



A graphic overlay in the bottom-left corner. It features a large yellow number '5' inside a circular frame composed of four overlapping, semi-transparent colored bands (red, green, yellow, and blue). To the right of the number is a white outline map of California with a yellow square highlighting the location of Corte Madera. Below the number and map, the text 'central corte madera' is written in a bold, yellow, sans-serif font.



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Central Cortez Madera contains an array of valuable single and multi-family residences, businesses, public safety facilities, critical public infrastructure and a multi-modal transportation network. Two Central Cortez Madera shopping centers, Town Center and The Village at Cortez Madera, are critical to the economic health and vitality of the Town, providing much of the Town’s sales tax income. In fact, sales tax revenue accounts for about 20% of the Town’s annual net revenue (based on 2016-17 revenue calculations).^{144,145} Inland flooding from extreme precipitation events is the biggest exposure for this area, though it is also at risk of coastal flooding, wildfire, and other secondary climate impacts. Stormwater runoff has been a particular prob-

lem in some areas of the Town due to climate-induced increases in extreme precipitation, undersized storm drain pipes, inadequate drainage systems, poor inlet conditions, the lack of sufficient gradient for runoff, and land subsidence, which increase the vulnerability of low-lying areas to flooding and pooling.¹⁴⁶

In specific areas, the stormwater network is already experiencing deficiencies during extreme precipitation events. High tides can exacerbate flooding by limiting drainage into the Bay. The steep hills surrounding Cortez Madera to the south and west contribute to flooding by funneling water into the central portions of town. Cortez Madera Creek, which drains the Ross

Valley Watershed, and San Clemente Creek, a tidal slough draining runoff into San Francisco Bay, also contributes to flooding within the Town. In response to flooding conditions along San Clemente Creek, many residents have raised and reinforced the foundations of their homes when remodeling.

The hazards of inland flooding come not only from the water itself, but the fact that there are people, buildings, and other assets in harm’s way. One way to reduce these risks is to redesign how the town builds. In 1986 the Cortez Madera Town Council established the Flood Control Board, which is responsible for advising the Town Council on all matters affecting flooding and flood protection in Cortez Madera.¹⁴⁷ Ordinances addressing flood damage prevention in the Town of Cortez Madera are contained in Chapter 16, Protection

of Flood Hazard Areas, of the Town’s Municipal Code. For example, most individual development projects are required to complete a detailed hydrologic study prior to Town issuance of development permits. These studies aim to identify downstream areas that experience localized flooding, detail potential impacts that proposed projects could create on these areas, and identify both on-site and off-site mitigation measures that would be required to prevent these impacts.¹⁴⁸

Flooding can also create pollution from combined sewer overflows¹⁴⁹ and roadway surface runoff to fresh and marine water systems and introduces toxins to the food chain and water supply. Further, flood-related transportation disruptions can cause significant hardship to both Cortez Madera and surrounding communities.

BY THE NUMBERS

7

The number of parks located in central Cortez Madera.

2

The number of fire stations in central Cortez Madera.

34

The number of water pump stations located throughout Cortez Madera.

242

The number of hotel rooms located in central Cortez Madera.

41.4

The total miles of pipes in the stormwater system in Cortez Madera.

121

The total number of retail stores located in the malls in central Cortez Madera.

6,315

The total number of living units in central Cortez Madera.

Central Adaptation in Practice

The suite of actions include: assessment and improvement to the Town’s drainage infrastructure;¹⁵⁰ careful planning for new developments; retrofitting, protecting and improving current infrastructure; supporting all residents, and enhancements of some planning policies. These actions generally fall into two main categories: collaboration and prevention.



COLLABORATE

© Corte Madera Memories

Central Corte Madera is located at the base of Mount Tamalpais and near the mouth of Corte Madera Creek. The steep hills surrounding Corte Madera to the south and west contribute to flooding by funneling water into the central portions of town. Corte Madera Creek, which drains the Ross Valley Watershed, and San Clemente Creek, a tidal slough draining runoff into San Francisco Bay, also contributes to flooding within the Town. In response to flooding conditions along San Clemente Creek, many residents have raised and reinforced the foundations of their homes when remodeling.

