ENHANCING WILDFIRE HAZARD MITIGATION IN LOCAL COASTAL PROGRAMS: IMPROVING THE CALIFORNIA COASTAL COMMISSION'S GUIDANCE FOR THE WILDLAND-URBAN INTERFACE AND COASTAL ZONE.

A Project

Presented to the

Faculty of

California Polytechnic University, Pomona

In Moderate Fulfillment

Of the Requirements for the Degree

Master

In

Urban & Regional Planning

By

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2025

COMMITTEE MEMBERSHIP

PROJECT: ENHANCING WILDFIRE HAZARD MITIGATION IN LOCAL COASTAL PROGRAMS: IMPROVING THE CALIFORNIA COASTAL COMMISSION'S GUIDANCE FOR THE WILDLAND-URBAN INTERFACE AND COASTAL ZONE

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ACKNOWLEDGEMENTS

I would like to acknowledge my committee chair, Dr. Nicole Lambrou for her guidance and support. I want to acknowledge Professor Richard Belmudez for his willingness to give of his time to support me on this project. I thank my family, specifically Judith, my wife, who helped provide encouragement throughout this degree. I thank Amber Dobson for her time and support in completing this project.

ABSTRACT

Wildfires increasingly threaten California's coastal communities due to climate change and expansion into the Wildland–Urban Interface (WUI). This study examines how the California Coastal Commission (CCC) can strengthen its wildfire hazard mitigation guidance for Local Coastal Programs (LCPs). Using a qualitative case study approach, the wildfire readiness of Laguna Beach, Malibu, and Santa Cruz was evaluated through the Fire Adapted Communities (FAC) framework. Laguna Beach demonstrated strong integration of wildfire mitigation strategies, earning a "Highly Fire Adapted" score (27/30), while Malibu and Santa Cruz scored lower (15/30), revealing significant gaps in wildfire adaptation. Key findings highlight inconsistent wildfire mitigation standards across jurisdictions. The study concludes that CCC wildfire guidance must be updated to include enforceable standards, coordination with Cal Fire, and planning for post-fire recovery. Strengthening wildfire mitigation in LCPs is essential to improving resilience in California's coastal WUI communities.

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EXECUTIVE SUMMARY

California's coastal regions are facing an increasing threat from wildfires, a hazard historically perceived as isolated to inland and forested areas. Driven by climate change, development pressures, and ecological shifts, wildfires now present a significant risk to communities within the state's Coastal Zone. This project, *Enhancing Wildfire Hazard Mitigation in Local Coastal Programs: Improving the California Coastal Commission's Guidance for the Wildland-Urban Interface and Coastal Zone*, addresses the research question: "How can the California Coastal Commission improve its wildfire hazard mitigation guidance for Local Coastal Programs to better protect communities located within the WUI and Coastal Zone?" It examines the gaps in wildfire mitigation within the Local Coastal Programs (LCPs) of three cities, as comparative case studies, and proposes recommendations to strengthen coastal wildfire resilience through improved California Coastal Commission (CCC) guidance.

The research was motivated by a clear need: the CCC's regulatory framework includes robust protections for hazards such as sea-level rise and coastal erosion, yet offers limited and fragmented guidance for addressing wildfire risks. As the Wildland-Urban Interface (WUI) increasingly overlaps with the Coastal Zone, a more integrated and proactive planning response is essential. The primary objective of this project was to assess current LCP practices and develop policy enhancements to better safeguard lives, property, and coastal resources from wildfire threats.

Using a qualitative comparative case study approach, the project evaluated the City of Laguna Beach, the City of Malibu, and the City of Santa Cruz. These jurisdictions were

selected based on several criteria, including their location within the Coastal Zone, significant WUI presence, recent wildfire impacts, and implementation of post-fire mitigation efforts. Each city's LCP was systematically reviewed using the Fire Adapted Communities (FAC) framework, a nationally recognized model that emphasizes comprehensive strategies for community preparedness, mitigation, and resilience for wildfire threats.

The FAC evaluation revealed considerable variability in wildfire resilience across the three jurisdictions. Laguna Beach demonstrated strong wildfire mitigation integration, marked by aggressive vegetation management, strict defensible space regulations, detailed evacuation planning, and robust interagency collaboration. As a result, Laguna Beach earned a “Highly Fire Adapted” rating, scoring 27 out of 30 FAC points. In contrast, Malibu exhibited significant weaknesses, particularly in emergency planning, public education, and post-fire recovery. Despite the lessons of the 2018 Woolsey Fire, Malibu’s LCP only Moderately incorporated fire-adapted principles and received a “Low Adaptation” rating, scoring 15 out of 30 FAC points. Santa Cruz showed incorporation of some wildfire mitigation strategies, including hazard mapping and emergency coordination; however, it lacked comprehensive vegetation management and recovery frameworks. Santa Cruz also fell within the “Low Adaptation” range, earning 15 out of 30 FAC points.

Several key patterns emerged across the three jurisdictions. Post-wildfire reforms varied significantly in scope and depth, often motivated more by immediate recovery efforts than by long-term resilience planning. In addition, the jurisdictions failed to adequately

integrate climate change considerations into their respective wildfire hazard planning, and coordination among regulatory agencies remained fragmented and inconsistent.

The project concludes that the CCC's existing wildfire guidance for LCPs is insufficient given the intensifying wildfire threat along the coast. Unlike Cal Fire's mandated General Plan Safety Element requirements, the CCC's policies lack specificity, leaving local jurisdictions without clear standards to follow. This results in uneven implementation and persistent vulnerabilities across the Coastal Zone.

To address these issues, the project recommends that the California Coastal Commission adopt several key measures: develop mandatory wildfire mitigation standards for LCPs; require the integration of future climate risk projections into wildfire planning; strengthen post-fire recovery planning within LCPs; and enhance coordination with Cal Fire and local fire agencies to ensure more consistent and effective implementation of wildfire resilience measures.

The study's limitations include its narrow focus on only three jurisdictions and its reliance primarily on planning document analysis, rather than stakeholder interviews or on-the-ground assessments. Future research should broaden the scope of case studies, incorporate community and agency perspectives, and utilize dynamic wildfire modeling to better understand and respond to evolving wildfire risks.

Ultimately, enhancing wildfire resilience in California's Coastal Zone requires a paradigm shift. Wildfire hazards must be addressed with the same urgency and regulatory rigor as sea-level rise and coastal erosion in coastal planning. Strengthening wildfire mitigation in

Local Coastal Programs will not only protect human life and property but also help preserve the environmental integrity and economic vitality of California's iconic coast for future generations.

INTRODUCTION

In recent decades, California has experienced an alarming rise in the frequency, intensity, and destructiveness of wildfires, with profound consequences for public safety, infrastructure, ecosystems, and local economies (Keeley & Syphard, 2016; Westerling, 2018). While much attention has been paid to inland and forested regions, the growing risk of wildfire in California's coastal areas, especially those located within the Wildland-Urban Interface (WUI), demands greater scrutiny. Coastal communities, once thought to be buffered from major wildfire events by geography and climate, are increasingly vulnerable due to a confluence of factors: prolonged droughts, hotter temperatures, increased development in fire-prone areas, and wind-driven fire behavior (Syphard et al., 2017; Moritz et al., 2014). As the climate crisis intensifies, these threats are no longer exceptional but expected (California Natural Resources Agency [CNRA], 2021).

Within this context, effective planning and hazard mitigation are essential to safeguarding lives, properties, and the environment. In California, the Coastal Act of 1976 governs land use within the Coastal Zone, mandating that cities and counties prepare Local Coastal Programs (LCPs) for California Coastal Commission (CCC) certification (California Coastal Commission [CCC], 2019). LCPs are intended to reflect both local conditions and state priorities for coastal protection, including natural resource conservation, public access, and hazard mitigation. However, despite the growing urgency of wildfire threats, CCC guidance on wildfire hazard mitigation remains limited and fragmented. Unlike other hazards such as coastal erosion or sea-level rise, wildfires have not received the same level of attention or detailed policy direction in the CCC's regulatory framework (CCC,

2020). This gap is especially problematic for communities located in Wildland-Urban Interface zones and the Coastal Zone (Cal Fire, 2022).

This thesis examines how the California Coastal Commission can improve its wildfire hazard mitigation guidance for Local Coastal Programs, with the goal of reducing wildfire risk for residents living in the WUI and Coastal Zone. This research explores how localized planning responses can inform broader regional and state-level policy frameworks. Comparative case studies of the City of Laguna Beach, the City of Malibu and the City of Santa Cruz, were conducted using the Fire Adapted Communities (FAC) framework to assess wildfire readiness within their LCPs and related planning efforts. Ultimately, this research highlights the need for the California Coastal Commission to adopt clearer, more enforceable standards and to support local jurisdictions in developing wildfire-resilient coastal communities. As the state continues to grapple with climate-driven disasters, integrating wildfire risk mitigation into coastal land use planning is not only timely, it is imperative.

LITERATURE REVIEW

Wildfire risk in California's Coastal Zones, particularly within the Wildland-Urban Interface (WUI), is a growing concern due to climate change, extended drought periods, and increasing development pressures. The California Coastal Commission (CCC), established to protect coastal resources through the implementation of Local Coastal Programs (LCPs), offers a critical platform for integrating wildfire hazard mitigation into coastal planning efforts. Historically, the CCC and LCPs have prioritized issues such as shoreline protection, public access, and habitat conservation; however, the growing encroachment of the WUI into the Coastal Zone necessitates a reevaluation of coastal management priorities. As wildfire risks escalate under projected climate scenarios, it becomes imperative for regulatory bodies such as the CCC to expand their guidance to address the intersection of wildfire hazards and development in the Coastal Zone.

This literature review synthesizes current research across several thematic areas to inform an integrated wildfire resilience strategy for coastal jurisdictions. It examines the influence of climate change on wildfire hazards, traces the historical evolution of wildfire mitigation practices, explores the expanding definition and risks associated with the WUI, analyzes the role of the CCC and LCPs in regulating coastal development, and evaluates the applicability of frameworks such as Fire Adapted Communities (FAC) to coastal wildfire resilience. Through this synthesis, the review identifies critical gaps in policy, implementation, and cross-agency coordination that must be addressed to enhance the capacity of coastal communities to adapt to increasing wildfire threats.

Climate Change and Wildfire Hazards and the Evolution of Wildfire Mitigation

Wildfires have always been a natural component of many ecosystems; however, climate change has significantly altered their frequency, intensity, and seasonality. Numerous studies have documented a strong linkage between rising global temperatures and increased wildfire activity (Westerling, 2016). In regions such as the American West, longer drought periods, higher average temperatures, and earlier snowmelt are leading to extended fire seasons and creating more favorable conditions for extreme fire behavior (Abatzoglou & Williams, 2016). Between 1984 and 2015, the western United States saw a doubling in the number of large fires, with climate factors accounting for more than half of the observed increases in fuel aridity (Abatzoglou & Williams, 2016). Research suggests that as global temperatures continue to rise, even aggressive wildfire suppression efforts will be increasingly overwhelmed by climatic drivers, making adaptation and mitigation all the more critical (IPCC, 2022).

Historically, wildfire mitigation focused heavily on suppression. During the 20th century, particularly following devastating fires like the Great Fire of 1910, U.S. federal agencies adopted a policy of total fire exclusion (Stephens et al., 2013). Although this approach initially reduced the number of fires, it had the unintended consequence of allowing fuel accumulation, leading to larger, more destructive wildfires when suppression failed. The evolution of wildfire mitigation strategies began to shift in the latter half of the 20th century. Scientists and land managers increasingly recognized the ecological importance of fire in maintaining healthy forest ecosystems (North et al., 2015). Prescribed burns, mechanical thinning, and managed wildfire use (where fires are allowed to burn under controlled conditions) have become critical tools in modern fire management.

