaptation strategies that prioritize vulnerable and frontline communities and support equity, social justice, and health. In many cases, these strategies will require significant resources to plan and implement and need to be fully understood and supported by the broader public to move forward. For example, in-depth engagement efforts can empower community members to understand adaptation challenges and participate meaningfully in adaptation planning processes.

[3] For more information, see the California Fourth Climate Change Assessment, which translates the most recent climate science on impacts and vulnerabilities into a California-specific context, including the San Francisco Bay Area Regional Report which highlights the impacts of climate change on the Bay Area. Note that the California Fifth Climate Change Assessment development was underway during the writing of this report, and may become the most up-to-date summary of Bay Area climate impacts.

[4] Example compounding impacts include the loss of Sierra Nevada snowpack, reduction in summertime fog, groundwater rise, and shoreline erosion, which can further reduce water supply, exacerbate fire risk, and increase pollutant exposure.

Figure 1 This is a systems maps illustrating the myriad ways in which climate hazards can impact communities. Climate hazards relevant to the Bay Area are shown on the left, with potential impacted systems on the right. For example, inland flooding can disrupt transportation networks, lead to injury, and damage infrastructure.



While climate mitigation action to reduce greenhouse gas emissions remains critical to limit the severity of future global climate change, this report focuses on adaptation to address the climate impacts that are already occurring and locked-in for the next several decades. As climate change accelerates, it is more vital than ever to invest in adaptation. As the United Nations Framework Convention on Climate Change (UNFCCC) notes, the longer adaptation is delayed, the more difficult and expensive it will be to respond to climate change, and the more communities, ecosystems, and people will be left vulnerable to increasingly destructive hazards. As Figure 1 shows, the impacts of climate change will affect all communities, infrastructure, and ecosystems in the Bay Area.

Adaptation: Adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change.

– United Nations Framework Convention on Climate Change (UNFCCC)

Regionalism in the Bay Area

In the early 20th century, an emerging regionalism movement called for a united approach to solve regional issues facing the Bay Area, including transportation, housing, wetland degradation, and Bay fill. These challenges transcended the boundaries of cities and local jurisdictions and required collaboration and shared decision-making across the Bay Area to create solutions, leading to the construction and renewal of cross-Bay bridges, the development of the area's transit system, and the protection of Bay habitats. Since then, regional entities have played a key role in bringing consistency to local approaches, coordinating overlapping governance structures, and scaling initiatives to address regional challenges.

Similar to other challenges the region has confronted, climate adaptation requires a regional approach as hazards like wildfire and flooding do not recognize jurisdictional boundaries. Adaptation requires a regional viewpoint to fully capture the breadth of interventions needed, the ways that multiple climate hazards intersect, and how climate hazards can impact entire networks, such as transportation or healthcare. While state agencies provide leadership, guidance, and resources for addressing climate change, adaptation needs vary greatly across a state as large and as diverse in geographies and climate zones as California. The measures necessary to protect and reduce risk in communities in Los Angeles County may necessarily be different from those needed in Sacramento or the Bay Area. At the same time, local agencies may not yet have capacity, authority, or desire to comprehensively evaluate or track the broader implications of their own adaptation actions. Acting alone, local agencies may risk inefficiencies, redundancies, or unintended, cross-jurisdictional impacts, while a broader regional perspective may help identify economies of scale, areas for collaboration, or cascading consequences.

Regional agencies are thus uniquely positioned to support adaptation and climate hazard mitigation along watershed boundaries or air basins, considering the needs and challenges facing all jurisdictions. In addition, regional agencies may bring technical capacity and the ability to provide technical assistance at the scale needed – a potential role for regional agencies that this report will also explore. Regional agencies also have the ability to raise and distribute funding and a track record of coordinating and implementing large-scale projects.

While this report focuses on the roles of BARC member agencies, it is important to recognize that many organizations are currently working on, and are essential to, the success of climate adaptation. Community-based organizations (CBOs), non-profit organizations, other regional and sub-regional agencies, activists, scientists, advocacy organizations, and a range of local, state, and federal actors all play important roles in informing, implementing, and improving adaptation measures. Moving forward, BARC member agencies will continue to collaborate with and support this network of peers, and this report will inform this critical ongoing coordination and conversation.

The region is the one that has the big picture. We see the patterns, we see the commonalities, we see the things that go wrong when people don't see the big picture. We see the cascading impacts and the unintended consequences, and it's our job to understand those, make those known, and set those standards that can prevent them from happening.

– BCDC interview

03 Research Process and Definitions

Project Team & Process

BARC commissioned AECOM, Nonlinear Ventures, and the Bay Area Climate Adaptation Network (BayCAN) to develop this report. The project team, with significant guidance and input from BARC, worked together with member agencies in a collaborative process to document agencies' existing adaptation efforts and the relationships and resources that support them. The project team also met with local, state, and federal agencies and CBOs through interviews and focus groups to understand the broader system of adaptation efforts occurring at all levels.

The research process consisted of five main components:

1. **Landscape Analysis**

- Review and understand existing plans, documents, and activities of local, state, and regional agencies related to adaptation
- Create a framework for classifying the different adaptation activities that agencies conduct
- Classify and compare adaptation efforts across agencies using the framework

2. **Interviews**

- Two rounds of interviews with BARC member agency representatives to understand each agency's key adaptation programs, partnerships, history of adaptation work, and perspective on gaps and opportunities in the region
- One round of interviews with select state and federal agency representatives on their roles in facilitating climate adaptation and perspectives regarding the Bay Area's adaptation priorities and challenges

3. **Stakeholder Engagement**

- Survey, focus group discussions, and BayCAN regional meetings centered on challenges for and opportunities to improve adaptation-focused technical assistance

4. **Systems Mapping**

- Diagram the multiple programs, processes, and relationships that shape adaptation activity today

5. **BARC Regional Team Input**

- Conversations with the BARC Project Management Team (PMT), executive leadership, and Governing Board to review and refine findings from the research process. The PMT was comprised of key staff designees from each of the member agencies along with a staff member of the San Francisco Estuary Institute (SFEI).

Interviews and stakeholder engagement provided the basis for the bulk of this report's findings. The table below details interview participants, and a full list of stakeholders involved in discussions of technical assistance can be found in *Appendix D, BayCAN's Technical Assistance Report.*

Interview Participants

Regional Agencies
(BARC Member Agencies)

- ABAG
- BAAQMD
- BCDC
- MTC
- Caltrans D4
- SF Bay Water Board
- SCC

State Agencies

- California Department of Forestry and Fire Protection (CalFire)
- Governor's Office of Emergency Services (CalOES)
- California Department of Public Health (CDPH)
- Ocean Protection Council (OPC)
- California Division of Occupational Safety and Health (CalOSHA)
- Governor's Office of Planning and Research (OPR)

Federal Agencies

- Federal Emergency Management Agency (FEMA)
- U.S. Environmental Protection Agency (EPA)
- U.S. Army Corps of Engineers (USACE)

Systems Mapping

Visual maps of complex adaptive systems offer one way to illustrate a system's components and relationships. The evidence-based methods used here, developed by the Cabrera Research Lab at Cornell University, provide a common language for adding structure to large amounts of information by exploring the distinctions, systems, relationships, and perspectives involved. The result is a visual model that aims to capture the reality of the system today, based on stakeholder understanding, and can be updated as conditions and stakeholders change in the future. More importantly, the model creates a forum for collaboration and builds shared understanding of the system amongst stakeholders.

Three types of maps were created for this project.

First, simple maps show the process of adaptation, such as Figure 2, which shows the relationship between adaptation preparation, funding, and implementation. Similarly, Figure 1 illustrates how multiple climate hazards impact communities. Though conceptually simple, these maps are valuable to ensure that all stakeholders have a shared understanding of the process and to guide gathering and organizing information throughout the process. This step addresses the common challenge of stakeholders who think they agree on terms and processes but, when documented carefully, do not.

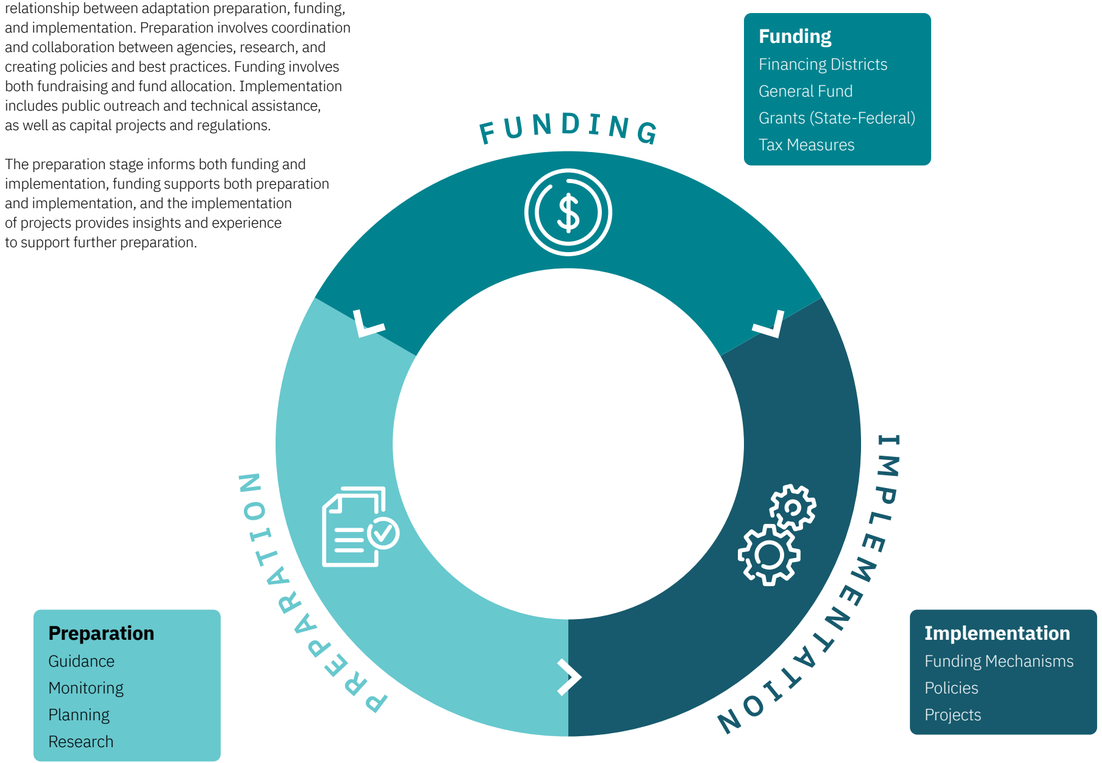
Second, a map was created for each BARC member agency to capture their adaptation activities along with their partners, funders, and target climate impacts. These maps, which can be found in Appendix A, represent the baseline for comparing the content and focus of each agency and a resource for building more complex topical maps.

Finally, hazard-specific maps, in Section 4, take the perspective of a single topic (wildfire, for example) and pull content from the member agency maps, interviews, and in-depth research to show the larger ecosystem of activities across agencies and jurisdictions. These topical maps are especially useful for identifying gaps, overlaps, and opportunities to engage with the system and make improvements.

Systems mapping can support climate adaptation by enabling all stakeholders to understand the challenges in a robust way through models that can be updated regularly to capture both ongoing progress and emerging challenges.

Figure 2 This systems map on the right shows the relationship between adaptation preparation, funding, and implementation. Preparation involves coordination and collaboration between agencies, research, and creating policies and best practices. Funding involves both fundraising and fund allocation. Implementation includes public outreach and technical assistance, as well as capital projects and regulations.

The preparation stage informs both funding and implementation, funding supports both preparation and implementation, and the implementation of projects provides insights and experience to support further preparation.



04
Regional Adaptation Activity: By Agency & Hazard

The following sections focus on the adaptation activities undertaken by BARC member agencies, summarizing research conducted through document review and interviews. The first section provides an overview of each BARC member agency's high-level roles and responsibilities in the region, as well as their main adaptation-related activities. Then, each hazard-specific section provides an overview of:

- BARC member agency's key **adaptation activities** for each climate hazard; and
- BARC member agency **relationships and partnerships** that support these adaptation activities.

Gaps and challenges across the landscape of adaptation activities are discussed in Section 5, while gaps and challenges observed for each hazard are found in Appendix B, p38.

BARC Member Agencies & Adaptation

A brief summary of each BARC member agency's roles and responsibilities and adaptation activities is provided below to further contextualize the hazard-based discussion in the following sections. For further detail on each member agency's programs and activities, please see Appendix A. In addition, this section also describes the role of BARC and key themes across all BARC member agencies.

Voting Members

Association of Bay Area Governments (ABAG)
ABAG is the comprehensive regional planning agency and council of governments for the nine counties and 101 cities and towns of the Bay Area. ABAG provides various services to local governments, including research and analysis, regional coordination, and data tools, with a focus on land use, housing, environmental and water resource protection, disaster resilience, and energy efficiency. ABAG's adaptation-related activities focus on multi-hazard mitigation planning and incentivizing land use planning responsive to hazards such as wildfire and coastal flooding. ABAG and MTC share a staff as well as joint responsibility for Plan Bay Area, the region's long-range plan.

ABAG houses the San Francisco Estuary Partnership (SFEP), a collaborative regional program of local, state, and federal agencies, non-profits, citizens, and scientists working to protect, restore, and enhance water quality and habitats in and around the San Francisco Bay Delta Estuary. The SFEP was established under the Clean Water Act's National Estuary Program. Its climate adaptation work focuses on promoting

integrated, coordinated, multi-benefit approaches to increase the resilience of estuary tidal habitats, tributaries, and at-risk communities. In partnership with the State Coastal Conservancy, the SFEP staffs the San Francisco Bay Restoration Authority (SFBRA).

Bay Area Air Quality Management District (BAAQMD)
BAAQMD is a regional special district tasked with monitoring air quality and regulating stationary sources of air pollution – including factories, refineries, and boilers – to meet state and national air quality standards. Its Climate Protection Program plays a catalyzing role in GHG reduction actions at the local level, including through inventorying GHG emissions, funding innovative projects, and supporting building decarbonization. BAAQMD's adaptation-related activities include permitting for controlled burns and protecting community members from the public health impacts of localized air pollution and wildfire smoke.

San Francisco Bay Conservation and Development Commission (BCDC)
A state agency with a regional jurisdiction, BCDC has regulatory authority over the Bay (including most tidally influenced tributaries, salt ponds, and managed wetlands), a 100-foot area upland of the Bay (called the "shoreline band"), and the Suisun Marsh (a part of the Bay where BCDC has additional authority and responsibilities). Its mission is to protect these areas for future generations, expand public access to the Bay and its shoreline, and to address the impact of sea level rise on local communities, especially after a 2008 law (AB 2094) tasked BCDC with the responsibility to lead the Bay Area's preparedness for sea level rise and coastal flooding. As a result, BCDC's adaptation work focuses almost exclusively on mitigating coastal flooding through permitting, planning, and regional coordination.

BCDC's voluntary Adapting to Rising Tides (ART) Program and Bay Adapt initiative provide technical support, research, tools and regional coordination for sea level rise adaptation. BCDC's legally enforceable policies require most major new development along the Bay and public access areas in the 100 ft shoreline band to include features that are resilient to rising sea levels through at least mid-century, and in many cases adaptable to coastal flooding through the end of the century.

Metropolitan Transportation Commission (MTC)
MTC is the transportation planning, financing, and coordinating agency for the nine-county region. MTC plays a key role in supporting local applications for transportation funding and allocates state and federal funding for roads, highways, transit systems, and other transportation resources. It also directly distributes funding to support transit systems and operate and maintain the Bay Area's seven state-owned toll bridges. Together with ABAG, MTC produces Plan Bay Area, the regional long-range plan addressing land use, transportation, and the environment in the Bay Area. MTC's adaptation-related activities focus on improving overall resilience in the transportation system to a range of climate impacts, with sea level rise being the primary focus thus far.