While the Town itself can do a lot to reduce local flooding, it can not tackle this issue on its own. As the recent Marin County Civil Grand Jury report on adaptation states, “Marin needs stronger collaboration among county, cities, towns, and agencies” to adapt to climate change,¹⁵¹ and this need for collaboration is readily ap-

parent in the Central portions of Town.

While there has been on-going project planning for Corte Madera creek that recognizes the need for multi-jurisdictional collaboration, more can be done to successfully reduce flooding in the area.¹⁵² Collaboration can extend beyond preparing for extreme precipitation events to enhancing partnerships to better understand and monitor groundwater, limit coastal flooding, and make efficient use of emergency management investments. The Town already benefits from a Joint Powers Authority for both police and fire protection and collaboration will be critical in both better understanding the complex set of climate and extreme weather risks for the area and developing effective solutions. Collaboration between the Town, businesses, residents, and workers require effort, but can drastically improve the success of any adaptation actions in the region.



FEATURED ACTIONS: COLLABORATE

Continue to monitor groundwater levels, and consider associated impacts in current and proposed designs for development.

Project

Lead: TBD

While there have been lots of geotechnical borings for development, there has yet to be a systematic monitoring system for tracking groundwater levels in the Town. SFEI is participating in a California Resilience Grant project to better understand groundwater levels around the Bay. Marin County is one of four counties participating in the study and the Town of Corte Madera should consider partnering with SFEI on this project.

Partner with other organizations and academic institutions to conduct studies of the impact combined riverine and coastal flooding and increased precipitation has on flood risk and vulnerability.

Project

Lead: TBD

Precipitation in the region is likely to remain extremely variable. Where that precipitation falls will largely determine where the flood waters go and who is affected. It will take detailed hydraulic modeling to better understand how the system will work with more extreme precipitation events and how different interventions can reduce or limit those impacts.

Collaborating to Limit Stormwater Pollution

The Marin County Department of Public Works/Flood Control District administers the Marin County Stormwater Pollution Prevention Program (MCSTOPPP). This is a collaborative effort by municipalities and unincorporated areas whose watersheds drain to San Francisco and San Pablo Bay. Formed in 1993, MCSTOPPP provides measures to dictate compliance with state and federal regulations, reduce or prevent stormwater pollution, and protect water quality in creeks and marshes.¹⁵³ Corte Madera has its own Urban Runoff Pollution Prevention ordinances that incorporate best management practices.¹⁵⁴



FEATURED ACTIONS: COLLABORATE

Coordinate with local/state/national agencies to create a certificate that improves resale property value and insurability for homes that have complied with flood-prevention regulations, community rating standards, and building codes.

Program

Lead: TBD

The creation of a standardized certificate that notes compliance with certain requirements could incentivize property owners to comply with stormwater management standards, floodproofing requirements, and other selected criteria. The exact use of the certification could be determined as the program is developed, and participating partners or agencies could help shape the program through development.

Collaborate with Flood Control Zone 9 advisory board, partner agencies, and municipalities within Ross Valley Flood Control Zone to align green infrastructure projects and regulations for watersheds across jurisdictions to reduce impervious hard surfaces and require integration of green infrastructure techniques into site design.

Policy

Lead: TBD

Working collaboratively to reduce impervious surfaces can effectively reduce the amount of stormwater runoff that flows into Corte Madera creek, which can inundate the Town and overwhelm the local stormwater infrastructure. Working collaboratively within the Flood Control Zone to align green infrastructure requirements makes localized action more effective at reducing flood risk.

Participate in any future discussions around creek restoration and flood mitigation in the Corte Madera Creek upper watershed.