Today's wildfire mitigation practices are increasingly informed by climate models and projections. Adaptive management strategies are gaining traction, emphasizing flexibility in planning and implementation to respond to changing climate and fire conditions (Millar, Stephenson, & Stephens, 2007). Moreover, interdisciplinary collaborations between fire ecologists, climatologists, urban planners, and public health officials are becoming essential for developing comprehensive wildfire mitigation frameworks.

Efforts to make communities more resilient to wildfires have also evolved. Programs such as Firewise USA and the Fire Adapted Communities initiative advocate for defensible space creation, use of fire-resistant building materials, community evacuation planning, and public education (National Fire Protection Association [NFPA], 2023). These programs reflect a shift from reactive suppression to proactive risk reduction.

In addition, wildfire mitigation is now being increasingly incorporated into state and local land-use planning. For instance, California mandates that cities and counties integrate wildfire hazard mitigation into their General Plan Safety Elements (California Department of Forestry and Fire Protection [Cal Fire], 2023). Such policies acknowledge that reducing wildfire risk requires not only managing forests and wildlands but also how and where communities are built.

Climate change will continue to exacerbate wildfire risk throughout the 21st century. Therefore, the evolution of wildfire mitigation is ongoing, requiring constant reassessment and innovation. As global warming trends persist, communities must move beyond traditional firefighting to comprehensive, science-driven strategies that blend landscape management, climate adaptation, and resilient development.

History and Role of the California Coastal Commission and Implementation of Local Coastal Programs to Regulate Development in the Coastal Zone

The California Coastal Commission (CCC) was established in 1972 through voter passage of Proposition 20, a landmark initiative driven by growing concerns over unchecked development and environmental degradation along the California coast (California Coastal Commission [CCC], 2023a). Recognizing the intrinsic ecological, recreational, and economic value of the coastline, citizens demanded greater protections to ensure continued public access and environmental stewardship. Four years later, the California Coastal Act of 1976 formalized the Commission's authority, creating one of the most robust coastal management programs in the United States.

The Coastal Act's primary mandates include maximizing public access to the coast, protecting sensitive coastal resources, regulating development to minimize adverse environmental impacts, and giving priority to coastal-dependent uses such as fishing, recreation, and port activities (California Public Resources Code § 30000 et seq.). To implement these goals at the local level, the Act requires coastal cities and counties to prepare and maintain Local Coastal Programs (LCPs). An LCP consists of a Land Use Plan (LUP) and an Implementation Plan (IP) that collectively guide land-use decisions within each jurisdiction's Coastal Zone (CCC, 2023b).

LCPs are crucial because they transfer much of the CCC's permitting authority to local governments once certified. This approach allows for site-specific considerations and fosters local ownership over coastal management, while ensuring alignment with the overarching Coastal Act goals (Trejo, 2020). Certification requires a rigorous review process where the CCC evaluates whether a local government's LCP policies and

ordinances adequately protect coastal resources. Once certified, local governments assume primary permitting responsibility, although the CCC retains appellate authority over certain types of development (e.g., projects located between the sea and the first public road, projects on tidelands and submerged lands).

The development and implementation of LCPs have been instrumental in shaping California's coastal landscape. Research shows that LCPs have effectively limited urban sprawl in sensitive coastal areas, preserved critical habitats like wetlands and dunes, and maintained public coastal access corridors (Morgan, 2011). To ensure that coastal resources are effectively protected in light of changing circumstances, such as new information and changing development pressures and impacts, including those posed by sea level rise, climate change, and, increasingly, wildfire risks in coastal Wildland-Urban Interfaces, the Commission is required to review each certified LCP at least once every five years. (CCC, 2021).

Despite these successes, implementation challenges persist. Many jurisdictions have outdated LCPs that do not fully address modern threats, including wildfires, which have expanded in Coastal Zones due to WUI growth and climate change (Bryant & Westerling, 2014). Updating LCPs can be a slow and resource-intensive process, particularly for small coastal cities and counties with limited planning capacity. Furthermore, tensions sometimes arise between local economic development interests and the Coastal Act’s conservation priorities, leading to conflicts that must be mediated by the CCC (Gibson, 2012).

Recent initiatives, such as the CCC's 2018 *Residential Adaptation Policy Guidance*, illustrate an evolving focus on climate resilience, encouraging local governments to incorporate hazard mitigation strategies, including fire resilience, into coastal planning (CCC, 2018). This guidance emphasizes nature-based solutions (e.g., dune restoration, managed retreat) and calls for integrating wildfire hazard mitigation with broader adaptation planning.

In sum, the CCC's historical and ongoing role in regulating coastal development through the LCP process has been pivotal in protecting California's coast. However, as environmental pressures intensify, there is a growing need for LCPs to evolve beyond traditional coastal hazards like erosion and flooding to include wildfire mitigation measures. Strengthening LCPs to address emerging hazards will be critical to sustaining the environmental, economic, and social vitality of the California coast in the decades ahead.

Wildland–Urban Interface: Definitions, Growth, and Risk

The Wildland–Urban Interface (WUI) refers to the geographical area where human-built structures and infrastructure meet or intermingle with undeveloped wildland vegetation (Radeloff et al., 2005). This zone is of particular concern for wildfire management because it represents a convergence of flammable natural fuels and human presence, increasing the risk of devastating fires. According to the Federal Register (2001), the WUI is categorized into two types: the "intermix" WUI, where structures are interspersed with wildland vegetation, and the "interface" WUI, where structures are adjacent to large, contiguous wildland areas.

The expansion of the WUI has been significant over the past few decades. Between 1990 and 2010, the WUI grew by 33% in land area and added approximately 12.7 million new homes, making it the fastest-growing land use type in the contiguous United States (Radeloff et al., 2018). This growth has been driven by multiple factors, including the attractiveness of scenic landscapes, housing affordability compared to urban centers, and broader demographic shifts such as suburbanization (Theobald & Romme, 2007).

However, the growth of the WUI has critical implications for wildfire risk. Structures located within or adjacent to wildlands are exposed to higher ignition probabilities, particularly during extreme weather events characterized by high winds and low humidity. Fires that occur in the WUI are often more destructive due to the challenges in firefighting logistics, the flammability of structures and landscaping, and the limited accessibility of some areas for emergency response vehicles (Syphard, Bar Massada, Butsic, & Keeley, 2013). Notably, catastrophic events like the 2018 Camp Fire in Paradise, California, which destroyed over 18,000 structures and caused 85 fatalities, illustrate the tragic consequences of WUI vulnerability (Kasler & Reese, 2018).

Beyond the immediate fire risk, the WUI presents a challenge to traditional land management and urban planning paradigms. The fragmentation of wildlands by residential development alters fire behavior, creating complex patterns of fire spread and increasing suppression difficulty (Kramer et al., 2018). Additionally, developments often encroach upon ecosystems adapted to frequent, low-intensity fires, disrupting natural fire regimes and exacerbating fuel build-up.

Land-use policies have not kept pace with WUI expansion. Many local jurisdictions lack wildfire-specific planning regulations, such as mandatory defensible space requirements, fire-resistant building codes, or evacuation planning mandates (Syphard & Keeley, 2020). Even where regulations exist, enforcement can be inconsistent, particularly in rural or resource-limited communities. Thus, the growth of the WUI continues to outpace efforts to mitigate associated risks.

Efforts to manage WUI wildfire risk emphasize three primary strategies: home hardening, defensible space creation, and community-wide planning initiatives. "Home hardening" refers to retrofitting structures with fire-resistant materials, such as Class A roofing and ember-resistant vents (Quarles et al., 2010). Defensible space involves managing vegetation and other combustible materials around structures to slow fire spread. Community-level approaches, including Community Wildfire Protection Plans (CWPPs) and land-use zoning, aim to reduce cumulative exposure by guiding growth away from the most hazardous areas (Jakes, Sturtevant, & Rusk, 2012).

Moreover, climate change is exacerbating WUI fire risks. Rising temperatures, more frequent droughts, and increased wind events contribute to conditions that favor rapid fire ignition and spread (Westerling, 2016). Thus, future WUI planning must not only address existing vulnerabilities but also anticipate how climate-induced shifts may further complicate wildfire dynamics.

In conclusion, the WUI represents a rapidly expanding and increasingly hazardous frontier in wildfire management. Addressing these risks will require a paradigm shift from

reactive suppression to proactive planning, incorporating land-use controls, building standards, and community engagement to create more fire-resilient landscapes.

The Background of the Fire Adapted Communities Framework and Its Role in Evaluating Wildfire Mitigation

The Fire Adapted Communities (FAC) framework is a proactive approach designed to reduce wildfire risk by preparing communities to live with fire rather than attempting to eliminate it altogether. Recognizing that wildfires are an inevitable natural process, particularly in fire-prone landscapes like those in the western United States, FAC emphasizes resilience through shared responsibility, planning, mitigation, and education (Fire Adapted Communities Learning Network [FAC Net], 2023).

The concept of fire-adapted communities emerged in the early 2000s alongside growing recognition of the limitations of suppression-based wildfire strategies. Traditional wildfire management had focused heavily on fire exclusion; however, catastrophic fires during the late 20th and early 21st centuries, such as the 2002 Rodeo-Chediski Fire in Arizona and the 2003 Cedar Fire in California, demonstrated that suppression alone was insufficient (Calkin, Cohen, Finney, & Thompson, 2014). In response, fire scientists, land managers, and policymakers began promoting an integrated vision that encouraged communities to adapt to fire as a natural and persistent element of their environment.

The FAC framework was formally articulated by agencies such as the USDA Forest Service and organizations like The Nature Conservancy, with support from federal initiatives like the National Cohesive Wildland Fire Management Strategy (U.S. Department of the Interior, 2014). FAC describes a community that accepts wildfire risk

and actively works across multiple scales, individual, neighborhood, municipal, and landscape, to reduce vulnerabilities. Key elements include defensible space around homes, fire-resistant construction, emergency preparedness, land-use planning that limits development in the wildland–urban interface (WUI), and robust community collaboration (Quarles et al., 2010; FAC Net, 2023).

The role of FAC in evaluating wildfire mitigation efforts is profound. It provides a comprehensive rubric by which communities can assess their readiness and resilience. For example, the FAC framework encourages communities to develop Community Wildfire Protection Plans (CWPPs), integrate wildfire mitigation into zoning and building codes, engage residents in home hardening programs, and create redundant evacuation routes (Jakes & Sturtevant, 2013). These tangible actions can then be measured against FAC's principles to gauge progress toward becoming truly "fire-adapted."

Importantly, FAC promotes a shift from reactive emergency response to proactive risk management. It calls for embedding fire considerations into everyday planning and governance rather than viewing wildfire mitigation as an occasional or peripheral task (North et al., 2015). This strategic approach is particularly relevant as climate change intensifies wildfire behavior, making fire events more unpredictable and harder to contain. A significant strength of the FAC framework is its emphasis on collaboration. FAC explicitly recognizes that no single entity, whether a homeowner, fire agency, or local government, can manage wildfire risk alone. Instead, successful wildfire adaptation requires coordinated action across jurisdictions and sectors (Abrams, Nielsen-Pincus, Paveglio, & Moseley, 2016). FAC Learning Networks (such as those in New Mexico and

California) help communities share best practices, access training resources, and foster peer-to-peer learning, which accelerates the adoption of effective mitigation measures (FAC Net, 2023).