Non-Voting Members

Caltrans District 4 (Caltrans D4)
Caltrans's mission is to provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability. District 4 covers the Bay Area, and its adaptation activities include corridor planning, flood prevention and response, including repairs, for the state highway system, and minimizing fire risk through vegetation control along transportation corridors.

San Francisco Bay Regional Water Quality Control Board (SF Bay Water Board)
The SF Bay Water Board's mission is to preserve, enhance, and restore the Bay Area's water resources. To accomplish this, it regulates discharges from industrial, commercial, municipal, agricultural, dredge and fill materials and other sources, and by developing and overseeing programs and policies. Agency adaptation activities focus on minimizing the effects of coastal flooding, inland flooding, and wildfire upon water quality through permitting requirements, funding for stormwater infrastructure, and cleanup activities.

California State Coastal Conservancy (SCC)
SCC's mission is to protect and improve natural lands and waterways, to help people access and enjoy the outdoors, and to sustain local economies along California's coast. SCC funds a wide variety of projects across all climate hazards, and also plays a role in direct implementation of projects related to coastal flooding and wetland restoration. SCC leads staffing and coordination of the SFBRA, which allocates funding for multi-benefit habitation restoration, flood protection and public access projects along the shoreline of the San Francisco Bay Area.

The Role of BARC

By convening regional agencies, BARC plays a key role in facilitating partnerships, conversations, and collaborations necessary to advance sub-regional and multi-jurisdiction adaptation projects. For example, BARC facilitated the Resilient by Design challenge – an initiative that brought together multidisciplinary teams to design equitable, inclusive, and resilient shorelines around the Bay – and is now leading several efforts to move these design concepts toward implementation. This includes managing Senate Bill 1 Adaptation Planning Grant-funded projects to develop community-supported adaptation concepts in Colma Creek and studying strategy feasibility to expand public access along the northern edge of San Pablo Bay. As additional adaptation grants are released by the State of California, such as the Governor's Office of Planning and Research's Adaptation Planning Grant program, BARC is likely to play a key regional role to develop multi-partner proposals, coordinate applications, and manage successfully funded projects. In addition, BARC and its member agencies work together to advance understanding of climate adaptation and deploy projects, such as the ART project.

Unifying Themes Across BARC Agencies

Across all of our conversations with regional agencies and the plans and documents reviewed, a few themes characterized the current adaptation activities of BARC agencies:

BARC member agencies want to ensure adaptation is equitable
Nearly every conversation and document recognized that both resources and risks are unequally distributed across communities, with low-income residents and communities of color disproportionately impacted by increasing climate hazards. Regional agencies recognized a need to ensure that under-resourced communities have a seat at the table in local and regional decisions and receive adequate support for adaptation planning, obtaining funding, and implementing projects. This recognition influences current projects, from MTC/ABAG and BCDC's funding framework to address sea level rise, to BAAQMD's pilot program distributing air filters.

BARC member agencies have already begun to integrate adaptation into core functions
Regulatory agencies like BCDC and SF Bay Water Board have included adaptation-related elements into their permitting, such as permits requiring the evaluation of sea level rise for shoreline development and adaptation considerations for dredge and fill permits, respectively. Meanwhile, planning agencies such as MTC and ABAG, as well as BCDC's planning program, have all built adaptation into their regional planning mandates, while SCC and Caltrans are involved in direct implementation of adaptation measures, from design and engineering of nature-based solutions to creating more resilient highways, respectively.

BARC member agencies are already collaborating extensively on large adaptation efforts in the region
Many of the programs and activities discussed in the hazard-specific sections involve the leadership and partnership of multiple BARC member agencies. For example, the Bay Restoration Regulatory Integration Team (BRRIT) is a partnership of permitting agencies, including BCDC and the SF Bay Water Board, that provides guidance and review for multi-benefit wetland restoration projects. MTC and Caltrans D4 are both partners on the Resilient State Route (SR) 37 project, which seeks to protect this critical transportation corridor from sea level rise. Further, BCDC, the SF Bay Water Board, MTC, and Caltrans District 4 have been working together on a collaborative permitting process for the Resilient SR 37 Project.

Many BARC member agencies have been actively addressing adaptation for multiple years, with BCDC and MTC partnering to pilot one of the region's first sea level rise vulnerability assessments over a decade ago. BARC has played a key role in catalyzing this regional approach to climate adaptation by providing a structure for ongoing, regular coordination and communication between regional agencies. Through bringing agencies together for sustained conversation, BARC has helped to foster productive relationships, collaborations, and partnerships, as demonstrated by the many adaptation projects in which BARC and its member agencies participate. As a convener for regional adaptation, BARC has a unique role to play to create connections across efforts, coordinate funding applications, and provide regional thought leadership. With their recognition of the importance of prioritizing equity, ongoing adaptation efforts, and strong collaborative relationships, the Bay Area's regional agencies are out in front of state and national requirements. While the following sections will highlight gaps and opportunities to better address each climate hazard, the region has a strong foundation to work from.

Sea Level Rise & Coastal Flooding

The waters of San Francisco Bay have long shaped the region's ecologies, development patterns, economy, and culture. In keeping with the Bay's centrality to the region, sea level rise and coastal flooding are among the earliest climate hazards to be addressed programmatically and systemically by BARC members and other Bay Area agencies. Compared to other climate hazards, coastal flooding is the subject of the most adaptation activity in the Bay Area. The following agencies play key roles in addressing sea level rise in the Bay Area, and a sea level rise.

Activities and Partnerships

This section describes the key activities and programs that BARC agencies are taking to address sea level rise, as well as the agencies and partnerships that enable these programs.

BCDC has incorporated sea level rise into key guiding documents and plans. As the state agency tasked with permitting development along the Bay, BCDC has been integrating climate change into its policies, guidance documents, strategies, and goals for over a decade. Notably, the inclusion of climate change (2011) and equity and social justice (2019) into BCDC's guiding document, the San Francisco Bay Plan, made climate and equity required considerations in BCDC permitting processes for some project types. Today, sea level rise and adaptation are also interwoven throughout BCDC's 2023-2025 Strategic Plan, which includes a goal to lead regional planning efforts for equitable adaptation for the Bay. BCDC's leadership and guidance on sea level rise has played a core part in sea level rise becoming so robustly identified as a priority issue to be addressed in the region.

BCDC helped launch the Adapting to Rising Tides (ART) program, which supports the sea level rise planning efforts of local practitioners. ART was intentionally designed to be distinct from BCDC's regulatory and permitting work and to evolve as climate adaptation needs shifted in the Bay. ART initially focused on supporting local vulnerability assessments and resilience studies: in 2010, a joint study with MTC piloted one of the earliest sea level rise vulnerability assessments in the area, for Alameda County. Subsequently, ART has inspired multiple jurisdiction- and sector-specific studies, established a common set of coastal flood data for the region (ART Flood Explorer), and outlined a roadmap for local adaptation planning. In partnership with BARC and MTC, and funded by Caltrans, ART Bay Area evaluated sea level rise impacts for systems, people, and habitats across the region.

More recently, the Bay Adapt Joint Platform transitions BCDC's focus from sea level rise planning toward implementation. The Joint Platform (2021) is a regional, consensus-driven strategy aimed at overcoming barriers and achieving successful outcomes to adapt to the rising Bay. Endorsed by over 50 local, state, and federal agencies and non-profit organizations, it provides the Bay Area with a roadmap for how to work across scales, jurisdictional lines, and authorities to adapt better, faster and more equitably. The Joint Platform emphasizes a shared challenge, with systemic solutions that can be implemented and iterated upon locally to support wider regional resilience.

A joint effort by MTC, ABAG, and BCDC, the Sea Level Rise Adaptation Funding & Investment Framework aims to quantify the region's total funding needs and study possible solutions. Together, the agencies developed a funding analysis that can inform local and regional efforts to adapt to sea level rise. While recent actions at the state and federal level have increased near-term funding for sea level rise adaptation efforts, the report identifies a greater than $100 billion funding gap over the next several decades. The cost of tackling this regional challenge is significant, but failing to adapt could result in a much larger deficit. The Framework develops a regional cost estimate for sea level rise adaptation across the bay shoreline, researches additional funding sources, and identifies possible paths for equitable distribution of new funds. It builds off BCDC's Bay Adapt Joint Platform, MTC/ABAG's Plan Bay Area 2050 Implementation Plan, and other previous regional planning work.

One key implementation action from the Bay Adapt Joint Platform is the BCDC-led development of a Regional Shoreline Adaptation Plan (RSAP). The RSAP will be a region-wide plan for the Bay shoreline that guides the creation of coordinated, locally planned sea level rise adaptation actions that work together to meet regional goals. The development process is still underway, but the aim is to establish common standards for local land use planning that support a resilient shoreline and incentivize their uptake through funding incentives and technical assistance.

Together, SCC and SFEP staff and coordinate the San Francisco Bay Restoration Authority (SFBRA), which distributes funding for projects to protect and restore the Bay, including sea level rise adaptation projects. See Appendix C: Sea Level Rise Activity Snapshots, p.43, for more details on the SFBRA. Projects that are funded by the SFBRA can also receive permitting assistance from the BRRIT, a cross-agency team that provides review and guidance through a pre-application permitting process.

Meanwhile, the SCC-led Regionally Advancing Living Shorelines in San Francisco Bay project is coordinating programmatic design and permitting for ten living shoreline adaptation projects. SCC is partnering with SFEI to implement living shorelines along three heavily urbanized reaches of the Central Bay shoreline that are currently impacted by coastal erosion, flooding, and storm events, and are threatened by intensifying climate hazards. Phase 1 includes development of regional design and constructability guidance, collaboration with interdisciplinary restoration practitioners, engineers, and municipalities to develop designs for ten living shorelines sites, workforce development with frontline communities, and implementation of a Living Shorelines Collaborative forum to increase community input and share best practices, lessons learned, and permit guidance. The team will then secure permits, prepare final design plans, and start construction at the ten sites.

The Resilient State Route (SR) 37 Project is a joint partnership of MTC, Caltrans D4, and county-level transportation authorities. The multi-agency collaboration aims to protect SR 37 from sea level rise, improve public access to the transit corridor, support ecological restoration, and reduce congestion. SCC leads the SR 37 Baylands Group, which consist of stakeholders focused specifically on ensuring conservation and restoration goals are achieved in the SR 37 project.

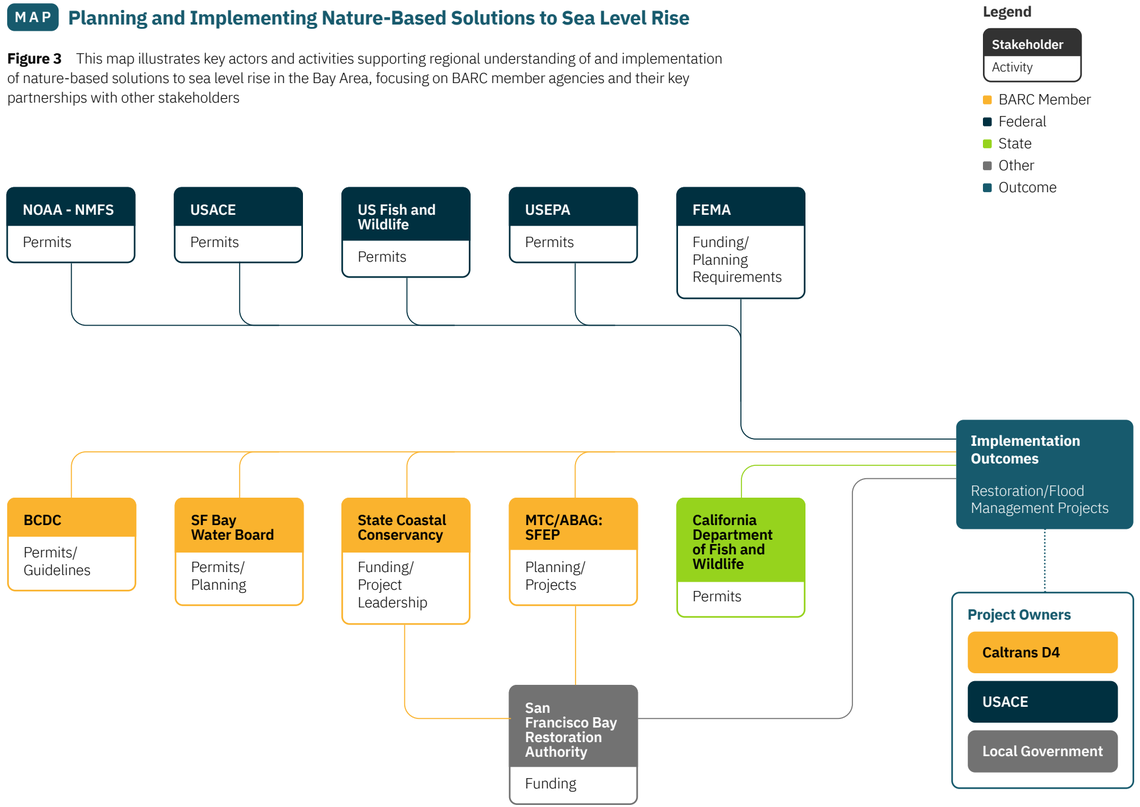
The San Francisco Estuary Institute's SF Bay Shoreline Adaptation Atlas introduces a framework of Operational Landscape Units (OLUs) to drive sub-regional collaboration on sea level rise. Defined by their physical, geological, and natural features, OLUs are sub-regions that align with the boundaries of natural processes such as waves, tides, and sediment movement, rather than agency or jurisdiction boundaries. As such, adaptation measures using the OLU framework require cross-boundary coordination, as demonstrated by the San Leandro Bay/Oakland-Alameda Estuary Adaptation Working Group, which came together in 2022 to pilot this approach for the San Leandro OLU. Stakeholders include cities, counties, CBOs, Tribes, non-profit organizations, the Port of Oakland/Oakland Airport, and BART, as well as nearly all BARC member agencies, including the SF Bay Water Board, SCC, Caltrans D4, SFEP, and BCDC. This working group provides a valuable test-case of the challenges of implementing projects across jurisdiction- and agency-boundaries and currently has several projects underway to develop concept designs and strategies to protect critical features of the shoreline.