Policy

Lead: TBD

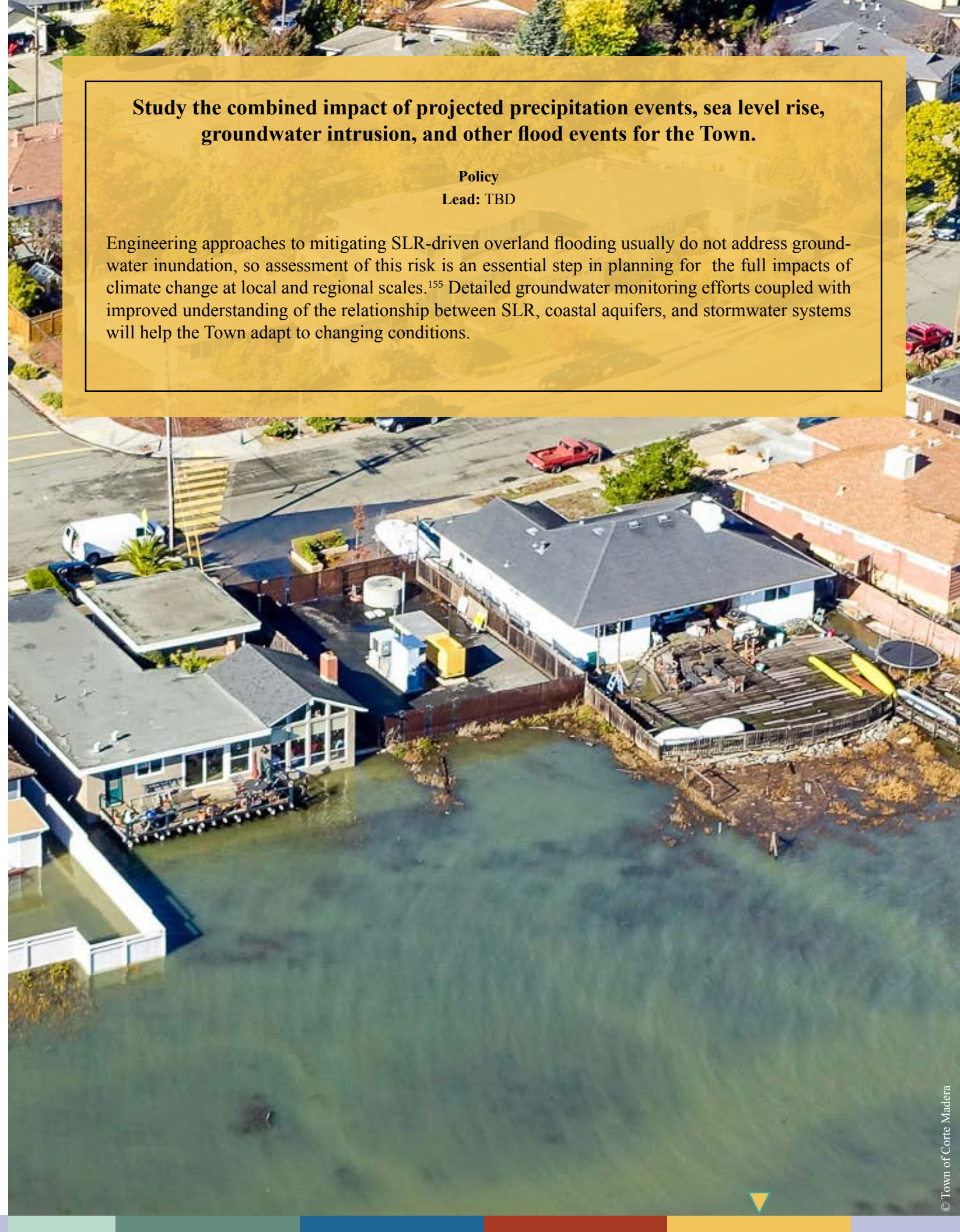
Ross Valley is a large watershed with many players and rainfall that happens upstream can end up in Corte Madera. Continuing to collaborate or strengthening the collaboration with other jurisdictions and agencies can ensure that funding and efforts are allocated effectively to reduce riverine flooding in the region.