Challenges remain in fully operationalizing the FAC vision. Many communities, particularly smaller or lower-income ones, face financial and staffing constraints that limit their ability to implement comprehensive wildfire mitigation strategies (Paveglio, Edgeley, & Stasiewicz, 2018). Moreover, public awareness and buy-in are variable; some residents may underestimate their personal wildfire risk or resist regulatory measures that require changes to landscaping or home construction. Nevertheless, the FAC framework provides an essential blueprint for sustainable wildfire management. It shifts the narrative from fire suppression to fire coexistence, promoting a model of resilience that is increasingly necessary as wildfire threats escalate. Evaluating communities through the lens of the FAC framework enables planners, emergency managers, and policymakers to identify vulnerabilities, prioritize interventions, and build stronger, more adaptive communities prepared for a fire-prone future.

Synthesis and Identified Gaps

Wildfire risk is an increasingly complex challenge at the intersection of climate change, land-use development, and community resilience. Across all sections, several key themes emerge: wildfire is a natural process exacerbated by climate change; historic land management practices often worsened current risks; proactive, localized planning efforts are critical to reducing vulnerability; and frameworks like Fire Adapted Communities (FAC) offer promising models for comprehensive resilience. However, significant gaps

remain in both policy and practice that threaten to undermine wildfire mitigation efforts in coastal and Wildland-Urban Interface (WUI) communities.

One major gap identified is the lag in integrating wildfire hazard considerations into traditional land-use planning processes. Despite the critical role of Local Coastal Programs (LCPs) under the California Coastal Commission (CCC) framework, many LCPs have not been updated to reflect modern wildfire threats, particularly in coastal WUI areas (CCC, 2021). While the CCC has made strides by encouraging the inclusion of climate adaptation strategies, wildfire hazard mitigation remains underemphasized compared to sea-level rise and coastal erosion concerns. The WUI overlaps with much of the Coastal Zone throughout California's coast (Figures 1 and 2), presenting a pressing need to formally integrate fire resilience measures, such as defensible space requirements, wildfire hazard mapping, and evacuation planning, into coastal zoning and land-use planning efforts (Trejo, 2020).

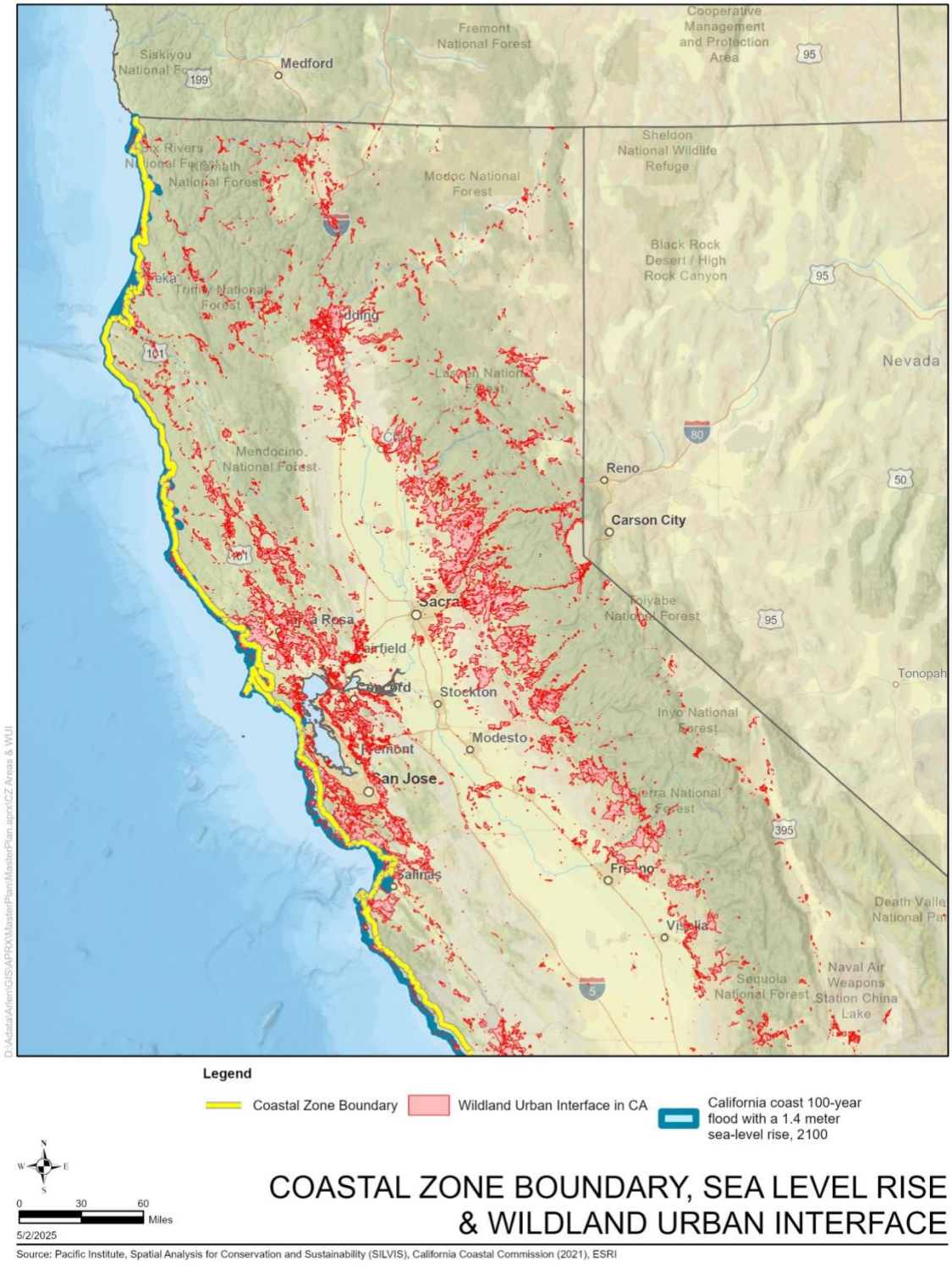

Figure 1. State of California Coastal Zone (Northern Area), Wildland-Urban Interface, and Projected Sea Level Rise: Areas of Overlap and Risk

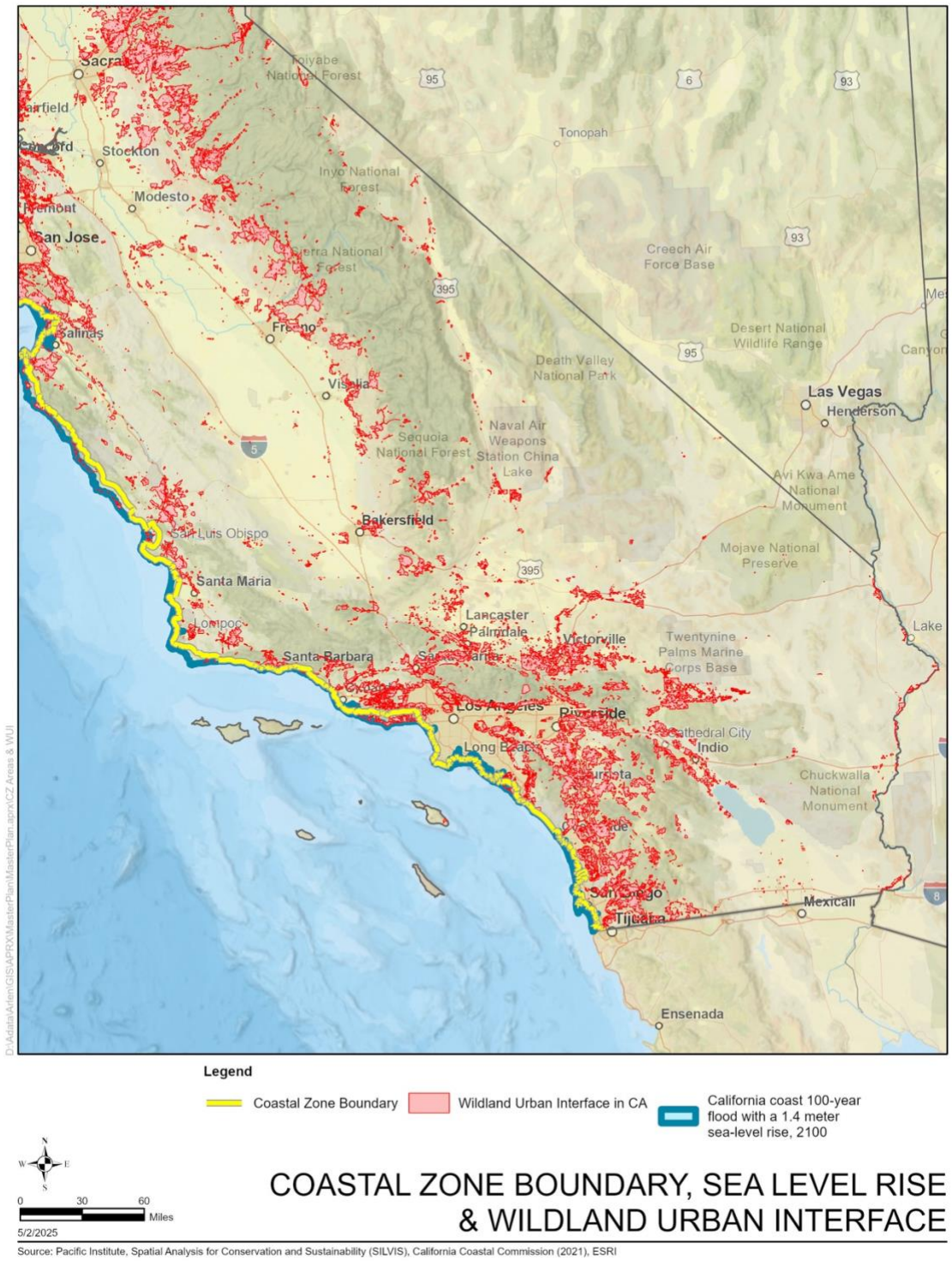

Figure 2. State of California Coastal Zone (Southern Area), Wildland-Urban Interface, and Projected Sea Level Rise: Areas of Overlap and Risk

Another critical gap lies in public understanding and participation. Many residents living in fire-prone areas underestimate their personal wildfire risk or are reluctant to make structural changes to their homes due to cost, aesthetics, or misinformation (Paveglio et al., 2015). Research has shown that voluntary compliance with fire-safe building standards and defensible space guidelines is uneven, particularly in lower-income or more isolated communities (Edgeley & Paveglio, 2019). Thus, while programs like FAC promote community collaboration, a lack of public engagement and social equity considerations can hamper successful implementation.

Resource disparities also create vulnerabilities. Updating LCPs to incorporate wildfire resilience requires significant investment in hazard assessment, public outreach, and inter-agency coordination which resources may be out of reach for rural or fiscally constrained communities. Moreover, grant funding for wildfire resilience (e.g., FEMA's Hazard Mitigation Grant Program) remains highly competitive and can disadvantage less-resourced applicants.

At a broader policy level, there remains insufficient coordination between federal, state, and local agencies in managing fire risk across jurisdictional boundaries. For example, while Cal Fire mandates fire safety elements in General Plans under California law (California Government Code § 65302(g)), and the CCC regulates coastal development, the two frameworks are not fully aligned when it comes to wildfire resilience requirements. A lack of standardized guidance complicates efforts by local governments to integrate fire safety measures comprehensively into their LCPs and other planning documents (CCC, 2018; Cal Fire, 2023).

Finally, climate change projections present an emerging gap. As wildfire seasons lengthen and fire behavior becomes more extreme, static mitigation plans based on historical conditions are increasingly inadequate. Adaptive management, dynamic evacuation planning, and integration of up-to-date fire modeling are critical to ensure plans remain relevant under future climate scenarios (Abatzoglou & Williams, 2016; IPCC, 2022).