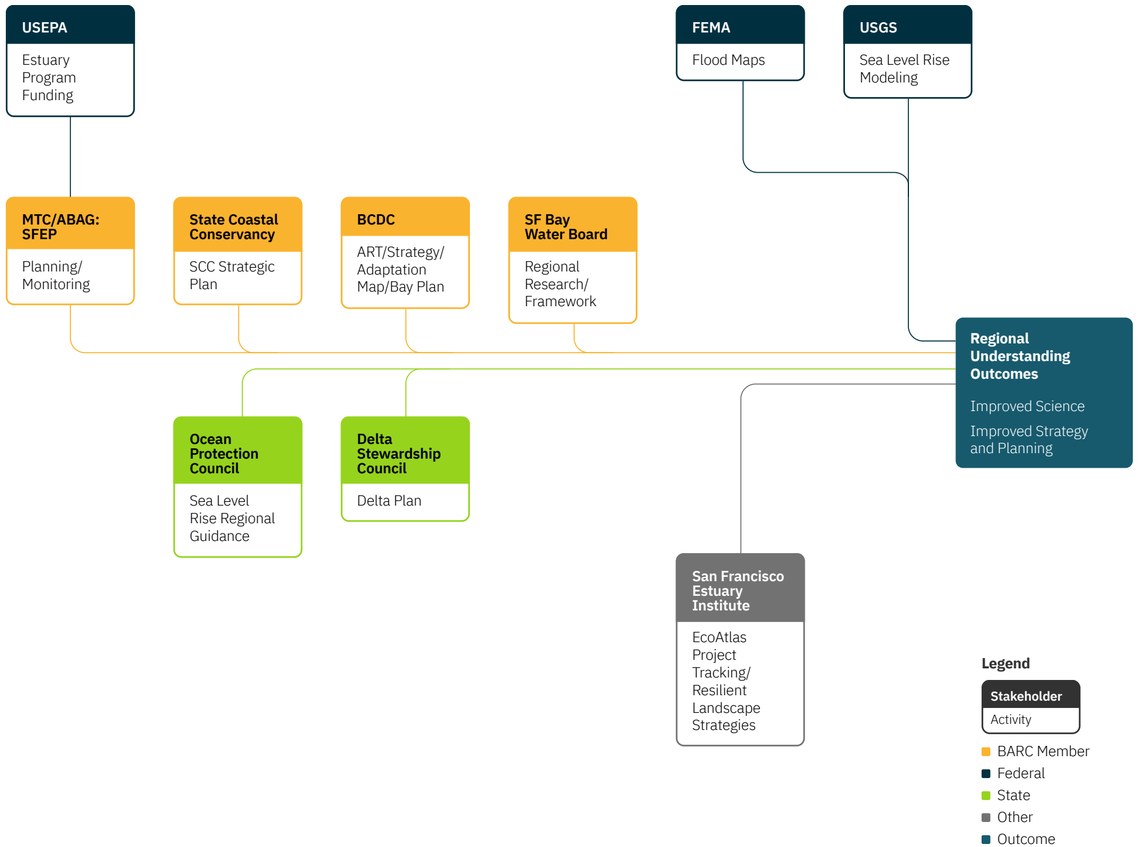
Due to the many stakeholders and activities in sea level rise adaptation in the Bay Area, three systems maps were developed for this hazard. Figure 3 illustrates the stakeholders engaged in developing nature-based solutions to sea level rise. Additionally, in Appendix C: Sea Level Rise Activity Snapshots, Figure 12 maps out the San Francisco Bay Restoration Authority, while Figure 13 depicts the stakeholders active in the Resilient State Route 37 project.

The waters of San Francisco Bay have long shaped the region's ecologies, development patterns, economy, and culture. In keeping with the Bay's centrality to the region, sea level rise and coastal flooding are among the earliest climate hazards to be addressed programmatically and systemically by BARC members and other Bay Area agencies.

MAP Planning and Implementing Nature-Based Solutions to Sea Level Rise

Figure 3 This map illustrates key actors and activities supporting regional understanding of and implementation of nature-based solutions to sea level rise in the Bay Area, focusing on BARC member agencies and their key partnerships with other stakeholders





Riverine & Inland Flooding

Climate change impacts the intensity, duration, and movement of atmospheric rivers – narrow corridors in the atmosphere of concentrated moisture, which transport water from the tropics – resulting in extreme precipitation events. From December 2022 to March 2023, multiple atmospheric rivers delivered winter storms and heavy rainfall that resulted in flooding. In the Bay Area, flooding closed several highways, disrupted transit, washed out roads in landslides, and caused billions of dollars in damages.[4] As climate change intensifies, intense precipitation events are projected to increase, and thus the risk of flooding as well. This will likely call for an enhanced local and regional response to mitigate the risk of riverine and inland flooding:

Activities and Partnerships

While many BARC member agencies have mobilized to meet the challenge of coastal flooding presented by sea level rise, their efforts to address inland flooding are relatively limited and have focused on emergency response and pollution prevention. In the Bay Area, inland flooding is primarily the responsibility of county-level flood control and water conservation districts, which have formed the Bay Area Flood Protection Agencies Association (BAFPAA) to facilitate regional coordination and collaboration with state and federal agencies. Their activities are a critical part of increasing resilience to local flooding in the Bay Area. However, this report focuses on the actions of BARC member agencies, presented here below.

[4] https://www.npr.org/2023/02/10/1155558812/after-january-storms-some-california-communities-look-for-long-term-flood-soluti

Caltrans D4 has led emergency highway repair projects after flooding events. For example, after the 2023 winter storms, Caltrans mobilized to carry out several highway repair projects in Marin, Sonoma, and San Mateo Counties.

The San Francisco Bay Water Board has incorporated considerations for inland flood risk and adaptation into permits for wastewater discharge. Some permits include requirements for climate vulnerability assessments that consider flooding and ensure that floodwaters do not result in local pollution. The agency also encourages wastewater infrastructure renewal projects to become resilient to sea level rise, groundwater rise, and other hazards and to provide multiple co-benefits by mimicking natural processes to infiltrate or use stormwater to protect water quality and associated habitat. These actions can help to manage stormwater as well as reduce pollutant impacts should flooding occur.

The San Francisco Bay Water Board's Municipal Stormwater Program encourages cities to implement multi-benefit green stormwater infrastructure with resilience co-benefits. The agency also requires low impact development that provide multiple co-benefits.

SFEP is a key participant in the Integrated Regional Water Management Program (IRWMP), which encourages a regional approach to water-related issues, including flooding, among local stakeholders. The program is an effort by stakeholders from the nine Bay Area counties to collaborate across borders on a strategic, regional approach to flood protection, water supply reliability, water quality, and habitat protection, among other goals. Required by the California Department of Water Resources (DWR), the IRWMP develops a regional plan and coordinates around regional projects for dedicated IRWMP funding.

Notably, SFEP participates in the IRWMP and coordinates regional grant applications for project implementation funding, including for flood protection, from DWR under multiple funding rounds.

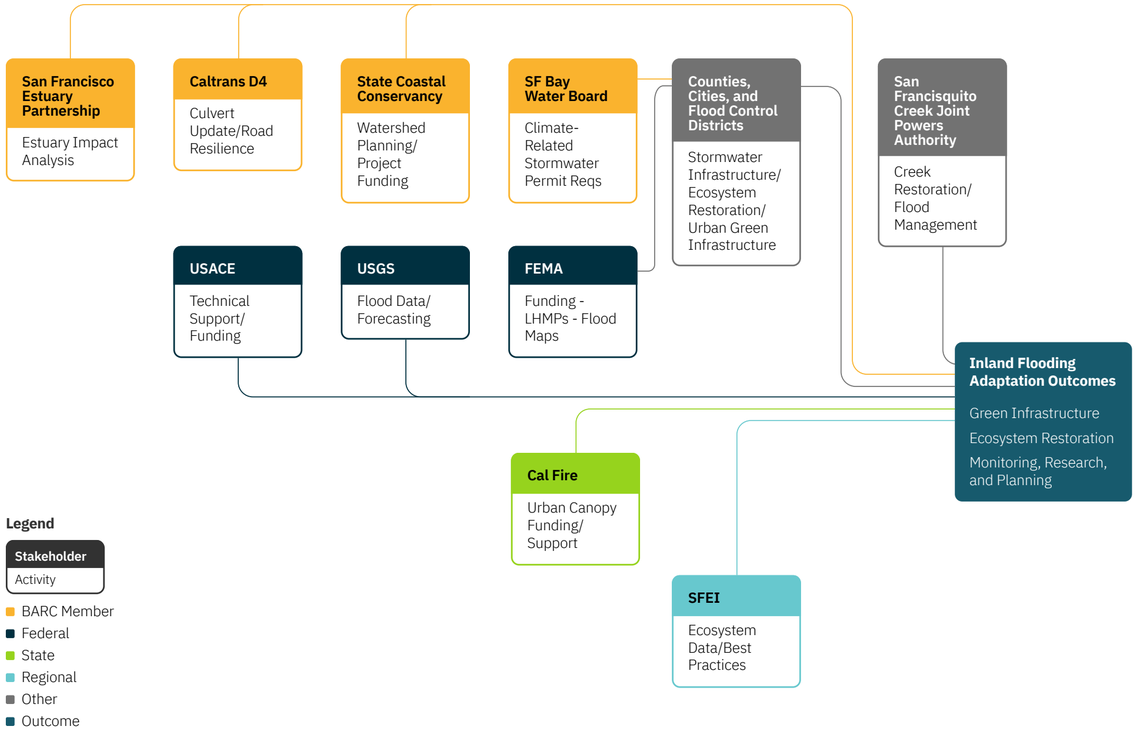
SFEP also considers the impact of inland flooding on estuary ecology. The Estuary Blueprint, a collaborative roadmap and agreement for protecting and restoring the Sacramento-San Joaquin River Estuary, identifies the need for green stormwater infrastructure that can distribute runoff over a long period of time, as well as other actions to address the increased precariousness of seasonal wetlands in the face of flooding. Green infrastructure projects can be critical to mitigate peak stormwater flows, reduce erosion, and improve water quality.

Figure 4 shows the systems maps for riverine and inland flooding activities in the Bay Area.

In the Bay Area, flooding closed several highways, disrupted transit, washed out roads in landslides, and caused billions of dollars in damages. As climate change intensifies, intense precipitation events are projected to increase, and thus the risk of flooding as well.

MAP Riverine & Inland Flooding

Figure 4 This systems map illustrates some of the key actors in inland flooding in the Bay Area, focusing on the actions of BARC member agencies and their key partnerships with other stakeholders.



Water Quality

Negative impacts to water quality are secondary impacts of coastal flooding and inland flooding, as tidal flooding, storm surge, groundwater rise, and stormwater can flush out toxins from industrial sites, lead to overflow from wastewater treatment facilities, and increase upland erosion. These toxins can impact communities, the Bay, and ecosystems. Water quality is also a secondary impact of wildfire, as both wildfire debris and ash and firefighting chemicals can threaten water quality. Moreover, as climate change accelerates, warming water temperatures can also impact water quality in the Bay Area by increasing eutrophication and threatening delicate aquatic ecosystems.

The SF Bay Water Board is the main regional agency focused on water quality, regardless of the cause, while BCDC plans for and responds to anything that may impact water quality in the Bay. The systems map for water quality-related regional activities is shown in **Figure 5**.

Activities and Partnerships

The SF Bay Water Board is the regional agency charged with preserving, enhancing, and restoring the quality of the San Francisco Bay Region's water resources for the protection of the environment, public health, and all beneficial water uses. Thus, unlike other hazards, there is a clear and integrated regional plan for addressing water quality concerns. Under section 401 of the Clean Water Act, the agency has the authority to regulate discharges of dredged and fill materials to waters of the state. The agency works closely with multiple local agencies and technical advisory groups. Due to its permitting authority, the SF Bay Water Board is also closely involved with federal agencies like USACE and multiple entities across the region.

The majority of the agencies, programs, and activities addressing changes in water quality is described above in the sections on sea level rise and riverine and inland flooding. Additional activities focused on water quality that are not described in previous sections include:

The Basin Plan is the SF Bay Water Board's Water Quality Control Plan. The Basin Plan designates beneficial uses and water quality objectives for surface waters and groundwaters, includes programs and implementation plans to achieve water quality objectives in the San Francisco Bay Basin. The Basin Plan is approved by the US Environmental Protection Agency (EPA), with whom the Regional Water Board works closely on water quality regulations under the Clean Water Act and permitting.

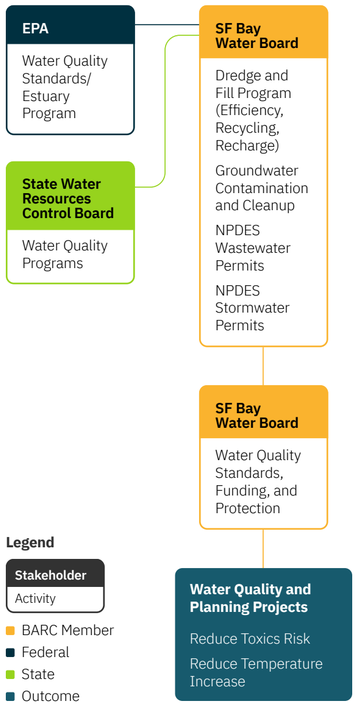
The SF Bay Water Board's Groundwater Program includes site cleanup and waste regulation to prevent water supply contamination. For example, the Underground Storage Tank Cleanup Fund assists private parties with cleanup of any leaking petroleum tanks and provides funds for the abatement of emergency situations or cleanups of abandoned sites that pose a threat to human and environmental health. The Regional Water Board also regulates land-based disposal facilities, refineries, large industrial facilities, and containment units that are near or could potentially impact wetlands.

The SF Bay Water Board funds scientific studies related to climate, water quality, and conservation. The research is completed via contracts with SFEI, as well as resource conservation districts, other public agencies, and academic institutions. The Regional Water Board works with SFEI to support improved understanding of how climate change impacts and human-driven eutrophication might alter water quality and the resilience of aquatic habitats. For example, the Regional Water Board is funding the planning study of adaptation pathways for the San Leandro Bay Operational Landscape Unit as part of its contribution to the San Leandro Bay/Oakland Alameda Estuary Adaptation Working Group

SF Bay Water Board runs multiple wetlands and aquatic ecosystem protection and permitting programs. The agency permits restoration and mitigation projects, develops action plans to protect stream health and support clean water, and is developing a policy to protect watersheds from climate change impacts for addition to the Basin Plan. The SF Bay Water Board also partners with BCDC, SCC, SFEP, and numerous other state and federal agencies on EcoAtlas, a web tool that tracks multiple restoration and enhancement projects across the Bay. In addition, the Regional Water Board also provides discretionary funding for restoration efforts, such as funding for San Mateo County to monitor water quality in the Marina Lagoon, and a grant that supported 15 miles of restoration along the Napa River.

MAP Water Quality

Figure 5 This systems map depicts key activity to address water quality in the Bay Area, focusing on BARC member agencies and their partners



Drought

California is predicted to experience more intense, extended periods of drought, as well as more extreme swings between wet and dry periods. Drought will exacerbate water supply challenges, particularly for areas that rely on surface water for supply,. In addition, drought will impact the health of wetland, estuarine, and riverine ecosystems; increase the risk of wildfire ignition; reduce agricultural output; and lead to subsidence, as groundwater supplies are depleted. Extended drought, and swings between wet and dry periods, can also damage levees and roadway and building foundations through the expansion and contraction of underlying soils, particularly clay soils.

The Bay Area draws water from a wide range of sources, including the Hetch Hetchy Reservoir in the Sierra Nevada mountains – which serves the City and County of San Francisco directly and wholesales water to 26 agencies in Alameda, Santa Clara, and San Mateo County – other sources of imported water (e.g., the Sacramento-San Joaquin Delta, the Mokelumne River), numerous local reservoirs and surface supply systems (e.g., Calaveras Reservoir, Sonoma Lake), and groundwater. The San Francisco Bay Hydrological Region includes at least 184 community water systems[5], which are publicly or privately owned, such as special districts, municipal utilities, regulated utilities, regional water systems, and water companies[6]. Some counties have water agencies that manage water supply, operate reservoirs, secure new sources of water, and sell water wholesale to dozens of smaller retail water utilities and service companies, which in turn then supply water to end users. These county-level agencies often actively consider long-term conservation and water management, such as Sonoma Water, Santa Clara Valley Water Agency (Valley Water), and the San Francisco Public Utilities Commission (SFPUC). The East Bay Municipal Utility District, which serves 1.4 million people in Alameda and Contra Costa counties, also operates its own reservoir system. Other counties lack such an overarching agency structure and are chiefly served by retail water districts and companies.

Activities and Partnerships

The fragmented landscape of water systems and water rights makes regional collaboration on long-term issues of drought and water supply challenging. At the same time, the interconnected nature of the water system means that any individual water utility's actions on supply and demand affect all other agencies drawing upon the same water sources. Groundwater management, for example, requires coordination across all water systems that draw from the same basin. This section details the regional activities and programs in place to address drought, with the associated systems map in Figure 6.