Addressing these gaps will require a multi-pronged approach. Policy reforms must mandate the inclusion of wildfire mitigation in LCPs and broader coastal planning. Public education campaigns must elevate awareness of wildfire risk and emphasize shared responsibility. Funding mechanisms must prioritize under-resourced communities, and greater collaboration between agencies must streamline regulatory requirements. Finally, resilience strategies must be dynamic, informed by evolving climate science, and integrated into every level of land-use and emergency planning. Without these concerted efforts, communities located in the coastal and WUI zones will remain increasingly vulnerable to devastating wildfire impacts.

METHODS

Research Design

This research adopts a qualitative comparative case study design to evaluate the integration of wildfire hazard mitigation measures into Local Coastal Programs (LCPs). A case study approach was selected to allow for an in-depth exploration of how individual jurisdictions have incorporated wildfire risk reduction strategies following significant fire events. By focusing on multiple jurisdictions that meet specific selection criteria, the study seeks to identify patterns, best practices, and gaps in current LCP wildfire mitigation efforts.

Primary data sources for this research include publicly available Local Coastal Program documents, such as Land Use Plans (LUPs) and Implementation Plans (IPs). These documents were systematically reviewed and evaluated using the Fire Adapted Communities (FAC) framework, which provides a structured method for assessing community wildfire preparedness and resilience across key thematic areas. A scoring rubric was developed to translate qualitative findings into a quantitative comparison among jurisdictions.

The research is designed to produce both individual jurisdiction evaluations and cross-case comparative insights. This dual approach allows for both a detailed understanding of each city's wildfire mitigation planning within the coastal context and a broader synthesis of common strengths and deficiencies across cases, ultimately informing recommendations for enhancing the California Coastal Commission’s guidance on wildfire hazards in Local Coastal Programs.

Selection of Jurisdictions for Evaluation

The first step of this research involved identifying and selecting jurisdictions for evaluation based on specific criteria relevant to wildfire risk and coastal management. Table 1 below shows the criteria were established to ensure consistency and relevance across case studies.

Table 1. Selection Criteria

Selection Criteria	Description
Coastal Zone Inclusion	All or significant portions of the city's jurisdiction are located within the Coastal Zone as defined by the California Coastal Act.
Wildland-Urban Interface (WUI) Presence	City contains substantial areas designated as WUI zones according to Cal Fire mapping.
Certified Local Coastal Program (LCP)	City has an LCP certified by the California Coastal Commission, aligning local land use planning with state coastal management policies.
Wildfire History	City has experienced significant wildfire events that caused structure loss or major property damage.
Post-Fire Mitigation Efforts	City has adopted or expanded wildfire mitigation programs, policies, or measures in response to past wildfire events.

Based on these criteria, three jurisdictions were selected for in-depth analysis: City of Laguna Beach (Figure 3), City of Malibu (Figure 4), and City of Santa Cruz (Figure 5). Each city meets all five selection criteria and provides an opportunity to examine different approaches to wildfire mitigation within the Coastal Zone context.

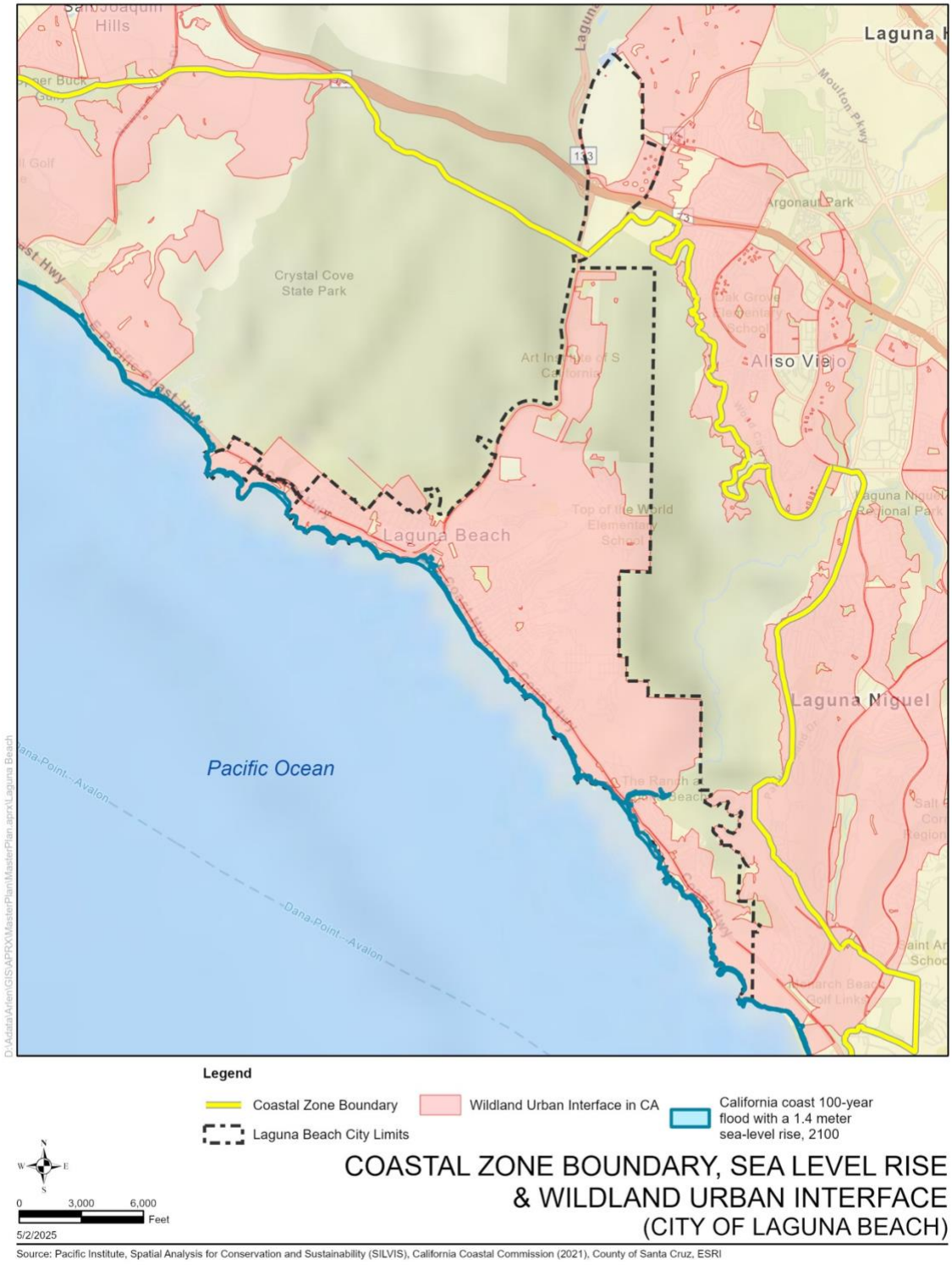

Figure 3. City of Laguna Beach: Coastal Zone, Wildland-Urban Interface, and Projected Sea Level Rise (2100)

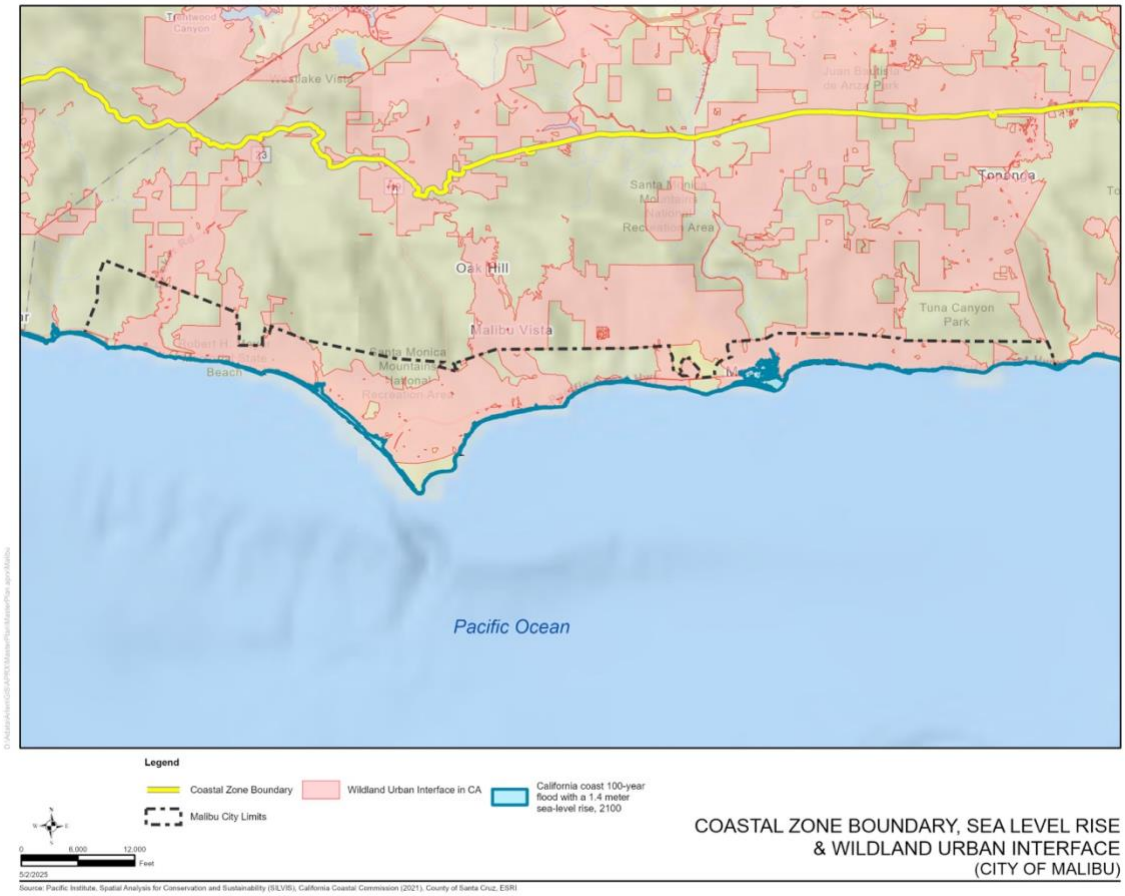

Figure 4. City of Malibu: Coastal Zone, Wildland-Urban Interface, and Projected Sea Level Rise (2100)

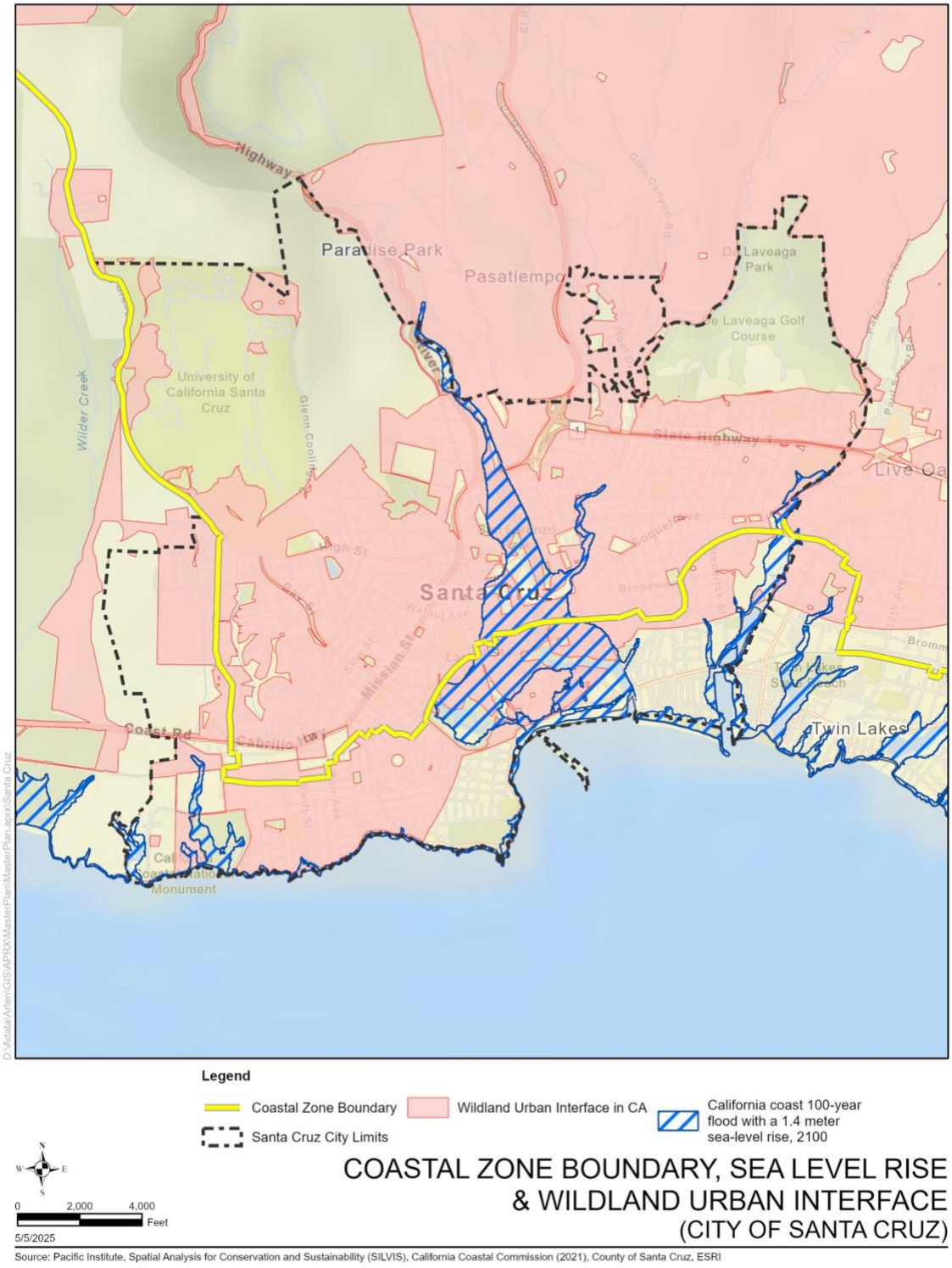

Figure 5. City of Santa Cruz: Coastal Zone, Wildland-Urban Interface, and Projected Sea Level Rise (2100)

Evaluation of Local Coastal Programs Using the Fire Adapted Communities (FAC) Framework

To systematically assess the effectiveness and comprehensiveness of wildfire hazard mitigation strategies within each city's Local Coastal Program, the Fire Adapted Communities (FAC) framework was utilized. The FAC framework, developed through interagency collaboration and outlined by organizations such as the Fire Adapted Communities Learning Network (FAC Net), provides a structured approach to evaluating community-level wildfire resilience planning. Figure 6 below shows the components the FAC framework uses to evaluate if a community is “fire adapted”.

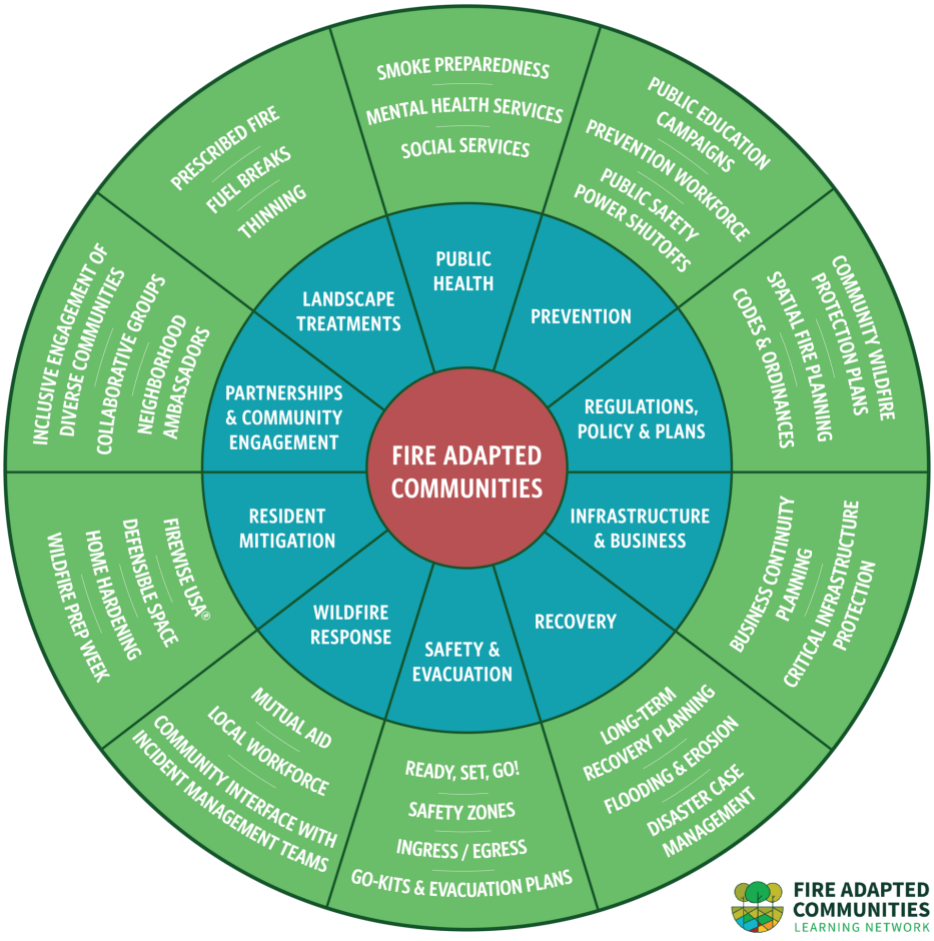

Figure 6. Fire Adapted Communities Framework

Each city's Local Coastal Program (LCP), including Land Use Plans, and Implementation Plans, were reviewed for alignment with these FAC principles. A rubric was developed to score each jurisdiction's LCP based on its incorporation of FAC framework components. The rubric assigned ratings for the presence, strength, and integration of mitigation measures addressing wildfire risks in the Coastal Zone.

Table 2 below details how each component of the FAC framework is scored from 1 (Limited) to 3 (Strong), offering a structured, comparative tool to analyze the extent and quality of wildfire planning integration in Local Coastal Programs.

Table 2. Fire Adapted Communities Evaluation Rubric

FAC Component	Description	Absent or Limited (1)	Moderate (2)	Strong (3)
1. Infrastructure & Business	Continuity planning, fire-resistant utilities, business resilience	No continuity or fire-resilient infrastructure planning	Mentions resilience for key facilities/businesses	Detailed, funded plans to harden infrastructure and maintain business operations
2. Landscape Treatments	Fuel breaks, prescribed burns, defensible space	No mention of vegetation or landscape treatment	General reference to fuels management	Site-specific strategies, timelines, and interagency collaboration
3. Partnerships & Community Engagement	Collaborations with stakeholders and public education	No partnerships identified	Some stakeholder mention or outreach	Robust engagement plans with diverse partners and community leadership roles
4. Prevention	Ignition prevention, risk awareness	No prevention strategies	Limited education or signage	Comprehensive ignition reduction and public

FAC Component	Description	Absent or Limited (1)	Moderate (2)	Strong (3)
				behavior campaigns
5. Public Health	Smoke readiness, air quality, vulnerable population protections	No health measures addressed	General health warnings or temporary shelters	Formal air quality alerts, HEPA filter distributions, and resilience hubs
6. Recovery	Post-fire housing, economic and ecological recovery	No recovery protocol or funding	Mentions rebuilding or debris management	Detailed recovery framework including equity and long-term monitoring
7. Regulations, Policies, Plans	Land use, building codes, defensible space ordinances	No regulatory integration	Basic codes or vague policy references	Enforceable standards aligned with WUI science and CEQA/CalFire
8. Resident Mitigation	Home hardening, defensible space education	No homeowner support or compliance mechanism	Education only	Funded retrofit programs, inspections, and compliance incentives
9. Response	Fire suppression coordination and resource readiness	No response planning	General emergency services noted	Detailed response protocols with resource sharing and ICS integration
10. Safety & Evacuation	Alerts, evacuation zones, drills	No evacuation planning or public alerts	Basic warning system or routes	Multi-lingual alert systems, maps, signage, and community drills

Document analysis included both qualitative and quantitative assessments. A narrative evaluation was developed for each jurisdiction, identifying strengths, gaps, and opportunities for improvement relative to the FAC framework. Comparative analysis

across jurisdictions was then conducted to synthesize best practices and recommend potential enhancements to future wildfire hazard mitigation efforts within LCPs.

FINDINGS

This chapter presents detailed findings from the application of the Fire Adapted Communities (FAC) framework to evaluate wildfire hazard mitigation strategies within the Local Coastal Programs (LCPs) of the City of Laguna Beach, the City of Malibu, and the City of Santa Cruz. Each jurisdiction was assessed using a ten-component rubric that measures community readiness, planning integration, and resilience capacity. The findings not only identify the relative strengths and weaknesses of each city's LCP but also explain why these outcomes vary based on policy history, institutional structure, post-fire response, and community engagement.

Evaluation of Local Coastal Programs Using the Fire Adapted Communities Framework

i. City of Laguna Beach – Highly Fire Adapted (27/30 FAC Points)

The City of Laguna Beach scored highest among the three jurisdictions (Table 3), demonstrating a comprehensive and proactive approach to wildfire mitigation. Its performance reflects a unique combination of early hazard exposure, institutional learning, and sustained political and financial investment in fire resilience.

Table 3. FAC Evaluation: City of Laguna Beach Local Coastal Program

FAC Component	Laguna Beach LCP Evaluation	Notes
1. Infrastructure & Business	Moderate (2)	Some fire-resilient infrastructure improvements; utility undergrounding still ongoing.
2. Landscape Treatments	Strong (3)	Aggressive and ongoing fuel modification programs coordinated with OCFA.

3. Partnerships & Community Engagement	Strong (3)	Strong interagency collaboration with state and local partners for fire mitigation and response.
4. Prevention	Strong (3)	Detailed evacuation planning, including Public Safety Power Shutoff (PSPS) preparation and wildfire-specific routes.
5. Public Health	Moderate (2)	Public smoke impact messaging present but limited formal clean air shelter planning.
6. Recovery	Moderate (2)	General recovery planning exists; formal rapid permitting frameworks could be strengthened.
7. Regulations, Policies, Plans	Strong (3)	Development standards integrate hazard avoidance and slope/fire hazard considerations.
8. Resident Mitigation	Strong (3)	Strict defensible space and home hardening requirements enforced through municipal codes.
9. Response	Strong (3)	Integrated response coordination with OCFA and regular training exercises.
10. Safety & Evacuation	Strong (3)	Robust public engagement programs, including CERT and wildfire evacuation drills.

Laguna Beach's transformation into a fire-adapted community began after the catastrophic 1993 wildfire, which destroyed over 400 homes and highlighted the city's acute vulnerability due to steep slopes, canyon topography, and dense vegetation adjacent to residential areas. In response, the city undertook aggressive reforms that laid the foundation for its current high score. The LCP now reflects an integrated approach to hazard planning that balances wildfire mitigation with coastal development constraints.