The SFEP is a key participant in the Integrated Regional Water Management Program (IRWMP), which encourages regional collaboration focused on drought. While most collaboration to address drought and water supply issues occur directly between water agencies, utilities, local agencies, and other stakeholders, the IRWMP offers an opportunity for strategic regional collaboration on drought. Drought-related program objectives include improving water use efficiency, increasing recycled water use, and recharging groundwater. Drought is also addressed in the regional plan and projects that receive IRWMP funding, through a regional application coordinated by SFEP. As part of the IRWMP, SFEP also coordinated a Regional Needs Assessment to understand the needs of disadvantaged communities, the unhoused, and Tribes around water access, water quality, and water reliability; the findings can then subsequently support the development of IRWMP projects to address these issues.

The Bay Area Regional Reliability (BARR) partnership, established in 2014 by eight of the Bay's largest water agencies, addresses drought preparedness from a regional perspective. BARR agencies aim to cooperatively develop regional projects that can strengthen long-term water supply reliability and resilience. To highlight priorities, they developed the Drought Contingency Plan, which takes a regional perspective to drought planning – a significant difference from prior agency-level drought-planning efforts. The Plan identifies drought response and drought mitigation strategies, some of which are under development by member agencies. Notably, BARR also convenes a taskforce of external stakeholders to provide input to the BARR on key efforts. Many of the participating stakeholders focus on water, land use development, and the environment, including ABAG, which brings a perspective linked to long-range regional planning and housing. The BARR approach will allow participating agencies to leverage existing infrastructure investments and coordinate to facilitate water exchanges during drought.

The Bay Area Water Supply & Conservation Agency (BAWSCA) represents the water-related needs and interests across dozens of local actors. Created by state legislation in 2003, BAWSCA jointly represents the needs and interests of the 26 cities, counties, and private water companies that buy wholesale water from the San Francisco Regional Water System (SFRWS, Hetch Hetchy Reservoir) and place them on an equal footing with the SFPUC, which owns and operates the system. The BAWSCA has the authority to conduct regional water supply reliability planning for its members agencies, coordinate water supply, conservation, and recycling activities, purchase wholesale water, and build water facilities.

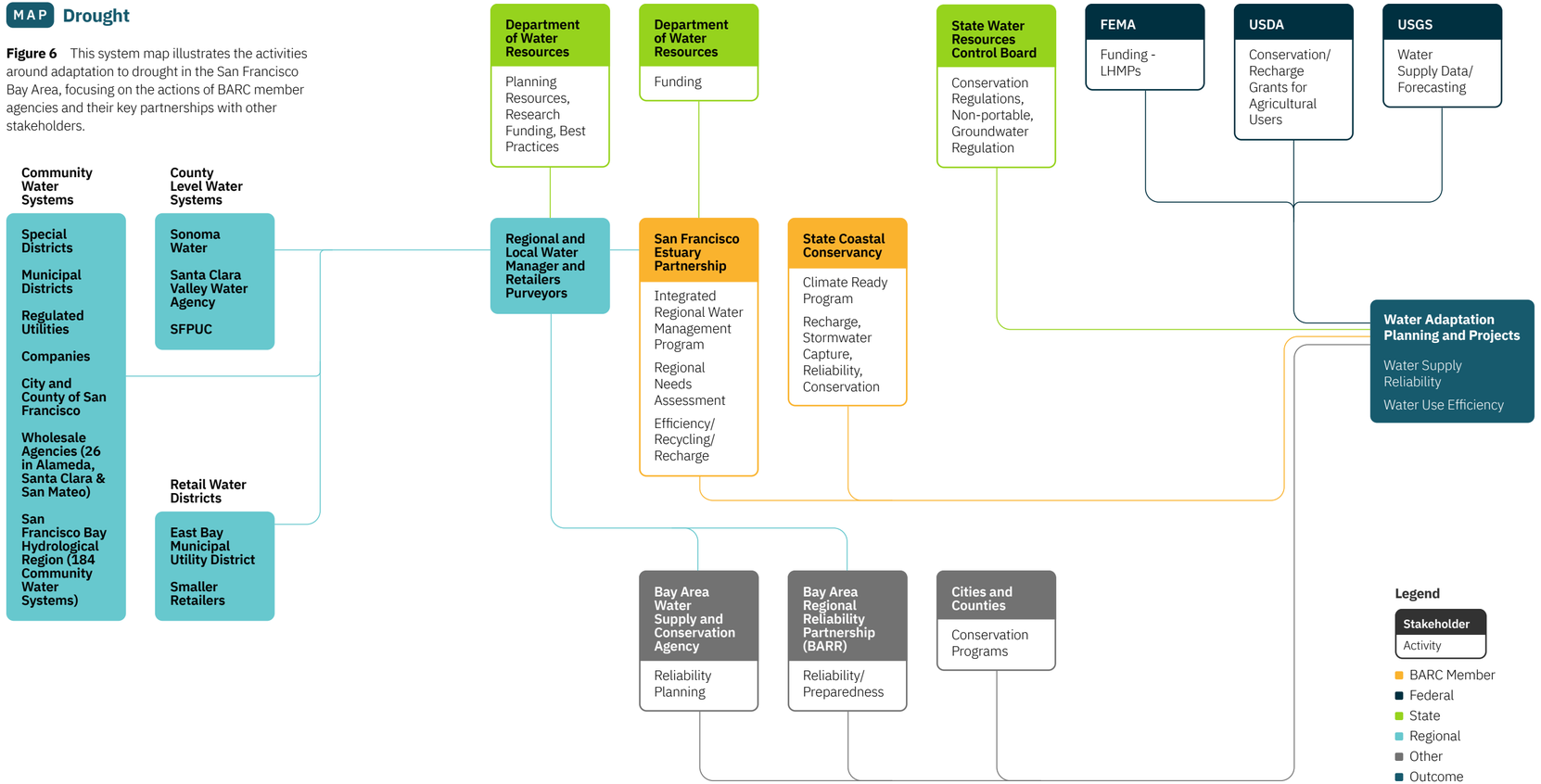
Beyond planning and coordination, the SCC's Urban Greening grant program provides funding for projects that increase water supply reliability. Project example types include identifying feasible catchments and best practices for groundwater recharge, construction of bio-retention basins and vegetated swales, and riparian habitat restoration.

[5] The San Francisco Bay Hydrological Region does not include large parts of Sonoma, Napa, Solano, Contra Costa, Alameda, and Santa Clara County, so the actual number of water systems in the nine-county MTC/ABAG region is likely to be far higher. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/Statewide-Reports/GWU2013_Ch4_SanFranciscoBay_Final.pdf

[6] https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/waterpartnerships/what_is_a_public_water_sys.pdf

MAP Drought

Figure 6 This system map illustrates the activities around adaptation to drought in the San Francisco Bay Area, focusing on the actions of BARC member agencies and their key partnerships with other stakeholders.



Extreme Heat

The San Francisco Bay Area's historically mild climate means that residents are not acclimatized to heat and many homes do not have air conditioning, exacerbating heat's potentially fatal consequences for vulnerable populations. Similarly, assets and infrastructure across the Bay are not designed for higher temperature thresholds. The recent September 2022 heat wave, for example, broke temperature records all across the Bay Area, and led to power outages for thousands of households.

Activities and Partnerships

Key agencies actively addressing extreme heat are at the state – California Department of Public Health (CDPH) and the California Division of Occupational Safety and Health (CalOSHA) – and local level (county and city public health departments and offices of emergency services), as well as universities and non-profit organizations. No regional agency or BARC member agency is directly responsible for addressing extreme heat. Some BARC members, such as BAAQMD and ABAG, have projects to help reduce heat impacts for vulnerable residents. The systems map in **Figure 7** captures the regional activity around extreme heat in the Bay Area.

BAAQMD programs for addressing wildfire smoke, such as the Bay Area Healthy Homes Initiative, indirectly provide some protection against heat. The initiative assists low-income residents or residents living within 1,000 ft of high-volume roadways in Alameda and Contra Costa County with interventions targeted at reducing exposure to air pollution, including home retrofits and energy efficiency assessments, which can help reduce home heat gain and increase efficiency of cooling systems. Similarly, the AB 836 Clean Air Centers program could potentially fund upgraded HVAC systems for community-supported clean airs centers, although all participating centers have thus far opted for air cleaners (due to their lower costs).

The Bay Area Regional Energy Network (BayREN) is a project housed at ABAG focused on energy efficiency with programs that can help vulnerable communities. In 2023, for example, BayREN announced new bonus rebates for rental housing providers located in communities with high levels of vulnerability to extreme heat. Rebates could help properties upgrade or retrofit buildings to reduce indoor summer temperatures. BayREN also offers rebates to individuals for home improvements like energy-efficient air conditioning, insulation, and air sealing that can lower cooling costs and heat-proof homes.

BayREN's Resilient Libraries Network is piloting a network of energy-efficient libraries that can serve as community resilience centers during natural disaster events. The one-year program provides participating libraries community engagement and facilitation support to develop community-driven goals, free engineering technical assistance and recommendations for upgrades needed to provide cooling and clean air, and matching with financing experts to help identify potential funding sources to carry out upgrades. The six participating libraries are in MTC's designated equity priority communities[7] or serve other vulnerable populations around the Bay Area. While the program is not hazard-specific, the recommended upgrades address heat and air quality.

The Resilient SR 37 project includes design criteria to address heat. While the project focuses on protecting the corridor from flooding, Caltrans D4 has ensured the multi-benefit project also includes heat adaptative design.

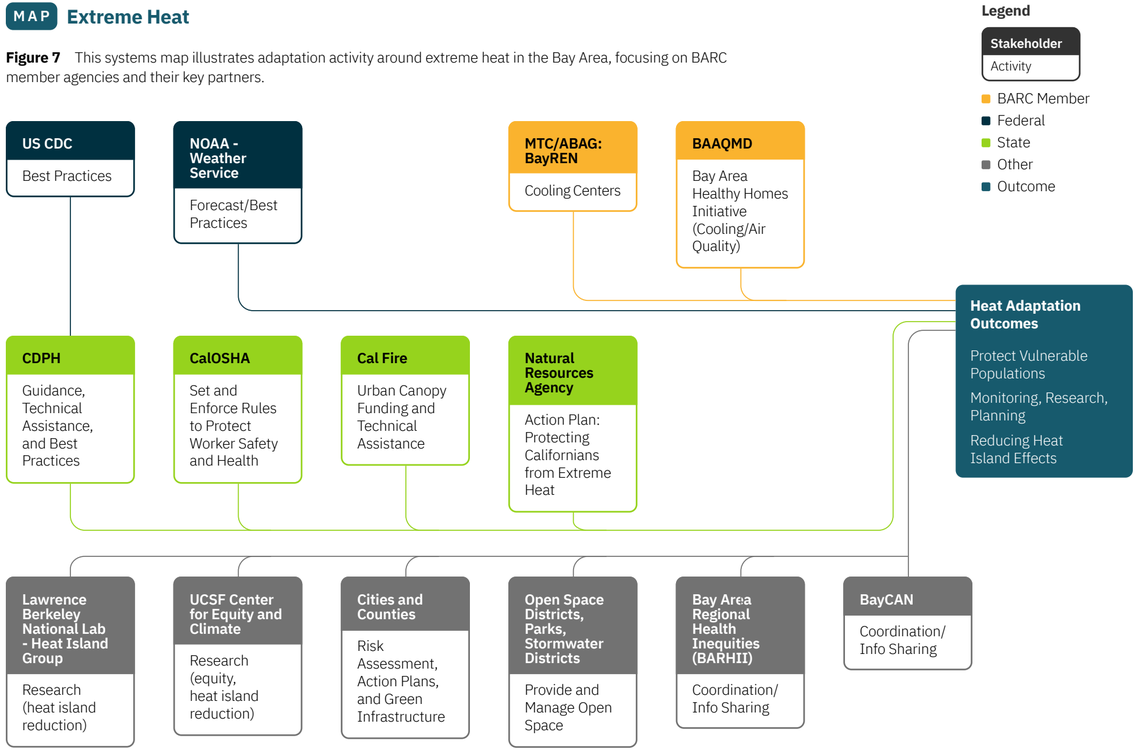
City and county-level collaborations demonstrate how extreme heat is often addressed at the local level. Santa Clara County has convened a heat and air quality resilience work group; Alameda County is developing a cross-agency extreme heat communications plan and convening a working group to coordinate efforts on opening and publicizing cooling centers (and clean air centers). The City of Berkeley, the only city in the Bay Area with its own public health department, is working on extreme heat plans for City infrastructure as well as cooling center operations, public messaging, community preparedness, emergency medical services, and a community resilience center program focused on serving vulnerable communities.

At the state level, CDPH's Climate Change and Health Equity Section has multiple programs to support these local heat responses. For example, a forthcoming syndromic surveillance system will report heat-related health symptoms in near-real time, with data made available to local health departments and first responders to inform emergency preparedness and response measures. CDPH also developed extreme heat guidance for first responders and local health departments to support vulnerable populations, as well as interim guidance for schools; they are also working with schools and county departments of education to expand readiness for extreme heat, as schools are often seen as critical resources and hubs in the community. Additionally, CDPH provides technical assistance to local health departments.

CalOSHA addresses extreme heat risks for outdoor workers. CalOSHA provides guidance, training, and education for employers, especially in the agricultural and construction sectors, to ensure workers receive adequate protection during extreme heat events. The agency conducts workplace inspections during heat events to investigate and prevent heat illness incidents, while a bilingual outreach team works directly with CBOs to inform workers of their risks and rights. Outreach efforts include visiting farms and other workplaces to provide resources and trainings for workers.

MAP Extreme Heat

Figure 7 This systems map illustrates adaptation activity around extreme heat in the Bay Area, focusing on BARC member agencies and their key partners.



[7] MTC has identified equity priority communities that have a significant concentration of underserved populations in the Bay Area, based on factors such as income, English proficiency, and transportation access. https://mtc.ca.gov/planning/transportation/access-equity-mobility/equity-priority-communities

Wildfire & Air Quality

In October 2017, four major wildfires erupted in the span of just five hours as the result of high winds and hot dry conditions, burning rapidly across Sonoma and Napa County.[8] When they were contained three weeks later, the North Bay Fires had claimed 46 lives and devasted 161,000 acres, making them the most destructive wildfires in northern California – at the time.[9] The speed and intensity with which the wildfires spread suggested that the Bay Area must prepare for new, heightened fire risks. Across the state, wildfire season has become a near-year round reality, requiring pre-fire hazard mitigation, emergency preparedness, intensive fire-fighting, and post-fire recovery. Even when the fires burn elsewhere, the Bay Area can be impacted by severe wildfire smoke, as occurred in September 2020. As the haze and smoke of wildfires have become a near-annual occurrence for Bay Area residents, so too has become the work of wildfire prevention and wildfire smoke mitigation.

Activities and Partnerships

This section details the key programs and activities that BARC agencies are taking to address wildfire and air quality risks, with the associated systems map in Figure 8.

ABAG's Priority Development Area (PDA) program aims to incentivize development outside the wildfire-urban interface (WUI). Increasingly, development in the WUI, especially residential development, is one reason why wildfires have become so costly and damaging in over the past few decades. ABAG PDAs offer guidelines and incentives for land use that can help decrease fire risk.

Caltrans D4 partners with CalFire in its Roadside Vegetation Control Program to prevent wildfire. The program implements an integrated vegetation management plan that increases defensible space along state highways and decreases vegetation, preventing wildfires that can start if dried grasses or brush are untended and sparked along roads. Fire risk to existing infrastructural assets is also evaluated in Caltrans D4's Climate Change Vulnerability Assessment and Adaptation Priorities Report, which aim to increase the transportation system's resilience to all climate hazards.