One of the most robust elements of Laguna Beach’s strategy is vegetation management. The city implemented and maintains fuel modification zones along its Wildland-Urban

Interface, with regular coordination between local government and the Orange County Fire Authority (OCFA). This coordination includes real-time assessments, mechanical thinning of fuels, and community alerts during high-risk weather conditions. These programs go beyond general environmental protection; they are rooted in specific fire behavior modeling and slope-risk assessments.

Defensible space regulations and home hardening measures are codified in municipal law and actively enforced. Through municipal code updates, the city requires property owners in Very High Fire Hazard Severity Zones (VHFHSZs) to maintain 100 feet of defensible space, retrofit older homes with ember-resistant vents, and install fire-resistant roofing materials. The city also provides education and compliance support, reducing enforcement burdens and increasing community participation.

In the realm of emergency planning, Laguna Beach excels in both policy detail and operational readiness. Evacuation plans include multi-modal strategies for residents without vehicles, designated community shelters, and wildfire-specific alerts through the AlertOC system. The city has conducted community-wide evacuation drills and maintains a GIS-based wildfire hazard zone map accessible to the public. Notably, their planning documents are updated regularly in response to simulated and real hazard events.

Areas where Laguna Beach could improve include public health smoke readiness and post-fire recovery planning. While the city does issue smoke advisories during high particulate days and collaborates with the South Coast Air Quality Management District (SCAQMD), it lacks permanent clean air shelters or distribution programs for HEPA filters. Likewise, the post-fire recovery framework is not as fully developed as its pre-fire

planning. There are no detailed policies on rapid permitting for rebuilds, mental health support for fire victims, or adaptive land-use reassessment post-fire.

Nonetheless, Laguna Beach's high score of 27/30 positions it as a model for wildfire adaptation within the California Coastal Zone, demonstrating that long-term institutional commitment, paired with robust interagency coordination, can significantly enhance community resilience.

ii. City of Malibu – Low Adaptation (15/30 FAC Points)

Despite experiencing one of the most devastating wildfires in recent California history, the 2018 Woolsey Fire, Malibu's Local Coastal Program shows significant gaps in wildfire hazard mitigation. The city of Malibu received a "Low Adaptation" rating (Table 4), reflecting limited integration of fire adaptation principles across its LCP and broader planning frameworks.

Table 4. FAC Evaluation: City of Malibu Local Coastal Program

FAC Component	Malibu LCP Evaluation	Notes
1. Infrastructure & Business	Absent or Limited (1)	No provisions for fire-resilient utilities or fire water supply improvements.
2. Landscape Treatments	Moderate (2)	Vegetation conservation addressed, but lacks citywide fuels reduction planning.
3. Partnerships & Community Engagement	Moderate (2)	Public access and recreation are emphasized; minimal discussion of wildfire education or evacuation drills.
4. Prevention	Absent or Limited (1)	No clear evacuation planning for wildfire emergencies.

5. Public Health	Absent or Limited (1)	No measures addressing smoke impacts or air quality concerns.
6. Recovery	Absent or Limited (1)	No planning guidance for recovery, rebuilding, or debris flow after wildfires.
7. Regulations, Policies, Plans	Strong (3)	Strong siting and development controls; wildfire risk overlays are limited.
8. Resident Mitigation	Absent or Limited (1)	No explicit standards for defensible space or home hardening identified.
9. Response	Absent or Limited (1)	No coordination with fire agencies specifically for wildfire response discussed.
10. Safety & Evacuation	Moderate (2)	General environmental coordination noted, but not wildfire-specific planning.

The Woolsey Fire in 2018 burned nearly 100,000 acres, destroyed over 1,600 structures, and resulted in mass evacuations across Malibu. In the fire's aftermath, local calls for reform intensified; however, changes to the LCP have been slow and incremental. The city has struggled to convert short-term emergency response into long-term resilience planning.

One of the most critical shortcomings is the absence of mandatory defensible space and home hardening requirements within the LCP. Although the city references Cal Fire standards and slope stability concerns in permitting processes, these measures are not codified in the municipal law. Post-fire rebuilding efforts did not include mandatory retrofits with fire-resistant materials, leaving structural vulnerabilities largely unaddressed.

Emergency planning and evacuation protocols are also underdeveloped. The LCP lacks detailed evacuation zone maps, contingency plans for road closures, or accessible

communication strategies for at-risk populations. During the Woolsey Fire, residents reported confusion about evacuation orders and a lack of coordination between agencies. These experiences underscore the urgent need for formalized, multilingual, and drill-tested evacuation frameworks.

Although Malibu's LCP includes some strong environmental planning policies, notably for slope protection and habitat conservation, these are not linked to wildfire-specific hazards. Fuel management across landscapes is weak. There are no city-wide vegetation reduction programs, no prescribed burn strategies, and limited coordination with the Los Angeles County Fire Department on fuel treatment initiatives. Moreover, public health protections related to wildfire smoke are absent from planning documents.

Another major omission is post-fire recovery planning. The city lacks policies that address long-term community recovery, rapid permitting processes, or rebuilding limitations in high-risk areas. Debris flow risks following wildfires are not discussed in the LCP, despite Malibu's steep terrain and proximity to coastal bluffs.

The City of Malibu's low score reflects a disconnect between the severity of past wildfire impacts and the institutional response captured in the LCP. Challenges include political opposition to stricter land use regulations, limited municipal capacity, and a planning framework that emphasizes coastal viewsheds and recreation over safety.

iii. City of Santa Cruz – Low Adaptation (15/30 FAC Points)

Santa Cruz, like Malibu, received a low adaptation rating, indicating major gaps in wildfire hazard mitigation within its LCP (Table 5). The city was impacted by the 2020 CZU

Lightning Complex fires, which burned over 80,000 acres in Santa Cruz and San Mateo counties.

Table 5. FAC Evaluation: City of Santa Cruz Local Coastal Program

FAC Component	Santa Cruz LCP Evaluation	Notes
1. Infrastructure & Business	Absent or Limited (1)	No provisions for fire-resilient utilities or fire water supply improvements.
2. Landscape Treatments	Moderate (2)	Vegetation conservation addressed, but lacks citywide fuels reduction planning.
3. Partnerships & Community Engagement	Moderate (2)	Public access and recreation are emphasized; minimal discussion of wildfire education or evacuation drills.
4. Prevention	Absent or Limited (1)	No clear evacuation planning for wildfire emergencies.
5. Public Health	Absent or Limited (1)	No measures addressing smoke impacts or air quality concerns.
6. Recovery	Absent or Limited (1)	No planning guidance for recovery, rebuilding, or debris flow after wildfires.
7. Regulations, Policies, Plans	Strong (3)	Strong siting and development controls; wildfire risk overlays are limited.
8. Resident Mitigation	Absent or Limited (1)	No explicit standards for defensible space or home hardening identified.
9. Response	Absent or Limited (1)	No coordination with fire agencies specifically for wildfire response discussed.
10. Safety & Evacuation	Moderate (2)	General environmental coordination noted, but not wildfire-specific planning.

Despite this, Santa Cruz's LCP has yet to fully incorporate wildfire resilience into its planning documents. While the city has taken steps toward hazard mapping and slope

management, these measures are not explicitly tied to wildfire risk. Vegetation management, for example, is generally framed as a habitat preservation issue rather than a fuels reduction strategy.

The LCP does not include mandatory defensible space standards, home hardening incentives, or property inspection programs. Resident-focused mitigation efforts are therefore limited, both in scope and enforcement. Unlike Laguna Beach, Santa Cruz does not have a clear partnership with Cal Fire or the Santa Cruz County Fire Department to support public education, community drills, or home retrofitting programs.

Emergency planning and evacuation protocols are similarly weak. While Santa Cruz maintains flood evacuation routes and coastal hazard response plans, wildfire-specific strategies are missing. No community-wide evacuation mapping or tiered alert systems are included in the LCP, despite the lessons of the CZU fires. Vulnerable populations, such as unhoused residents, non-English speakers, and the elderly, are not addressed in evacuation scenarios or shelter planning.

In terms of infrastructure resilience, Santa Cruz has not developed plans to underground power lines, enhance fire hydrant networks, or ensure redundant communication systems during fire events. Smoke preparedness measures, such as air quality alerts, clean air shelters, or support for schools and seniors, are notably absent.

Perhaps most concerning is the lack of post-fire recovery protocols. The LCP contains no language on how to assess wildfire damage, restrict rebuilding in unstable or high-risk areas, or support social and mental health services for affected populations. These

omissions leave the city vulnerable to cascading risks after fire events, such as debris flows and housing displacement.

Santa Cruz's low FAC score suggests an urgent need to update its coastal planning approach to reflect emerging wildfire threats. While the city has demonstrated leadership on sea-level rise and environmental stewardship, these efforts must be paralleled by comprehensive fire adaptation strategies that reflect the growing overlap of climate hazards in the WUI-Coastal Zone interface.

Key Findings Across Jurisdictions

The comparative analysis of LCPs across the three jurisdictions revealed significant differences in how wildfire hazard mitigation is approached within the Coastal Zone (Table 6). Despite each city meeting the selection criteria for analysis, including WUI presence, Coastal Zone inclusion, and wildfire history, their policies and planning strategies vary widely in comprehensiveness and effectiveness.

Table 6. FAC Evaluations of Local Coastal Programs Comparison

FAC Component	Laguna Beach	Malibu	Santa Cruz
1. Infrastructure & Business Continuity	2	1	1
2. Landscape Treatments	3	2	2
3. Partnerships & Community Engagement	3	2	2
4. Prevention	3	1	1
5. Public Health	2	1	1
6. Recovery	2	1	1
7. Regulations, Policies, Plans	3	3	3
8. Resident Mitigation	3	1	1
9. Response	3	1	1
10. Safety & Evacuation	3	2	2
Total FAC Score	27/30	15/30	15/30

While each city has experienced significant wildfire impacts, only Laguna Beach has translated past fire events into sustained, structural changes to its planning framework. The 1993 wildfire served as a catalyst for long-term investment in fuel modification zones, slope stabilization, and the institutionalization of evacuation planning. In contrast, Malibu and Santa Cruz, both of which experienced recent, destructive fire events, have not yet fully incorporated those experiences into their LCPs. In Malibu's case, despite the immense losses from the 2018 Woolsey Fire, key post-fire lessons have not been codified into enforceable policies or community-wide mitigation strategies. Santa Cruz, although engaged in some hazard planning, lacks the specificity and scope necessary to address the full range of wildfire risks emerging from the 2020 CZU Lightning Complex Fire.

All three jurisdictions reveal weaknesses in wildfire-specific emergency preparedness, with Laguna Beach being the only city to maintain detailed, publicly accessible evacuation planning documents, drills, and alert systems. Malibu and Santa Cruz either lack clear evacuation planning in their LCPs or mention it only in broad terms. This gap is particularly concerning given the documented challenges faced by residents during fast-moving fire events in both cities. The absence of multilingual alerts, evacuation signage, and coordinated emergency operations planning places vulnerable populations, including tourists, renters, and elderly residents, at heightened risk.

Planning for the long-term health and well-being of residents affected by wildfire remains a consistent deficiency across all jurisdictions. None of the LCPs evaluated includes robust public health interventions such as clean air shelters, smoke advisory protocols, or strategies for reaching at-risk populations with health information. Post-fire recovery

planning is either entirely absent or only vaguely addressed. Given the increasing frequency and intensity of wildfires due to climate change, this omission leaves communities poorly equipped to respond to the social and economic disruption of fire disasters.

Despite widespread scientific consensus that wildfire frequency and intensity are being exacerbated by climate change, none of the three jurisdictions explicitly integrates future climate risk projections into their wildfire planning frameworks. While sea-level rise has become a standard part of coastal adaptation discussions, fire risk remains treated as a static hazard rather than one evolving with climate variables such as wind speed, temperature rise, fuel aridity, and drought duration. Without incorporating these projections, LCPs risk becoming outdated and unresponsive to future wildfire behavior.

Laguna Beach distinguishes itself by embedding fire hazard considerations directly into land use and development review, including defensible space setbacks, fire-resistant construction requirements, and site-specific hazard assessments. Santa Cruz and Malibu fall short in this area, often treating fire as an ancillary rather than central planning concern. Without mandatory defensible space ordinances or home hardening requirements, new development in high-risk areas continues without adequate fire risk reduction.

The quality of interagency collaboration emerged as a key determinant of wildfire readiness. Laguna Beach's strong relationship with the Orange County Fire Authority has resulted in effective joint implementation of mitigation projects, evacuation drills, and hazard assessments. Conversely, Malibu and Santa Cruz do not appear to have

formalized wildfire coordination mechanisms between local planners and fire agencies in their LCPs, resulting in fragmented and reactive mitigation efforts.

Why the Findings Differ

Understanding the reasons behind these divergent outcomes is essential to crafting effective statewide wildfire guidance and ensuring equity in hazard mitigation across California's coastal communities. Several underlying factors explain why Laguna Beach is significantly more fire-adapted than Malibu and Santa Cruz.

Laguna Beach's experience with wildfire predates those of Malibu and Santa Cruz by over two decades. The 1993 fire occurred at a time when few cities had begun addressing wildfire as a core land use issue. The trauma of that event left a lasting imprint on local institutions and prompted a long-term commitment to hazard reduction. In contrast, Malibu's and Santa Cruz's most destructive fires occurred within the last seven years, and local governments have struggled to translate emergency recovery into durable policy change. The recency of those events, while still raw, may mean that institutional learning and long-term planning shifts are still underway.

Laguna Beach benefits from a relatively cohesive governance structure with a strong planning department, consistent political support for hazard mitigation, and established partnerships with regional fire authorities. By contrast, Malibu's political climate has often prioritized property rights, development freedom, and recreational land use, leading to local resistance to stricter land use controls. Santa Cruz, while progressive in coastal access and environmental justice, has directed more planning resources toward coastal

erosion and sea-level rise than wildfire. The lack of political urgency surrounding wildfire policy has contributed to delays in LCP updates.

Smaller or less-resourced jurisdictions often lack the staffing and technical capacity to undertake extensive LCP amendments or to develop complex wildfire mitigation programs. Santa Cruz, in particular, may face planning staff shortages and budget constraints that slow the pace of LCP updates. Malibu has experienced staff turnover and community pressure that further complicate its planning environment. Laguna Beach, with a more stable local planning apparatus and stronger technical partnerships, has been better positioned to maintain continuity in wildfire planning.

In Laguna Beach, repeated community outreach and public awareness campaigns have established a shared understanding of wildfire risk. Residents participate in CERT training, understand evacuation protocols, and actively support defensible space measures. In contrast, public engagement in Malibu has often focused on post-disaster litigation and insurance disputes rather than forward-looking mitigation. Also, Malibu and Santa Cruz residents may underestimate their wildfire exposure, leading to a slower uptake of adaptation measures.

All three cities operate under the purview of the California Coastal Act, which can create real or perceived conflicts between wildfire mitigation and other coastal priorities such as habitat preservation and visual resource protection. Laguna Beach has successfully navigated these tensions by integrating hazard avoidance into coastal conservation. Malibu and Santa Cruz, however, appear to treat fire mitigation as secondary to habitat

and access priorities, delaying implementation of measures like vegetation clearance or emergency road expansion due to potential Coastal Act conflicts.

The findings reveal that while some cities have made significant strides in incorporating wildfire resilience into their coastal planning, significant gaps remain, particularly in emergency preparedness, vegetation management, post-fire recovery, and climate change adaptation. The CCC's existing guidance for wildfire hazard mitigation in LCPs is insufficiently detailed, leading to inconsistent implementation across jurisdictions. Strengthening CCC requirements to align more closely with the FAC principles would enhance wildfire risk reduction efforts for communities in the WUI and Coastal Zone.

DISCUSSION

The evaluation of wildfire mitigation in Local Coastal Programs (LCPs) through the Fire Adapted Communities (FAC) framework reveals critical insights into the readiness and resilience of coastal jurisdictions in California. While the City of Laguna Beach demonstrates a model of fire adaptation with a score of 27 out of 30, the Cities of Malibu and Santa Cruz both score significantly lower (15 out of 30), highlighting substantial deficiencies in policy integration, emergency preparedness, and community engagement. These disparities underscore an urgent need for the California Coastal Commission (CCC) to update and enhance its wildfire guidance to address the growing risks associated with the Wildland-Urban Interface (WUI) within the Coastal Zone.

The findings reflect that wildfire mitigation within coastal communities remains uneven and largely reactive, with only jurisdictions like Laguna Beach converting past fire experiences into long-term planning reforms. This uneven implementation is attributable in part to the lack of mandatory wildfire-specific standards within the CCC's current LCP certification process. Unlike Cal Fire, which mandates fire hazard assessments, safety element updates, and fuel management under Government Code § 65302(g), the CCC offers only generalized guidance under the umbrella of "natural hazard mitigation" (California Department of Forestry and Fire Protection [Cal Fire], 2023; CCC, 2023b). This regulatory gap leads to a patchwork of local approaches that often omit comprehensive wildfire planning, especially in jurisdictions with limited resources or recent fire exposure.

Importantly, none of the jurisdictions studied fully incorporate climate change projections into wildfire mitigation strategies. This is a significant oversight, as climate science indicates that wildfire frequency, intensity, and geographic spread are increasing rapidly due to rising temperatures, prolonged droughts, and altered precipitation patterns (Abatzoglou & Williams, 2016; IPCC, 2022). LCPs that fail to consider future climate-driven fire scenarios are at risk of becoming outdated, resulting in static policies that cannot keep pace with dynamic environmental conditions.

A further concern is the consistently weak integration of public health and post-fire recovery planning across all jurisdictions. Wildfire impacts extend beyond the immediate burn zone, affecting air quality, community mental health, and economic stability (Edgeley & Paveglio, 2019). The absence of smoke readiness protocols, clean air shelters, and recovery planning in both Malibu and Santa Cruz exposes residents to cascading post-disaster risks that could be mitigated through proactive inclusion in LCPs. Even in Laguna Beach, public health strategies are only moderately developed, suggesting a broader statewide need to address wildfire-related health vulnerabilities as part of coastal resilience.

Interagency coordination also emerged as a distinguishing factor among the jurisdictions. Laguna Beach's close collaboration with the Orange County Fire Authority has resulted in well-integrated fuel treatment programs, evacuation drills, and shared risk assessments. In contrast, Santa Cruz and Malibu lack formalized partnerships with their respective fire agencies within the context of LCP planning. This deficiency underscores

the importance of institutional relationships in translating state or regional fire management strategies into effective local action.

Socio-political dynamics further influence the extent and effectiveness of wildfire mitigation integration. Malibu's reluctance to adopt stringent mitigation standards appears tied to political resistance to land use restrictions, concerns over property rights, and a legacy of valuing coastal aesthetics and access over risk reduction. Meanwhile, Santa Cruz's progressive coastal and environmental planning efforts have not translated into comprehensive fire planning, likely due to institutional focus on other pressing issues like sea-level rise and housing affordability. These cases illustrate that technical solutions alone are insufficient without corresponding political will and community engagement.

The FAC framework proved to be a useful tool for evaluating LCP effectiveness, offering a holistic lens through which to assess wildfire preparedness. However, one limitation is that the FAC model relies heavily on voluntary local participation and assumes a baseline level of planning capacity that may not exist in all jurisdictions (FAC Net, 2023). Smaller cities or under-resourced coastal communities may require additional state support to reach even the "moderately adapted" threshold. Embedding FAC components directly into CCC guidance and LCP requirements could ensure more equitable and standardized wildfire mitigation across the Coastal Zone.

In summary, the findings from this study demonstrate that current CCC guidance is not sufficiently robust to ensure comprehensive wildfire hazard mitigation across California's coastal jurisdictions. By adopting more prescriptive and enforceable wildfire standards, the CCC can help close the resilience gap between jurisdictions and support a more

proactive, climate-informed approach to coastal wildfire planning. Integrating wildfire mitigation into the core of LCPs, on par with sea-level rise, erosion, and habitat conservation, is essential to safeguarding the future of California's coastal communities.

Regulatory Guidance

To implement the wildfire hazard mitigation improvements proposed in this thesis, a structured policy pathway is necessary. The first step involves identifying and framing the issue: wildfire risk within the California Coastal Zone remains under-addressed in current California Coastal Commission (CCC) guidance, despite increasing overlap between Wildland-Urban Interface (WUI) areas and coastal communities. Showing this overlap will help establish wildfire as an emergent hazard that requires more proactive integration into the CCC's Local Coastal Program (LCP) guidance.

The second step is to build a coalition of stakeholders committed to integrating wildfire mitigation into coastal planning frameworks. This coalition should include representatives from the CCC, CAL FIRE, the Office of Planning and Research (OPR), the Governor's Office of Emergency Services (Cal OES), local city planners, and community-based organizations. This cross-agency collaboration can foster the development of model policies and strengthen intergovernmental coordination. Through this partnership, a third step can be undertaken: the development of model wildfire hazard mitigation language for use in LCPs. These model provisions should align with CAL FIRE's General Plan Safety Element requirements—such as those mandated by Senate Bills 1241, 379, and 99—and include actions such as wildfire vulnerability assessments, defensible space requirements, fuel

modification zones, evacuation route planning, and land use limitations within Very High Fire Hazard Severity Zones (VHFHSZs).

Once model policies are developed, the fourth step involves initiating updates to the CCC's administrative procedures and LCP Update Guide. Petitioning the Commission to formally include wildfire hazard mitigation as a priority, alongside sea-level rise and erosion, would institutionalize this risk within the agency's review and certification criteria. This step is supported by provisions in the Coastal Act (e.g., Sections 30253 and 30006.5), which provide a legal basis for addressing emerging hazards and integrating climate resilience. Following this, pilot projects can be launched in selected jurisdictions, such as Santa Cruz or Malibu, to test implementation of the proposed policies. Funding for these pilot efforts could be obtained through sources such as the California Coastal Resilience Program or Sustainable Communities Planning Grant Program. These pilots would demonstrate the feasibility and effectiveness of enhanced wildfire mitigation in LCPs and provide models for statewide replication.

To sustain and scale these efforts, the sixth step involves seeking legislative and budgetary support. New legislation could mandate the integration of wildfire mitigation into all future LCP updates, similar to how SB 379 requires climate adaptation to be addressed in General Plans. Budget allocations should also be secured to support jurisdictions with technical assistance, wildfire vulnerability mapping, and community engagement efforts. Lastly, ongoing monitoring and evaluation should be institutionalized to ensure continuous improvement. The CCC could include wildfire resilience metrics in annual LCP reporting

requirements, and jurisdictions could periodically reassess their programs using the FAC rubric. This comprehensive policy pathway not only supports the recommendations made in this thesis but also promotes long-term resilience for coastal communities increasingly vulnerable to wildfire hazards.

Overall differences and similarities for General Plan Safety Element and Local Coastal Programs

The General Plan Safety Element and Local Coastal Programs are both vital planning tools used by California jurisdictions to guide land use and development while addressing environmental hazards. However, their scopes, mandates, and implementation frameworks differ in important ways. The Safety Element is a required component of every local general plan under California Government Code §65302(g), focusing broadly on protecting communities from hazards such as wildfires, floods, earthquakes, and climate change. It is designed to reduce risks to life, property, and critical infrastructure across the entire jurisdiction. In contrast, LCPs are specific to jurisdictions within the California Coastal Zone and are required under the California Coastal Act of 1976. LCPs consist of a Land Use Plan (LUP) and an Implementation Plan (IP), and are certified by the California Coastal Commission to ensure consistency with the Coastal Act's goals, which include protecting coastal resources, ensuring public access, and minimizing coastal hazards.