BAAQMD works with CalFire, Caltrans D4, and local fire departments to facilitate and permit prescribed, controlled burns. Prescribed burns control vegetation and help prevent combustible material from accumulating and fueling wildfires.

BAAQMD operates multiple programs to alleviate the impact of wildfire smoke on air quality and public health. The agency coordinates with local public health and public emergency officers to forecast and monitor wildfire smoke and air quality and prepare communities for wildfire smoke events. Its Wildfire Air Quality Response Program offers communities resources to protect public health and grants and incentives for installing air filtration. The Clean Air Filtration Program includes a number of activities, including working with county emergency services offices to prepare for wildfire smoke, high-performance air filtration systems for schools in communities with poor air quality, and a pilot program with the Red Cross to distribute portable filtration units to evacuation centers and shelters during wildfire events. Recently, BAAQMD also drafted and supported Assembly Bill 836, which established and provided funding for a Clean Air Centers Pilot Program. The program, operated in partnership with Bay Area counties, funds high-efficiency air filtration for publicly accessible facilities such as community centers, senior centers, and schools.

Similarly, the Home Air Filtration Program directly provides filtration units to vulnerable households, such as those with asthma.

BAAQMD also operates multiple community health programs to reduce the impacts of air pollution overall. For example, the Bay Area Healthy Homes Initiative pilot program provides retrofits for low-income households living near highways in Alameda and Contra Costa counties. Retrofits reduce pollution exposure and decrease asthma.

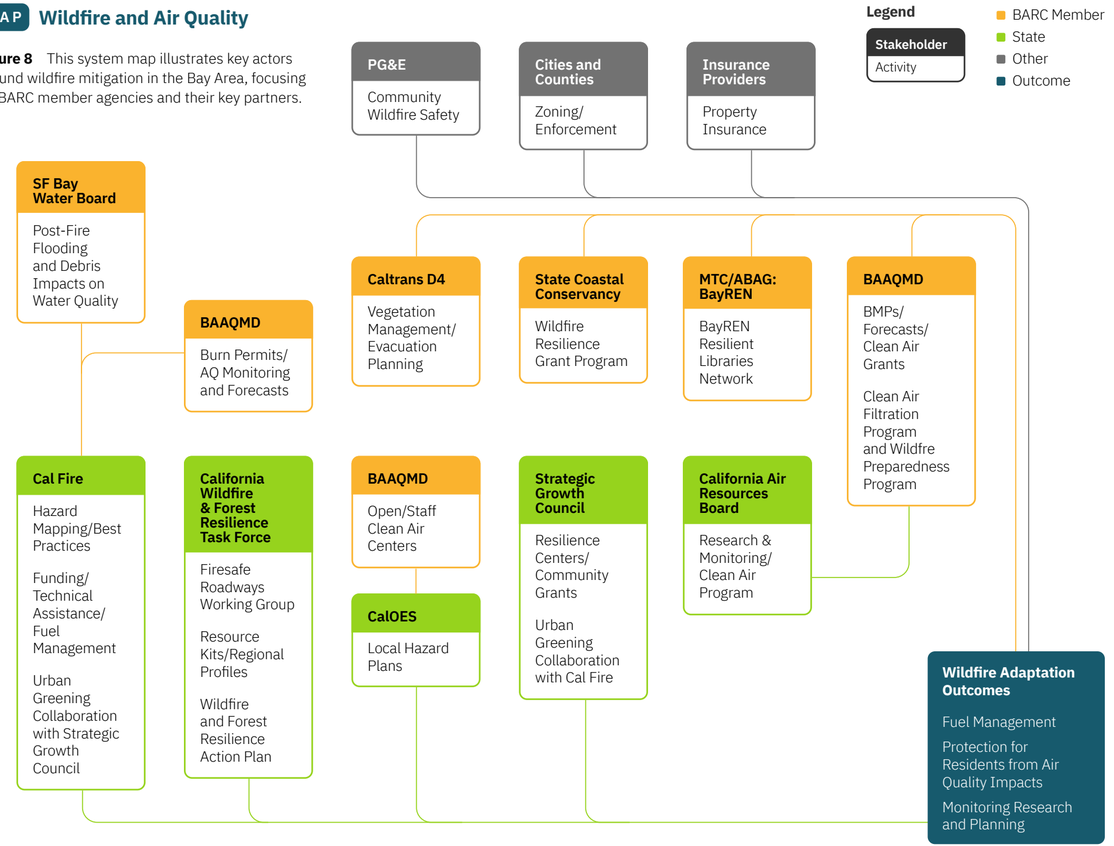
SCC operates a Wildfire Resilience Program that provides grants to restore the health and resilience of natural lands to reduce wildfire risk.

[8] https://abag.ca.gov/tools-resources/maps/map-month/2017-north-bay-wildfire-affected-areas

[9] https://www.spc.noaa.gov/publications/nauslar/2017cali.pdf

MAP Wildfire and Air Quality

Figure 8 This system map illustrates key actors around wildfire mitigation in the Bay Area, focusing on BARC member agencies and their key partners.



05
Gaps and Challenges Across Hazards

Climate adaptation is a complex challenge, requiring a collective, coordinated response to a wide array of climate impacts across interconnected communities, sectors, and systems. At the same time, the Bay Area is home to numerous regional and local agencies, and their state and federal partners, that have responded to the challenge and begun the process of understanding climate adaptation and how to best integrate it into their missions and programming. As Section 4. Regional Adaptation Activity: By Agency and Hazard illustrated, agencies at every level and scale are actively seeking solutions to the key hazards facing the Bay Area. This section further distills the findings from the document review and interviews conducted for this report into themes on the gaps, challenges, and opportunities for climate adaptation in the Bay Area, particularly from the perspective of regionalism and regional agencies.

Often counties are thinking about their counties, sometimes their neighbors – but not often across the Bay. And in some instances, there are studies that show that what do you do on one side of the Bay could actually have repercussions.

Hazards & Authorities

Almost every form of infrastructure is impacted by every hazard.
Nearly every system, from transportation to telecommunications networks, is vulnerable to risks from multiple major hazards. The same highway may need to be elevated to avert coastal flooding, reinforced to withstand inland flooding, and surrounded by defensible space to defend against wildfire. Adaptation requires not only hazard-specific considerations, but a systems-wide approach to resilience.

Given how many hazards affect nearly every system, there are clear opportunities for multi-benefit adaptation projects
Planning, designing, funding, and implementing multi-benefit adaptation projects demand a high level of effort and coordination, due to the number of disciplines, departments, stakeholders, and funding sources that must be assembled. Nonetheless, such an approach can ultimately deliver significant time and cost savings. For example, a community center undergoing retrofits and improvements to serve as a cooling center can simultaneously be equipped with air quality filters to protect people during wildfire smoke events. Multi-benefit projects can also ensure that key lifeline systems are functional and resilient to a variety of climate hazards.

The number of adaptation entities and activities presents both challenges and opportunities:
Over 60 federal, state, and regional agencies and collaboratives, in addition to CBOs and non-profit organizations, are engaged in climate adaptation to some degree. While climate change demands an all-hands-on-deck approach to address society-wide impacts, the sheer magnitude of activities also creates its own challenges. First, the complexity can make it difficult to discern clear ownership of a specific issue or understand requirements and available resources, particularly for communities and local agencies new to the adaptation space. This in turn increases the need for technical assistance to help project stakeholders navigate the field. Second, the complexity dictates a high level of both formal and informal coordination for most activities, which may be difficult to scale up over the coming decades.

The role and responsibilities of regional agencies varies by hazard.
Multiple BARC members (SCC, BCDC, SF Bay Water Board, and MTC/ABAG via SFEP) are planning around sea level rise and coastal flooding from the regional perspective, considering region-wide priorities and needs. On the other hand, no agencies are bringing that regional perspective to addressing heat, wildfire, or drought. These hazards are led by local and state agencies such as CalFire districts, CDPH, and cities and counties, with only moderate engagement with BARC members.

Responsibility for adaptation is dispersed across multiple agencies at multiple levels.
No single agency at the federal, state, regional, or local level has primary responsibility for preparing for or coordinating the response to the multiple hazards associated with climate change. Similarly, no single agency is clearly responsible for each individual hazard or specialized in a particular kind of adaptation activity (e.g., research or regulation alone). Instead, agencies are often focused on mitigating at least two to three hazards that impact their operations and working on a range of adaptation activities, from planning to implementation, in collaboration with a wide range of partners.

This dispersal of responsibility can make it difficult to identify the key agency responsible for addressing any particular hazard.
Local agencies, community organizations, or other agency partners may struggle to identify the right party to contact when seeking technical assistance, partnership, or giving feedback on a particular project. When adaptation projects reach implementation stage, progress may be slowed as decision-making about specific policies, programs, and projects is hampered by lack of clear leadership.

Engineering is approached right now to be more multimodal, but completely silent on a multi-benefit type of approach.

– Caltrans District 4 Interview

Moving from Planning to Implementation

Successful adaptation requires planning, funding, and implementation, but most activity thus far is concentrated at the planning stage.
Multiple state, regional, and local agencies have led planning, research, and facilitation efforts on climate adaptation in the Bay Area, as Figure 10 shows. However, these plans often lack details and timelines for deployment and do not include clear commitments or mandatory actions. In contrast to the amount of planning activity taking place, fewer agency activities are dedicated to funding and implementation, especially for big, transformative projects. Few actions also focus on formalizing (e.g., new regulations) and financing and implementing adaptation projects.

The pace of project design, approval, and implementation is out of sync with the rate of climate change.
Years or decades can pass from initial concept development to completion for complex adaptation projects. The long timeline can result in challenges such as the ability to secure multiple years of match funding or staff turnover leading to the loss of project knowledge, expertise, and relationships. The lag in project deployment also creates friction in the system as projects and teams must remain activated over long periods of time, reducing their ability to take on new responsibilities. It also can contribute to increased project costs.

Multiple layers of regulatory requirements can complicate climate adaptation implementation.
Untangling federal, state, and local permitting requirements can place a significant burden on project stakeholders. Especially for projects occurring along the San Francisco Bay shoreline, applying for the necessary permits from multiple state and federal agencies can complicate and delay project design.

Nature-based solutions can be especially challenging to build and implement.
Nature-based solutions, such as horizontal levees, are relatively new and entail new levels of design guidance and engineering, which takes time, money, and expertise. In some cases, existing regulations or permit requirements can make nature-based solutions challenging and expensive to implement, due to the amount of project-level mitigation required to meet permit requirements (e.g., to mitigate Bay fill).

Agencies can learn a great deal about the impacts, co-benefits, challenges, and opportunities of adaptation measures that have been implemented.
This is especially important for emerging measures, such as nature-based solutions or cool pavements, which are often perceived to be riskier for funders due to the lack real-world test case data. There are opportunities for agencies to evaluate impact and track and share data as the first Regionally Advancing Living Shoreline projects and SFBRA-funded projects are implemented or completed.

Figure 9 This map diagrams the adaptation activity framework developed for this project. Adaptation activities are categorized as 1) planning (facilitation, research, planning); 2) funding (fundraising and fund allocation), and 3) implementation (providing education, formalizing through creating and enforcing policies and regulations, and implementation).

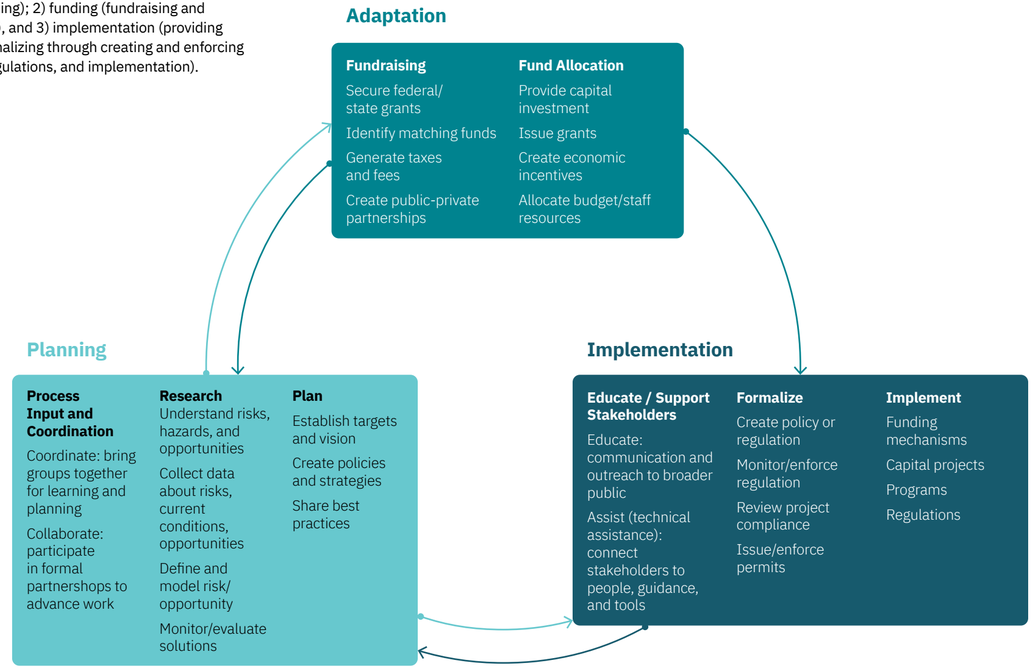


Figure 10 This matrix shows the distribution of climate adaptation actions by hazard and by activity type in the Bay Area for regional, state, and federal agencies. A higher number indicates that there are more programs and initiatives for that hazard and activity type. Note that number is by count alone, and not indicative of the magnitude of effort; a one-year, $300,000 pilot effort and a multi-year, multi-million program will each receive a count of one.

	Coastal Flooding	Inland Flooding	Drought	Heat	Wildfire	Air Quality
Facilitate	73	42	61	60	48	31
Research	48	28	40	30	28	13
Plan	41	20	29	25	26	11
Finance	21	15	17	18	13	11
Formalize	22	14	18	10	13	11
Implement	12	9	14	10	11	9

Collaborating Across Jurisdictions & Agencies

Projects that cross jurisdictions are especially challenging, and necessary.
Adaptation projects often have the greatest benefit when implemented according to natural landscape features, e.g., watersheds and shorelines, not jurisdictional boundaries. In the Bay Area, even relatively small projects may cross city or county borders and require engaging multiple permitting and resource agencies. This is especially true for sea level rise projects. The level of coordination and collaboration needed to advance cross-jurisdictional projects requires high levels of engagement from all partners to work through questions of funding, governance, and implementation. This process can be costly and time-consuming and may affect the speed of project implementation.

Narrow regulatory authorities can limit agencies' ability to plan and implement holistic projects.
A holistic project addresses multiple hazards while also activating related opportunities that benefit overall community well-being. However, agencies are generally limited in their jurisdictions and authorities; for example, BCDC's authority is primarily limited to projects in the Bay and the Bay's 100-foot shoreline band, while MTC/ABAG can only seek to influence local land use planning decisions through voluntary incentive programs. Caltrans' jurisdiction is limited to their right-of-way, while the SF Bay Water Board is focused solely on water quality. These limitations may mean an agency is unable to partner on projects outside their jurisdiction that would nonetheless produce important benefits for their assets or mission. The existing process could be described as a chessboard where each agency has limited movements constrained by rules, unable to formally engage with surrounding neighbors without significant effort. This model is not structured to facilitate holistic, ecosystem-based project design and funding.