Despite their differing mandates, both planning mechanisms share a strong emphasis on hazard mitigation, climate adaptation, and sustainable development. Both documents are required to consider current scientific data, mapping, and risk assessments in their planning

processes. Recent legislative updates, such as SB 379, require Safety Elements to include climate change vulnerability assessments and adaptation strategies, mirroring the Coastal Commission's guidance that LCP updates account for sea level rise and evolving coastal risks. Additionally, both planning tools encourage integration with Local Hazard Mitigation Plans (LHMPs) to ensure consistency and eligibility for post-disaster funding. The emphasis on public safety, infrastructure resilience, and environmental sustainability makes them complementary frameworks, especially in coastal communities where overlapping hazards occur.

The primary difference lies in their jurisdictional scope and regulatory authority. Safety Elements apply citywide or countywide and are developed and implemented solely by the local government. LCPs, however, apply only to the designated Coastal Zone and require certification by the California Coastal Commission. Once certified, local governments gain authority to issue coastal development permits (CDPs), though the Commission retains appellate authority in specific areas. Moreover, the Safety Element focuses broadly on all hazards, geologic, climatic, and human-caused, while LCPs emphasize hazards unique to the coastal environment, including shoreline erosion, bluff collapse, tsunami risk, and increasingly, wildfires at the wildland-urban interface near the coast.

Finally, implementation mechanisms differ: Safety Elements guide zoning, subdivision, and infrastructure decisions across the general plan, while LCPs establish coastal-specific zoning ordinances and permit procedures that must align with the Coastal Act. The CCC's LCP Update Guides (Parts I and II) stress clear procedures for permit processing,

exemptions, appeals, and alignment with evolving climate science. In contrast, the OPR's Safety Element guidance emphasizes regional coordination, integration with hazard mitigation strategies, and climate adaptation across a broader landscape. Together, these planning tools ensure that development in California, especially in high-risk, high-value coastal zones, is done safely, equitably, and in harmony with environmental stewardship goals.

Standardized Regulations

Integrating the required information from the General Plan Safety Element Assessment provided by the CalFire Board of Forestry and Fire Protection into LCPs offers a critical opportunity to align coastal land use planning with modern fire hazard mitigation standards. LCPs, which must be consistent with the California Coastal Act, guide development within the Coastal Zone and are required to address hazards such as erosion and sea level rise. However, given the increasing frequency and severity of wildfires, particularly in the Wildland-Urban Interface (WUI), there is an urgent need to expand LCPs to also incorporate comprehensive wildfire risk reduction strategies. Incorporating the safety element compliance guide into the LCP update process ensures that wildfire hazard data, fire-safe land use policies, and infrastructure requirements are addressed within coastal jurisdictions that contain State Responsibility Areas (SRAs) and Very High Fire Hazard Severity Zones (VHFHSZs).

Coastal jurisdictions should begin by incorporating CAL FIRE's Fire Hazard Severity Zone maps into coastal zoning maps and identifying the general location of land uses, roads, and

critical infrastructure within fire-prone areas of the Coastal Zone. By including these datasets in the LUP, jurisdictions can better assess vulnerabilities and ensure that proposed land uses are evaluated with respect to wildfire exposure. Furthermore, referencing related documents like Community Wildfire Protection Plans (CWPPs) and Local Hazard Mitigation Plans within the LCP provides a legally recognized foundation for hazard mitigation and enables consistency across planning frameworks.

The goals, policies, and implementation measures required by the safety element compliance guide can be embedded into the hazard mitigation sections of LCPs, especially as part of the safety and conservation components of the LUP. For instance, LCP policies could prohibit new subdivisions in VHFHSZs unless fire-safe development standards are met and adequate emergency access and water infrastructure are ensured. Policies should also promote vegetation management, defensible space, and long-term maintenance of community fire breaks, particularly for residential developments adjacent to natural open space. Incorporating these measures ensures LCPs not only reduce wildfire risk but also remain compliant with both the Coastal Act's hazard avoidance mandates and California Government Code §65302 requirements.

Coastal cities and counties can apply the infrastructure standards from the compliance guide to Coastal Development Permit (CDP) review processes. As part of the permitting review, applicants should be required to demonstrate compliance with fire-safe access, water supply, visible addressing, and evacuation planning before approval is granted. These conditions can be integrated into the implementation plans and zoning ordinances of the

LCP, ensuring that wildfire resilience is a prerequisite for new development. In this way, the LCP can act as a regulatory mechanism to enforce the infrastructure and mitigation goals laid out in the safety element compliance guide.

Finally, the compliance guide's emphasis on interagency coordination and public outreach can be leveraged through the LCP's implementation program. Coastal jurisdictions should formalize partnerships with CAL FIRE, local fire protection districts, and the Office of Emergency Services to plan, review, and implement fire hazard reduction projects. This can include joint fire-safe education campaigns, evacuation route signage, and training drills tailored for high-risk coastal communities. Furthermore, jurisdictions can update their LCP monitoring and reporting procedures to track wildfire resilience metrics, thereby supporting adaptive management and continuous improvement of wildfire mitigation in the Coastal Zone.

Public Education of Local Coastal Programs

The California Coastal Act of 1976 created a comprehensive framework to protect California's unique and sensitive coastal resources while balancing environmental preservation with responsible development. One of the Act's most significant planning tools is the LCP, which allows for the delegation of permitting authority from the California Coastal Commission to individual local governments. This delegation reflects a broader policy principle of subsidiarity, where governance responsibilities are assigned to the lowest possible level that can effectively carry them out, in this case, allowing cities and counties to tailor coastal planning policies to local conditions.

An LCP is a locally prepared and implemented planning document that governs land use and development in the Coastal Zone. It consists of two main components: a Land Use Plan (LUP) that sets out goals and policies for coastal development and environmental protection, and an Implementation Plan (IP) that contains the specific zoning ordinances, regulations, and review procedures to carry out those policies. Together, these elements must be certified by the CCC to ensure they are consistent with the goals of the Coastal Act. Once certification is complete, the local jurisdiction assumes authority to issue Coastal Development Permits (CDPs) for most proposed developments in its portion of the Coastal Zone, reducing the need for state-level review and streamlining the permit process.

The function of LCPs extends beyond administrative efficiency. By allowing local jurisdictions to manage development in the Coastal Zone, LCPs are intended to integrate state-level environmental mandates with localized planning expertise and community priorities. This decentralized approach supports place-based decision-making and offers flexibility for local governments to develop coastal policies that are tailored to specific ecological, social, and economic contexts. It also fosters a greater sense of ownership and accountability over land use decisions, potentially leading to more innovative and community-responsive outcomes.

However, this delegation of authority also creates challenges. While LCPs must initially meet the policy requirements of the Coastal Act to receive certification, there is no uniform mandate for hazard-specific updates, particularly for emerging threats such as wildfires, sea-level rise, and extreme weather events. As a result, LCPs often remain static and

outdated, especially in jurisdictions with limited planning capacity or resources. Without ongoing oversight or required periodic revisions to address evolving climate risks, LCPs may fail to offer adequate protection for people, property, and coastal ecosystems. This has led to calls for the CCC to revise its guidance and update protocols to incorporate mandatory hazard mitigation standards, including alignment with Cal Fire's General Plan Safety Element requirements.

Compounding this issue is the general lack of public awareness and engagement with LCPs. Despite their critical role in determining what gets built and protected along California's coast, LCPs remain largely invisible to the average resident. Many community members are unaware that their city or county even has a certified LCP, let alone how it functions or what it regulates. This lack of public understanding represents a significant barrier to accountability and climate adaptation. A well-informed public is more likely to engage with local planning processes, advocate for necessary updates, and support the integration of hazard mitigation strategies into coastal policies.

To address this gap, local governments and the CCC must invest in public education and outreach efforts that demystify the role of LCPs. This can be achieved through a variety of means, including interactive web platforms that display LCP maps and development standards, community workshops that explain how LCPs influence development decisions, and educational campaigns using local media and schools to raise awareness. In high-risk areas such as the Wildland-Urban Interface (WUI), targeted outreach should emphasize the connection between land use decisions and hazards like wildfire, highlighting how LCPs can

serve as a tool for risk reduction. Public participation should be viewed not as a procedural formality, but as an essential component of long-term climate resilience and equitable coastal governance.

In conclusion, Local Coastal Programs serve a vital function in California's coastal management framework by enabling local control over development while ensuring alignment with state environmental goals. However, without required hazard-specific updates and robust public engagement, the effectiveness of LCPs is undermined. A renewed focus on education, transparency, and community empowerment is necessary to ensure that LCPs evolve alongside California's growing climate challenges and truly serve the interests of the communities they are meant to protect.

Limitations and Future Research

While this study provides valuable insights into the integration of wildfire mitigation into Local Coastal Programs, several limitations should be acknowledged.

First, the study was limited to three jurisdictions: Laguna Beach, Malibu, and Santa Cruz. Although these cities were selected for their relevance and wildfire history, broader generalizations across California's entire Coastal Zone should be made cautiously. Future research could expand the evaluation to additional coastal cities facing similar wildfire risks, such as the Montecito, Half Moon Bay, or Monterey communities.

Second, the FAC framework evaluation was based primarily on document analysis. Although supplemented with secondary literature, direct interviews with fire officials,

emergency managers, or city planners were outside the scope of this project. Future studies could include stakeholder interviews to gather perspectives on the effectiveness of implemented wildfire mitigation strategies and identify operational challenges.

Third, while the study considered climate change as an emerging risk factor, detailed modeling of future wildfire scenarios in the specific study areas was beyond the research's scope. Future research could integrate localized climate modeling and scenario planning to assess how future wildfire risk might alter the effectiveness of current LCP policies.

Finally, as wildfire science, mitigation technologies, and land use planning strategies continue to evolve, ongoing research is needed to update best practices and inform coastal policy. Continuous reassessment of the CCC's wildfire guidance will be necessary to ensure that it remains responsive to emerging threats.

CONCLUSION

The evaluation revealed that while certain cities, such as Laguna Beach, have adopted relatively strong wildfire mitigation strategies, overall integration of wildfire resilience into LCPs remains inconsistent and incomplete. Emergency evacuation planning, vegetation management, community education, and post-fire recovery processes are often underdeveloped or entirely absent in coastal planning documents. Furthermore, climate adaptation remains insufficiently incorporated, despite clear evidence that wildfire hazards are being amplified by climate change.

The CCC must adopt a more proactive leadership role by updating its wildfire guidance for LCPs. By providing detailed, enforceable standards, particularly in the areas of evacuation planning, defensible space, fuels management, climate resilience, and post-fire recovery, the Commission can better protect both human communities and the coastal resources it is mandated to steward.

Wildfire resilience is no longer a concern isolated to inland or mountainous regions; it is now a central challenge for coastal communities as well. The Coastal Zone faces a unique intersection of environmental, social, and governance challenges, from sea-level rise to wildfire hazards, that require a more integrated and anticipatory planning approach. Strengthening wildfire mitigation within LCPs is not merely a technical planning exercise; it is an essential step toward ensuring the long-term sustainability, safety, and livability of California’s coastal regions.

The findings of this study emphasize that proactive wildfire planning must be treated as a core element of coastal resilience. As the climate continues to change and wildfire

threats escalate, the California Coastal Commission has an opportunity and a responsibility to lead the way in building safer, more adaptive coastal communities.

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