Funding & Financing

Winning competitive funding requires significant staff capacity, making it difficult for less-resourced jurisdictions and CBOs to apply.
Federal, state, and regional adaptation funding programs each have their own specific requirements, criteria, contracting processes, and timelines. Although the total amount of funding for adaptation is growing, the entire process to secure a single grant can be daunting and expensive: A successful project must identify grants, develop an initial project concept, build a coalition, identify match funding, secure executive approval, develop proposal, and receive funds – all before project execution. The level of effort this requires effectively excludes CBOs and less-resourced jurisdictions from applying. CBOs participating in the TA process have noted that a common application or bundled application can reduce some of these burdens.

Climate adaptation funding, planning, and implementation can be piecemeal.
Beyond the effort needed to seek and secure funding, project development may be based on grant availability and the programmatic requirements of funders, rather than local, ecosystem-based needs or community-driven priorities. The finite timeline for grants and funding programs may also limit continuity; for example, the Resilient Libraries Network pilot program by MTC/ABAG through BayREN has only one year to develop community centers in disadvantaged neighborhoods.

Disadvantaged communities face difficulties in competing with better-resourced communities for attention and resources.
Communities that have access to staff expertise, funds, and consultants to develop proposals are better positioned to obtain funding, remove barriers, and implement innovative projects. Communities without these assets typically lack the capacity required to identify and pursue funding. Smaller CBOs and communities also face difficulties participating in reimbursement-based grants, which would eliminate nearly all state and federal grants. A number of initiatives are underway around California and the nation to reduce these burdens, but these inequities will require sustained attention from federal, state, and regional agencies for the foreseeable future to rectify.

Funding infrastructure with the capacity needed to raise and distribute funding for adaptation at scale.
Regional agency staff noted that the Bay Area does not have the framework to deliver and successfully utilize the billions of dollars needed to meet anticipated climate adaptation challenges. Unlike the established system for transportation funding that delivers steady, predictable amounts of funding annually, the funding framework for climate adaptation has yet to achieve this level of maturity.

Building & Sustaining Capacity

Many agencies are on a year-round emergency response footing as climate-related disruptions accelerate and intensify, creating new impetus for action but also straining resources.
From severe drought and wildfires to atmospheric rivers and a pandemic, the Bay Area has experienced many disasters in recent years. The increase in hazard frequency and intensity places a strain on staff capacity and reduces the time and energy to pursue new and innovative programs. On the other hand, disasters can also inform a more resilient response. For example, the 2017 North Bay fires spurred Caltrans D4 to adopt a proactive roadside vegetation management program. This ability to learn and respond will likely become increasingly relevant as climate hazards intensify over the coming decades.

Staff capacity is strained at all levels as the pace and complexity of adaptation continues to increase.
Agencies at all levels (federal, state, regional, local) and CBOs report insufficient staff resources and adaptation expertise to adequately respond to climate adaptation and more importantly, initiate novel programs. This deficit is not in numbers alone but also in technical expertise. As a result, even when funding is available, the lack of skilled staff may hinder implementation. In some cases, more funding may resolve bottlenecks, but in others there is a lag in training and hiring staff with the right technical expertise.

The current approach to community engagement is resource-intensive for communities and agency staff.
With the well-intended goal of seeking community input throughout all phase of adaptation project development, government agencies now request multiple rounds of input from community members and Tribes on various projects and topics. At the same time, CBOs and individuals are not resourced to track many different processes, attend frequent community meetings, and submit comments on lengthy documents. As a result, CBOs and Tribes are overburdened and strained, which in turn reduces meaningful engagement. This places a strain on both agencies and community members, and the resulting engagement may be of limited utility, due to poorly timed outreach activities, mismatch of questions and local expertise, and limited participation that often does excludes members from the most disadvantaged and historically underrepresented communities.

Caltrans does not have in place currently funding mechanisms to fund via cost-share local adaptation projects off our system, outside of our right-of-way... and if there's a clear co-benefit of protecting the state transportation system by contributing funds, we just don't have that mechanism yet.

– Caltrans District 4 Interview

06 Technical Assistance

As part of its shared work plan, BARC is exploring the development of a coordinated regional climate adaptation technical assistance program to identify the most impactful ways in which regional agencies can support cities, counties, special districts, and CBOs in conducting actionable adaptation planning and project implementation.

Because climate adaptation can involve highly technical subject matter, regional and state agencies may be well-positioned to provide technical assistance and guidance. These agencies may have the requisite staff expertise, institutional knowledge, resources, and capacity that local agencies and CBOs may not. Technical assistance is especially important to build capacity and level the playing field for historically underserved communities to plan and initiate equitable, locally responsive adaptation efforts.

To identify key considerations for a regional climate adaptation technical assistance program, BayCAN led a series of engagement efforts to better understand how local agencies and communities perceive currently available technical assistance. These activities included a survey, discussions at two BayCAN network-wide quarterly meetings, and facilitated focus group sessions for local agencies, CBOs, and TA providers. Key objectives were to understand:

- Who are the key providers and recipients of technical assistance in the region?
- Does the provided assistance meet the needs of recipients, and how can it be improved to better serve local agencies and CBOs?
- What are the most desired types of technical assistance?

The findings from the engagement process are summarized here and are intended help inform future work by BARC to develop a regional climate adaptation technical assistance program that can enable and support adaptation planning at the local and sub-regional levels. The full report on technical assistance can be found in Appendix D, BayCAN's Technical Assistance Report.

Certain communities are being left behind because they don't have the resources to plan. Places that have capacity are getting the funding – then they already have [plans] in place, so they're going to get the funding for the project too. There are real risks for places that nobody's helping.

– MTC/ABAG interview

Defining Technical Assistance

Technical assistance (TA) is a broad concept that encompasses an array of services and products intended to meaningfully advance the work of recipients. For this project, technical assistance was defined as:

Services provided to help intended audiences have the knowledge, ability, or capacity to achieve specific goals and outcomes related to climate adaptation.

Based on input from the engagement process, TA generally falls into one of the categories below:

Knowledge Generalized information and guidance (e.g. best practices or case studies) to site specific technical datasets (e.g., sea level rise projections, water quality data)

Sponsorship Project participation from a trusted entity to provide additional credibility, increase visibility, improve funding opportunities, or secure community support. Sponsor roles may include serving as an advisor, task force member, or signatory.

Guidance Wayfinding and strategic guidance to resolve specific barriers and establish a path to move adaptation work forward.

Ability Information and tools that helps build planning, analysis, and technical capabilities, such as help untangling regulatory requirements that builds an organization's skills so that they can achieve specific outcomes.

Capacity Enhances recipient's staff, financial, or organizational capacity, such as through training, workshops, and assistance with grant applications, contracting, and organizing.

Critically, most of these types of TA can be provided broadly to a general audience (e.g., an online training module, workshops, or guidance document), or as direct, targeted one-on-one assistance and consulting tailored to a specific recipient and provided on request. Additionally, these components of technical assistance are not mutually exclusive and often are bundled together. Altogether, these types of TA help the recipient build credibility, scale, clarity, and efficiency as illustrated in the graphic below.

Additionally, TA can also be defined and categorized by the following characteristics:

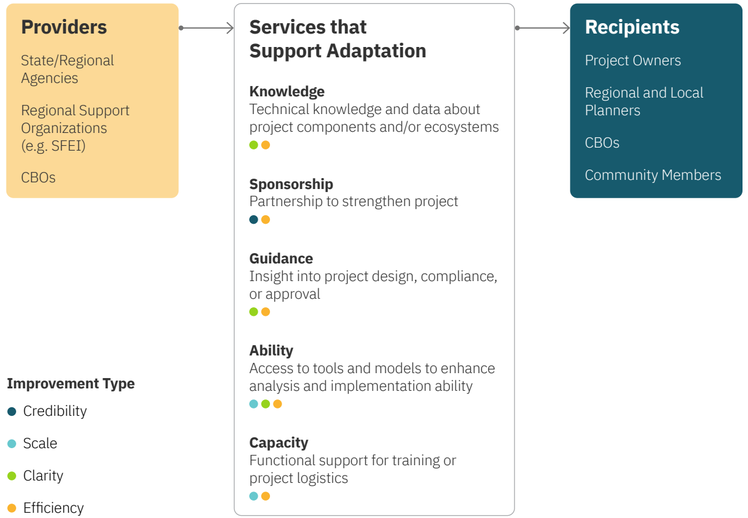
Who is the provider? TA may be provided by one agency to another agency, CBOs, or project stakeholders. CBOs and non-profit organizations also provide TA to other CBOs, agencies, project stakeholders, and community members. Much of the existing TA in the Bay Area appears to come from regional entities or regionally-focused state agencies to local government and communities.

How is it delivered? The nature of TA delivery generally falls on a scale from passive (posting materials and data on a website for general, self-directed use) to active, high-touch, tailored engagement including one-on-one discussion or support for specific planning and implementation activities. The delivery cost of TA increases significantly from passive delivery to one-on-one support, though the potential value to the recipient increases as well. A potential middle ground that still delivers significant value and engagement but for lower cost may be small workshops that address the needs of multiple participants at the same time, with opportunities for further individualized support. Workshops could be planned with the input of participants to maximize benefit.

What is the objective? TA may aim solely to support an agency-specific program or service (Figure 11), such as assistance applying for a grant program or navigating permitting requirements. TA may also aim to help recipients achieve broader adaptation goals and objectives, such as adapting to sea level rise or learning about the benefits and challenges associated with a type of adaptation solution (such as horizontal levees, for example).

What is the duration? TA may range from a single-contact interaction to answer a specific question to long-term assistance supporting the recipient to achieve an adaptation objective.

Figure 11 A model of technical assistance, showing technical assistance providers, their service types, and the recipients.



How can climate adaptation TA be improved?

Government agencies provide TA to us, but when they want guidance from CBOs, they should name what we're providing TA as well.

– CBO Focus Group Participant

What support is needed around TA to make it more useful?

Relationships, relationships, relationships... The best support comes down to building and sustaining relationships.

– Local Agency Focus Group Participant

Findings and Emerging Themes

BayCAN's survey and engagement process identified multiple findings and observations around the status of available TA, highlighting the complexity of providing assistance to a highly diverse stakeholder group across a large geographic area in a format that is both accessible and useful. It should be caveated that the survey response was small (n=69), and the results are not scientific. Nonetheless, participants included representatives from key government agencies, CBOs, and TA providers, and their responses and recommendations are helpful to further inform the next steps involved in developing a TA program. Further development will necessarily involve delving further into these subjects with an expanded set of stakeholders. High-level themes from both the survey and the focus groups are summarized here:

- **One-on-one / high-touch technical assistance is a highly valuable and in-demand form of TA.** Many participants emphasized the importance of one-on-one support because it provides a tailored response to specific project needs and questions. This high-touch engagement is valuable whether the recipient is new to adaptation, or developing advanced adaptation projects and resolving complex questions. However, high-touch TA is difficult to scale for providers, whose staff may already be at capacity. Conversely, static resources such as documents in clearinghouses can be difficult to navigate or overwhelming for some recipients.

- **Demand for TA is greater than capacity to supply TA.** TA providers indicated that there was a large demand for TA that they could not meet. The most in-demand topics are governance and funding, and the most-in demand TA services are grant writing and trainings on mapping, modeling and adaptation pathways.

- **The complexity of government programs creates its own demand for TA.** State and especially federal grants are highlighted for their complex application processes, requiring substantial organizational capacity and knowledge to navigate – despite the fact that many programs state the explicit goal of encouraging applicants from under-resourced, disadvantaged communities. Grant documents, regulations, and permitting programs are often written in inaccessible, technical language, and even applications to access TA can be demanding to complete successfully. This complexity creates a need for TA to help stakeholders navigate resources, interpret requirements, assemble applications, and access TA itself. The demand for TA to navigate government programs will likely continue to grow as adaptation programs scale up over coming decades.

Some CBOs, in particular, perceive TA as a bandage for a broken system, noting that federal grants are too overwhelming even with TA. CBOs suggest that an overhaul of the grant application system is needed to reduce barriers; until then, they recognize an essential need for TA for grant writing, reporting, and invoicing.

Key Challenges

There is still work to do to build trust between TA providers and CBOs.
Many TA providers indicate they integrate equity by prioritizing TA to underserved communities or CBOs, modifying TA to meet the needs of communities, or offering low- or no-cost services. However, the CBOs who participated in the stakeholder engagement process stated that they have low trust in regional agency TA and prefer to seek assistance from other CBOs first, and that existing TA is difficult to access.

CBO participants recommend that TA providers partner with CBOs to implement TA, train CBOs new to the climate space, dialogue more with CBOs, and recognize the expertise of CBOs. The value of plain language, one-on-one conversations, and peer-to-peer learning sessions was also noted. Local governments were also interested in TA for developing governance models that would enable better collaboration with CBOs.

There is demand for more tailored TA to fit the needs of specific audiences.
Many respondents note that existing TA does not fit their needs. The TA may be too technical and jargon-filled for less advanced recipients or it may be too general for more sophisticated stakeholders. Similarly, TA may provide examples that are too granular to be transferrable to other projects or may represent a large geography and be difficult to downscale for local needs. The breadth of these comments indicate that there is an opportunity to better tailor TA offerings for various audiences to make them more timely, useful, and accessible. This effort may also reduce the demand for individualized one-on-one support.

The complexity of adaptation programs can be a challenge for TA providers as well as recipients.
The complexity and volume of adaptation activity makes it difficult for TA providers to stay fully updated, informed, and coordinated, especially about cross-hazard opportunities. This challenge can further complicate potential recipients' search for clear, accurate, locally specific information. In an ideal world, the stakeholder will be able to find all information needed from a small number of providers. In reality, they may be passed from one provider to the next and need to make their own judgements about which is the most accurate and pertinent information for their project.

Informal relationship-building and convenings provide valuable connections.
Many recipients noted the most effective TA came through trusted relationships and knowing who to call. Relationship-building through collaboratives and networks can help recipients find and access needed assistance, including targeted, one-on-one support. However, this type of TA access is by nature limited in reach. Suggestions for a more open network include establishing a bench of TA providers, listservs, or other more formalized way to connect TA recipients to the right contacts and resources.

Existing TA may be difficult to access.
CBOs participating in the engagement process noted that they were not familiar with existing TA offerings, suggesting that providers may need to improve outreach to CBOs. Other respondents said that limited capacity and resource challenges limit their ability to identify and access TA. Organizations that are fully consumed managing day-to-day work may simply not have sufficient time to identify, pursue, and fully utilize TA. Staff turnover, especially at smaller organizations, can further compound this challenge through the loss of knowledge.

Existing TA does not cover all hazards.
In the Bay Area, the quantity of regionally provided TA varies significantly by hazard, with coastal flooding and sea level rise having the most support available, and drought and extreme heat having the least. Potential recipients may need to expend additional effort to identify and access federal, state (including other states), or local sources of information, and may not be able to obtain the assistance needed. A broad search for TA may also put more burden on the recipient to assess the quality and relevance of resources for their project.

Potential Follow-Up Activities

The findings and observations on the existing landscape of TA can inform and improve new or existing TA offerings by regional and local agencies. In particular, the following recommendations may help to increase TA effectiveness:

1

Distinguish the audiences and objectives of technical assistance

Being more purposeful about the goals of the TA, its targeted audiences, and topics can lead to more focused TA that will be more useful to recipients. For the example, the type of TA needed by CBOs will likely be different from that needed by local governments, and differ further based on the specific project, hazard, or geography of concern. This intentional approach can be applied to in-person workshops, trainings, webinars, websites, tools, and other resources.

2

Identify and seek to streamline especially complex or confusing elements of standard government processes, including permitting and grant applications.

Many respondents noted that the inherent complexity of regulations, grant programs, and other requirements generates a significant need for navigational guidance and support. Some of the need for TA could be eliminated if this underlying complexity was reduced, through simplifying regulatory language, developing a common application for grants, and other recommendations offered by CBOs. Working with TA recipients to identify and simplify these especially challenging elements may facilitate adaptation and support more equitable processes.

3

Measure and monitor TA effectiveness.

A quantitative and qualitative framework to track and understand the cost, objective, and impact of TA materials and activities may accelerate the effort to simplify and target TA to achieve successful outcomes. Develop a feedback loop with recipients to keep TA relevant, useful, and responsive to needs.

07
Conclusion

Across the Bay Area, there is an urgent need for adaptation to the impacts of climate change. The Bay Area's regional agencies have already mobilized to address some hazards, but gaps remain in the existing system of adaptation activity. A regional multi-hazard adaptation plan may offer an opportunity to further improve the speed and scale of adaptation activities and better serve the region's interconnected communities and ecosystems. This approach can also support coordination and collaboration across the region while facilitating and supporting sub-regional, local, and community-driven initiatives within a broader, holistic framework. Critically, a regional approach can align efforts, avoiding duplication and unintended consequences, while progressing toward a shared strategy and vision for a climate-resilient Bay Area. As BARC and its member agencies explore a regional adaptation plan and technical assistance program, this report can inform considerations around their framing, objectives, strategies, approach, and content.

This report documents the existing roles of BARC's member agencies in climate adaptation. It represents both a snapshot in time and the beginning of further conversations and outreach that will ultimately inform new regional initiatives on climate adaptation. The report lays the groundwork to support and inform regional agencies as they work together to explore a regional-scale approach to adaptation. As they do so, some key questions BARC and its member agencies and stakeholders can consider in their exploration of a regional multi-hazard adaptation plan include:

What should the role of BARC member agencies be in addressing each climate hazard?
For which hazards is more regional presence useful and where is state or local engagement most effective? What role should individual agencies play in activities such as offering technical assistance, funding and financing support, cross-jurisdictional coordination, research and evaluation, and regulatory guidance?

What should the role of BARC member agencies be in addressing the pressing need for adaptation funding?
Regional agencies have historically played a role in administering funding sources for transportation, environmental, and other regional goals. What should their role be in expanding funding for adaptation, and ensuring equitable distribution of funds?

What changes might be required for BARC member agencies to fulfill needed regional roles?
As agencies identify appropriate roles, changes may be required such as legislation to expand agency authority, increased funding and staff, and/or creation of a new organization under a parent member agency.

How can BARC member agencies help improve resource-intensive processes like community engagement and technical assistance?
Stakeholders identified that the current approach to community engagement creates burdens on communities, CBOs, and agency staff, while there is a need for more tailored and individualized technical assistance. How can the region facilitate improved processes to meaningfully support communities and CBOs?

How should responsibility for technical assistance be distributed?
What will each agency's role be in the RTAP? How will agencies work together with CBOs and other technical assistance providers?

How can BARC member agencies systematically evaluate and track adaptation efforts?
How will the agencies monitor – and improve - the outcomes of their activities over time?

Appendices

APPENDIX A

Links to Agency Maps

MTC/ABAG

MTC/ABAG – San Francisco Estuary Program

BAAQMD

BCDC

Caltrans D4

State Coastal Conservancy

San Francisco Bay Water Board

APPENDIX B

Hazard-Specific Gaps and Opportunities

Our interviews with BARC member agencies, state, and federal agencies asked participants to identify what they perceived as the core gaps and challenges for the climate hazards they actively address, and for climate adaptation as a whole in the Bay Area. These observations can offer valuable insight into the existing landscape of adaptation activities and the priority challenges, gaps, and opportunities for each climate hazard. For drought and inland flooding, which did not emerge as a focus topic during the interviews, the gaps and hazards are supplemented by desktop research; for all other hazards, the primary sources are the agency interviews.

Sea Level Rise and Coastal Flooding

The multiple programs and projects addressing coastal flooding in the Bay Area represent significant progress in adaptation activity. However, agencies still spoke to remaining gaps and opportunities:

Funding
While adaptation funding has increased in recent years, funding levels still remain far below what is needed for multiple large capital projects, such as the levees, elevating infrastructure, and extensive habitat restoration (nature-based solutions) necessary to address coastal flooding. The Sea Level Rise Adaptation Funding and Investment Framework notes that hundreds of miles of Bay Area shoreline remain in need of adaptation and protection, and a preliminary analysis estimated that the region needed $76 to $152 billion to cover the cost of sea level rise adaptation through 2050[10].

A need for regional leadership in cross-jurisdictional planning
A few multi-agency collaborations have begun to plan and implement sea level rise adaptation projects that cross jurisdictional boundaries, but similar efforts have yet to emerge – and mature – all along the Bay shoreline. BARC member agencies see a critical need for regional leadership on cross-jurisdictional planning given the nature of sea level rise: Coastal adaptation strategies undertaken in one location can worsen flooding in another location, if not designed carefully. Further, the scale of subregional adaptation planning required to meet the challenge of coastal flooding will require navigating land use planning and approvals between multiple jurisdictions. Hence, agencies noted that there is a clear need for a regional role to understand commonalities and consequences on a broader scale, set shared standards, provide linkages and connections between stakeholders, and provide uniform technical guidance. The regional approach is also seen as necessary to make sure that habitats and ecologies are not excluded or ignored by adaptation projects, due to the lack of economic incentives for their protection.

Lack of guidance for nature-based solutions
Adaptation plans often recommend or prioritize nature-based solutions, but the lack of technical and design guidance and expertise make them a nebulous concept and difficult to implement. While agencies like SCC and SFEP are funding pilots, there are not enough. Agencies also expressed concern that some nature-based solutions involve elements (e.g., Bay fill) that directly go against existing agency requirements or legislation (e.g., Endangered Species Act). For example, projects that propose Bay fill to restore habitats are required to undertake corresponding mitigation, which may be so expensive that it renders a potential nature-based sea-level rise project infeasible.

Complex permitting processes
Sea level rise projects in the Bay, especially those deploying nature-based solutions, are also subject to complex permitting approvals. Agencies noted that navigating this permitting process required expertise, coordination, and leadership. While the Bay Restoration Regulatory Integration Team (BRRIT) was formed by permitting agencies, including BCDC and the SF Bay Water Board, to provide guidance and review on potential regulatory roadblocks for projects, BRRIT only assists multi-benefit wetland restoration projects that qualify for funding from the SF Bay Restoration Authority (SFBRA). To help the full range of sea level rise adaptation projects advance to the scale needed, BRRIT may need to be expanded or replicated.

Under-resourced jurisdictions need expertise and support
BARC member agencies noted that better regional coordination is necessary to make sure that communities are not left behind; currently, significant swathes of the Bay shoreline, particularly in less-resourced jurisdictions like Contra Costa County, remain without adaptation plans or implementation projects. Notably, BCDC was identified as one way to close gaps in expertise and capacity for jurisdictions.

[10] https://mtcdrive.app.box.com/s/bm7kiyylcnqyz0k2t9pvrhjdfxzy5qc1 see slide at 18:36

Riverine and Inland Flooding

Few of our regional, state, or federal agency interviews explicitly touched on challenges with or plans to address inland flooding when asked about the climate hazards they focus on. Existing plans and documents often treat flooding as one general category with no distinction between separate risks posed by storms and sea level rise, while hazards such as wildfire and drought received more attention than inland flooding. In an interview, FEMA staff noted that inland flooding may be generally under-addressed even beyond the Bay Area: the western region of the US, they observed, had more activities addressing heat, drought, and sea level rise, compared to more activity addressing flooding in the east. The gaps and opportunities noted either by agencies or in literature pertaining to flooding in the Bay Area include:

Funding
With the assistance of federal agencies including USACE, local agencies have been working on solutions to prevent future flooding, but many lack the funds for huge infrastructure upgrades. East Palo Alto, for example, has been working with the San Francisquito Creek Joint Powers Authority to reduce flood risk along the creek channel. The first stage of a multi-part creek restoration effort helped reduce flood damage during the winter storms in 2023, but finishing the entire restoration project requires at least $50 million more and may not be financially feasible, leaving the city continuously vulnerable.[11]

Lack of data and research on new risks
MTC pointed out that large data gaps remain that have delayed efforts to address riverine and inland flooding. One example of this is groundwater rise, which the San Francisco Bay Water Board and BCDC both noted was rapidly becoming a clear, yet under-addressed concern due to lack of information and awareness. Similarly, Caltrans D4 noted there is a need for focused hydrological studies and expertise to understand culvert upscaling needs and design changes.

Limited jurisdiction even when an agency is interested in addressing the issue
BCDC noted that their jurisdiction was restricted to flooding as related to tides, despite their concerns about groundwater rise and riverine flooding. While BCDC could potentially address cases where coastal and inland flooding combine, the agency's mandate requires them to focus on issues that directly touch the Bay.

Need for a comprehensive, proactive action plan to build resilience
Caltrans D4 described how the emergency-driven nature of their highway repairs after the 2023 winter storms pointed to a lack of planning or initiatives that pre-empted flood damage. However, the agency suggested that similar piecemeal responses to wildfire emergencies in the past resulted in lessons learned that transformed into a partnership with CalFire and a clear coordinated action plan to reduce wildfire risk, and that a similar process might unfold for storms and inland flooding.

Water Quality

Gaps related to water quality include:

Lack of staff and funding capacity
Agencies indicated that efforts to prevent impacts to water quality were constrained by lack of staff and limited funding.

Need for continued data and research
Issues such as groundwater rise and eutrophication require more research to understand the risks and to inform preventative strategies. Agencies also identified the need for more research on wildfire impacts on water supply and water quality, such as through contamination from debris, toxins, firefighting chemicals, and fire damage to infrastructure itself.

Siloed decision-making between land use and water management
The San Francisco Bay Regional Water Board noted that there was a lack of coordination between land use planning and water management and a more holistic strategy to account for how land use impacts water quality and vice versa was necessary. The status quo requires agencies with limited authority to react to changes or decisions from other parties.

Need for additional technical assistance
Local entities need more technical assistance to be prepared for funding, guidance, and collaborative opportunities from regional water boards.

[11] https://www.npr.org/2023/02/10/1155558812/after-january-storms-some-california-communities-look-for-long-term-flood-soluti

Drought

During the research process for this project, BARC member agencies did not explicitly name drought as a gap in regional adaptation activity. California's recent severe drought means that state agencies have issued significant regulations, mandates, and guidance regarding drought. For example, the Governor has proclaimed multiple drought state of emergencies in California that have led to water conservation emergency regulations, including prohibitions on outdoor water, street cleaning, and other residential uses.[12] The State Water Resources Control Board and California Public Utilities Commission have also developed a platform to streamline drought-related data from public water systems.[13] Thus, the existence of statewide drought mandates and strategy is a key difference compared to hazards such as sea level rise. From our review of existing documents and plans focused on addressing drought, potential challenges observed at a high level include:

Balancing water supply between multiple needs
For example, State Water Resources Control Board's proposed amendments to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan) include the recommendation to increase water flows in the tributaries of the Delta to support ecosystems and habitat health. If implemented, this will affect water supply and water availability for Bay Area water agencies and increase their vulnerability to drought. Resolving the tension between water quality, ecosystem health, agricultural, and residential uses will be an ongoing challenge as California is likely to see reduced water supply from all current sources, including snowpack, surface water, and groundwater.

Split authority between water agencies and retail utilities, whether public or private
Water agencies such as BAWSCA, Sonoma Water, and Valley Water are responsible for long-term water supply and reliability planning but do not have authority over water demand on the retail end, e.g., through water use restrictions. Their only means is through voluntary reduction programs such as rebates for more water-efficient appliances. The authority to reduce water demand lies with retail utility districts and retail companies, who can implement mandatory water use restrictions (e.g., bans on landscape watering), set drought-related surcharges and rates, and are responsible for meeting state-mandated water reduction targets. This split authority may impact an effective plan for long-term water reliability, if water agencies have no influence over demand. In addition, the high number of retail water systems may complicate drought-related implementation, enforcement, target monitoring, and coordination.

Lack of regulatory guidance to help balance water extremes
As the Bay Area, and California as a while, is likely to continue experience cycles of severe droughts and intense rainfall, more technical and regulatory guidance is needed to help balance water supply between these extremes. Improved guidance and programs around water storage, stormwater storage, and aquifer recharge can help reduce flood risk while increasing water reliability and water supply during drier periods. Additional infrastructure, mobilization, and changes in regulation can facilitate more stormwater storage.[14] Stormwater diversion could also keep dams, currently at risk of failing during extreme rainfall events, from being overwhelmed.[15] DWR recently allocated grants to counties and municipal water districts for groundwater recharge, while the Governor and State Water Resources Control Board eased restrictions in March 2023 to facilitate groundwater recharge from stormwater that otherwise would have flowed into the San Joaquin River.[16] [17] As the Bay Area sources much of its water from upstream areas, additional guidance and policymaking in this area can enable the region to explore local water storage opportunities and increase its overall water resilience.

[12] https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/regs/emergency_regulation.html

[13] https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/clearinghouse_drought_conservation_reporting.html

[14] https://www.nytimes.com/2023/02/21/climate/california-storms-groundwater-aquifer-recharge.html

[15] https://www.nytimes.com/2023/06/22/magazine/california-dams.html

[16] https://www.gov.ca.gov/2023/06/08/california-announces-288-million-for-drought-and-flood-projects/

[17] https://www.gov.ca.gov/2023/03/13/icymi-flush-with-rain-california-plans-to-replenish-drought-depleted-groundwater-with-floodwaters/

Extreme Heat

From review of existing planning and documents focused on adaptation, input from a few regional agencies, and interviews with state agencies, potential challenges observed at a high level include:

Narrow jurisdiction or lack of resources at regional agencies
Staff from multiple agencies noted that while they'd like to work more on extreme heat issues, narrow regulatory authorities, lack of funding, and lack of staff with heat expertise restricted their ability to address extreme heat.

A regional heat plan may consolidate resources and support coordinated heat response across localities
CDPH observed that heat plans are currently developed on a voluntary basis by local health departments, so that no two heat plans are alike in content and focus. CDPH also noted the potential benefit of a regional heat plan to coordinate more efficient and comprehensive local responses. A recent UC Berkeley workshop on extreme heat and health[18] which convened some 70 Bay Area cities, counties, CBOs, non-profit groups, and academia, also identified a regional heat plan as a regional need that can consolidate resources rather than reinventing the wheel in each jurisdiction.

Lack of resources and best practices for protecting especially vulnerable communities
The UC Berkeley workshop also noted that more work needed to be done to identify vulnerable communities and strategies to alleviate heat impacts. Additionally, more resources needed to be deployed to help the unhoused and outdoor workers, evaluate the cost-efficiency of different cooling strategies, and identify best practices for cooling centers.

[18] https://bccn.berkeley.edu/resources

Lack of general staff capacity and resources
More resources are necessary to provide training and expertise to agencies that can make investments in addressing extreme heat, as well as for capital investments such as cool building materials (e.g., cool roofs) and cool school yards.

A community-led approach for extreme heat resilience
CDPH noted that a community-based approach to addressing extreme heat may be more effective at supporting resilience, through trusted organizations, neighbors, and mutual-aid networks checking in on each other during heat events. This approach has the benefit of overcoming some of the barriers associated with government-run cooling solutions, such as lack of trust, and can focus on the most vulnerable or socially isolated community members. However, community members and organizations much be resourced to perform these roles and responsibilities.

Wildfire and Air Quality

While important work is being done to prevent wildfires and alleviate the impacts of wildfire smoke and other climate impacts to air quality, we heard from many interviewees that more needs to be done. The gaps and opportunities identified for addressing wildfire in the region include:

Need for a regional plan to address wildfire
MTC and ABAG staff pointed out that regional hazard planning and coordination for wildfire was a clear gap, while the San Francisco Bay Water Board noted the need for cross-hazard, regional coordination to address how post-fire chemicals impact water quality. While Caltrans D4 staff reported that their approach to wildfire had shifted from being emergency-activated to proactive vegetation management, they noted a need for further planning, especially since priorities between hazards often seem to shift on an annual basis depending on major events and local agencies' needs.

Need for wildfire-specific workforce development
CalOES and CalFire staff described extensive engagement with local agencies, but saw a gap in workforce and workforce development to adequately address the extent of wildfire risk. CalOES noted that staff were often burned out when facing year-round emergencies and natural disasters, including multiple large-scale fires. Meanwhile, CalFire pointed out that its most significant shortage is trained foresters, not funding; the current number of available foresters is far from enough to accomplish all forest management projects needed to reduce wildfire risk.

Need for additional protections for vulnerable workers
CDPH and CalOSHA staff described the need for further protections for workers, especially outdoor agricultural and construction workers. The agencies described the need for a system similar to the one currently employed to address extreme heat, including guidance for employers to minimize work during smoke events, and inspections to evaluate employee protections against wildfire and smoke threats.

There's a strategy dedicated to sea level rise, but when it comes to wildfire, it's all small elements... there is no comprehensive strategy to address wildfire... there is no regional perspective on that.

APPENDIX C

Sea Level Rise Activity Snapshots

Due to the high level of collaborations and programs on sea level rise in the Bay Area, three focused snapshots for specific projects and activities around sea level rise have been developed here. These snapshots illustrate the active agencies, roles, funding relationships, and partnerships working in nature-based solutions for sea level rise, the SFBRA, and Resilient SR 37.

SNAPSHOT
Nature-Based Solutions for Sea Level Rise

Nature-based solutions to coastal flooding may be one of the most popular topics related to sea level rise adaptation in the Bay Area, while also remaining one of the more uncertain due to a lack of technical guidance, test cases, and evidence-based research. Figure 3, on page 24, illustrates just how many stakeholders, including BARC members and their state and federal partners, are actively engaged on nature-based solutions.

Efforts can be divided into two categories 1) to advance regional understanding of the challenges and options, and 2) to support project-specific implementation. Regional understanding describes the planning, modeling, guidance, and other activities that are needed develop strategies, collect regionally relevant data, and collate best practices. Project-specific activities include permitting, funding, technical design, and construction – all work on the ground. Many of the BARC member agencies actively support both components.

This map also illustrates the role of the BRRIT, a cross-agency permitting team supported by the SCC and the SFBRA to provides a more streamlined permitting path for multi-benefit habitat restoration projects and associated flood management and public access infrastructure in SF Bay. Initiated in 2019, the BRRIT includes staff from six of the state and federal agencies that have jurisdiction over habitat restoration projects in the Bay, including the SF Bay Water Board and BCDC. For projects related to wetland restoration, and funded by the SFBRA, BRRIT provides consultation, review, and guidance early in the project initiation and planning process to enable a more efficient permitting process.

SNAPSHOT
San Francisco Bay Restoration Authority

The San Francisco Bay Restoration Authority (SFBRA) is a regional agency created by the State Legislature in 2008 to fund shoreline projects that will protect, restore, and enhance San Francisco Bay. It is funded by the Measure AA parcel tax, notable as one of the first voter-approved climate adaptation funding measures in the US. Passed by voters in all nine Bay Area counties in 2016, Measure AA levies a $12 parcel tax over 20 years, from 2017 to 2037. The Authority distributes approximately $25 million each year for projects that protect and restore San Francisco Bay, protect communities from floods, and increase shoreline access; this can also include non-adaptation-related components such as reducing pollution and increasing water quality. Supporters of the SFBRA intend to place another funding measure on the ballot several years prior to the 2037 sunset of Measure AA.

The map for the SFBRA on the next page (Figure 12), illustrates a number of characteristics. SFBRA currently manages a single source of funds (Measure AA), although it has the ability to and intends to raise funds in multiple ways. This single-purpose method of fund distribution is frequently used both within California and by federal agencies. This approach puts the burden on project stakeholders to discover, investigate, and apply for multiple funding sources to piece together sufficient funding to accomplish their projects. Second, the common structure of a governing board, oversight committee, and advisory group implemented at SFBRA illustrates the number of stakeholders engaged to distribute funds and ensure that they are spent fairly and for the best purpose. While the work of these groups is not necessarily time-intensive (e.g., it meets four times annually), it still demands staff time, capacity, and focus, and requires coordination for meeting logistics, communications, and responsibilities.

Third, the $25 million of funding distributed each year is divided between a general grant program and a restricted program offering funds for CBOs representing economically disadvantaged communities. This is one of many initiatives around the Bay Area to support capacity building, community participation, and project implementation for those with fewer resources. Finally, BARC members serve as advisors and provide staff and leadership to SFBRA. This example simultaneously shows the benefits of collaboration, as it brings in the expertise of SCC and SFEP staff, and the challenges of scaling similar adaptation funding mechanisms by an order of magnitude or more, with this level of complexity in place to distribute a relatively modest $25 million a year.

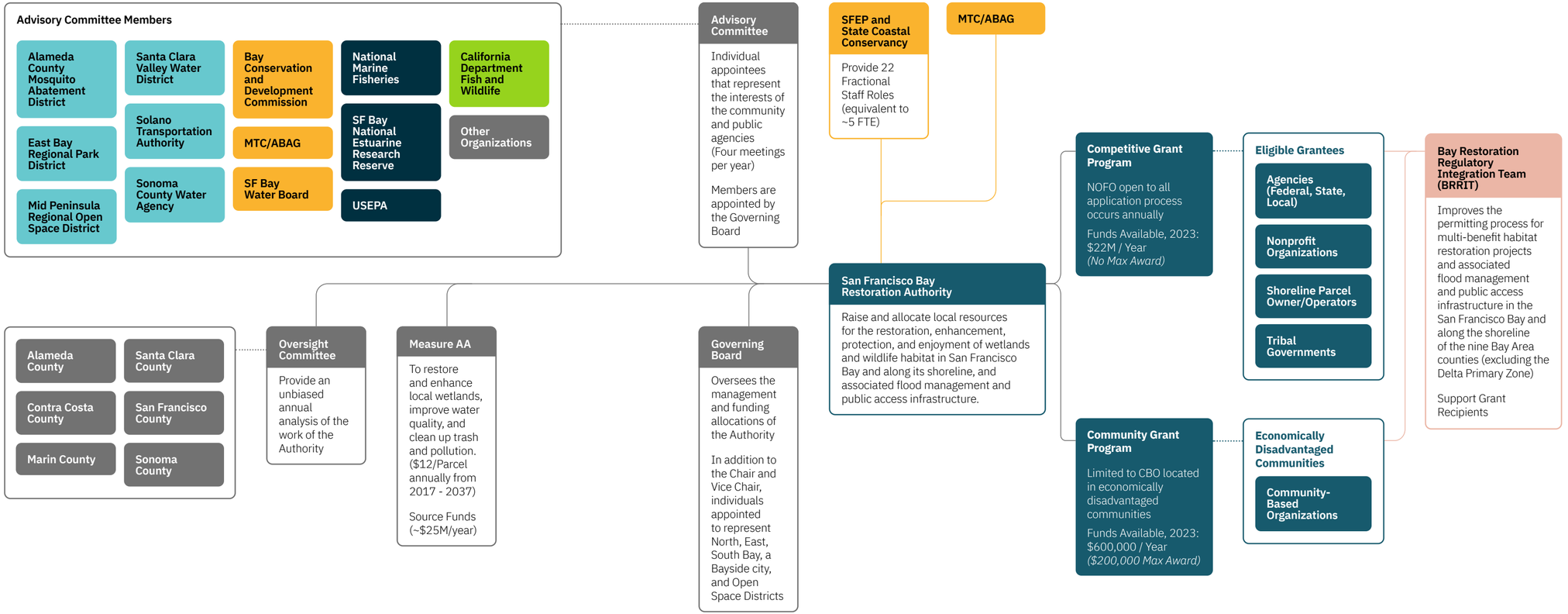
MAP San Francisco Bay Restoration Authority

Figure 12 This systems map illustrates the governance, staffing, and fund distribution mechanisms of the San Francisco Bay Restoration Authority, further described above

Legend

Stakeholder
Activity

- BARC Member
- Federal
- State
- Regional
- Support
- Other
- Outcome



SNAPSHOT

Resilient State Route 37 and San Pablo Bay Enhancement

The State Route (SR) 37 corridor connecting Vallejo in Solano County to Novato in Marin County faces numerous interrelated concerns about its long-term viability. The highway already experiences storm-related flooding and is predicted to become fully submerged due to sea level rise. SR 37 also serves many commuters and experiences significant congestion and delays. In 2015, the four counties (Solano, Napa, Sonoma, and Marin) served by SR 37 signed a memorandum of understanding (MOU) to work together on a strategy to increase the resilience of this critical corridor. In 2019, MTC and Caltrans D4 also signed an MOU to foster increased cooperation and provide support for the Resilient SR 37 program, as it is now called. Most recently, both MTC and Caltrans have led significant outreach efforts to local and regional governmental and transportation agencies, environmental organizations, the public, and other stakeholders in planning for SR 37 improvements.

These planning efforts focus on a 21-mile stretch of SR 37 that extends along the north edge of San Pablo Bay. The highway crosses the San Pablo Baylands, an important wetland ecosystem providing food and refuge to millions of waterfowl passing through each year.[19] From an adaptation and systems perspective, the SR 37 activities illustrate the complexity of simultaneously pursuing two significant initiatives around transportation resilience and ecological restoration within an ecologically complex system. The project requires collaboration between regional- and county-level transportation stakeholders and habitat-focused stakeholders, which have coalesced as the SR 37-Baylands Group to ensure that any redesign of SR 37 is compatible with and advances ecological and conservation goals for the San Pablo Baylands.

This map in Figure 13 shows how BARC member agencies are engaged throughout the process as project owners, planners, facilitators, and regulators. MTC and Caltrans D4 have played significant roles as leaders and funders in the program. BARC itself was involved in the SR 37-Resilient by Design Bay Area Challenge and a subsequent Public Access Scoping Report, which explores SR 37's role as a vital east-west corridor for communities that are not served by public transportation. BARC remains engaged in the project to support public recreation opportunities that balance access and protection of sensitive habitats.

This example also illustrates the need for integrated planning for projects derived from different authorities (transportation and ecosystem restoration) where each decision will have costs and benefits on both sides of the equation, and the ideal solution should maximize benefits across stakeholders to the greatest extent possible. While agency authorities have shared interests, they must often constrict project activities to specific contexts and geographies – for example, Caltrans has noted its difficulties in funding wetland restoration projects outside of its right-of-way, even though it may provide significant protection to highway infrastructure. In addition, the SR 37-Baylands Group's diverse membership illustrates the many stakeholder perspectives involved in a project of this scale, including public access, migratory bird protections, open space stewardship, equity, and more.

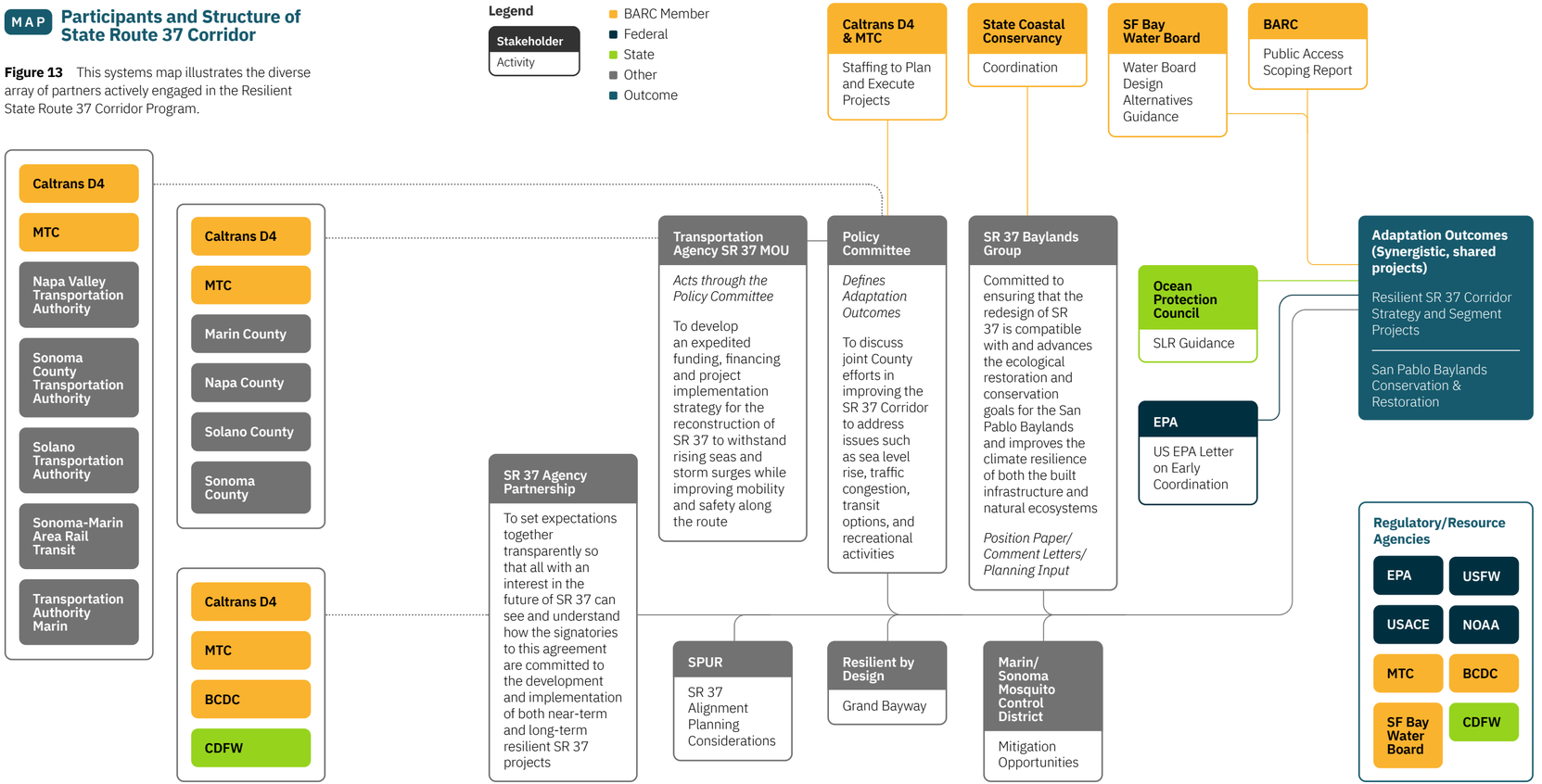
While the SR 37 redesign project has been highlighted as a positive example of stakeholders coming together to work toward a shared goal, it also underscores the amount of energy, coordination, and time required to move these substantial projects forward collaboratively. The future will likely bring many more large projects like this to the Bay Area to address climate hazards.

[19] https://scc.ca.gov/climate-change/climate-change-projects/highway37/

MAP

Participants and Structure of State Route 37 Corridor

Figure 13 This systems map illustrates the diverse array of partners actively engaged in the Resilient State Route 37 Corridor Program.



APPENDIX D

Technical Assistance Report

Acknowledgments

Throughout this research process, many people contributed their time and insights, including BARC member agency staff, state and federal agencies from the Bay Area region and beyond, and BayCAN members and affiliates. Without them, this report would not be possible. In particular, we deeply appreciate agency staff who took time to speak with us about adaptation activity across the region, and the numerous agencies and organizations who participated in the technical assistance-focused stakeholder engagement. All these conversations contributed invaluable perspectives to this report. The work described here marks only the beginning of conversations that will continue to support a robust response to climate hazards, including conversations between communities and CBOs, between agencies at different levels, between governments and their constituents, and many more.

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