Study the combined impact of projected precipitation events, sea level rise, groundwater intrusion, and other flood events for the Town.

Policy

Lead: TBD

Engineering approaches to mitigating SLR-driven overland flooding usually do not address groundwater inundation, so assessment of this risk is an essential step in planning for the full impacts of climate change at local and regional scales.¹⁵⁵ Detailed groundwater monitoring efforts coupled with improved understanding of the relationship between SLR, coastal aquifers, and stormwater systems will help the Town adapt to changing conditions.



Climate, Housing, and Resilience

Corte Madera is a unique and desirable place to live. It is a great place to raise children, has good schools, great public services, and strong shared community values. In addition, the Town's natural features - the mountains, Bay, and ocean - are beautiful and provide fantastic opportunities for recreational activities like hiking, boating, and biking.

While all change can be hard, it is in many ways inevitable. Extraneous forces - like the changing economy, climate change, and globalization - are shaping the Town, region, and State. The State of California is currently facing an extreme housing shortage and is requiring communities to invest in, and develop, new housing. At the same time, climate change, global pandemics, and other economic forces are causing disruption across the country and are pushing people to move. One 2017 study indicated that around 1/3 of the people in Marin County (roughly 700,000 people) may need to move in the coming decades due to sea level rise alone.¹⁵⁶ Another study shows that "one in 12 Americans in the Southern half of the country will move toward California, the Mountain West or the Northwest over the next 45 years because of climate influences alone."^{157,158} Climate change is increasingly intensifying these challenges and will continue to be a factor in human migration patterns across the region, country,¹⁵⁹ and globe.¹⁶⁰

The Town will have to evolve, grow, and create opportunities for new development and housing. How can Corte Maderans embrace new development while designing it in a way that also enhances the resilience of the community?

As the State prioritizes local housing production goals, objective design standards can provide a streamlined and predictable review processes, and ensure that new infill development and redevelopment reflect market realities and the desired character of current residents. Key questions continue to emerge as a part of this discussion of the Town's priorities for future growth:

1. How can the Town ensure that future growth is in line with the Town's broader community goals, including sustainability, equity, resilience, and accessibility?
2. What kind of new development will help meet its goals for future growth (i.e. development location, uses, density, and design)?
3. Where, and what kind of infill and redevelopment should the Town prioritize?

By creating the framework for decision-making now, the Town can accommodate new residents (or residents who have to move out of harm's way) in ways that reduce climate risk, enhance economic vibrancy, and create affordable spaces to live, work, and play.

Nearly 90% of Corte Madera's current residential housing is single family homes and the majority of those homes are located in either a wildfire or sea level rise risk area. If the Town is going to successfully make space for Corte Maderans who may eventually need to move and also for new residents, more attention will need to be dedicated to diversifying housing opportunities and potentially creating more multi-family dwelling units.

Resilient Development

Resilient new development is situated away from high risk hazard zones, uses climate-safe building materials (in line with both the Town's WUI requirements and Sea level rise overlay zone), and provides access to multimodal transportation options. Some parts of the Town, including many hillside and waterfront neighborhoods, already have limited connections to the Town center's civic uses and to mobility options including transit, ferry, and US Highway 101. Within and near the center of Town, Tamal Vista and Tamalpais Drive are two of the town's major transportation corridors. Each has a mixture of business and residential land uses and could be targeted areas for future zoning and land use changes to support more dense mixed-use development. Planning for development at these locations will position the Town to meet future State-mandated housing production goals. In addition, there are considerable opportunities to retrofit or repurpose existing parking lots in Central Corte Madera for residential housing. Encouraging compact, mixed-use, bikeable/walkable redevelopment in these corridors can also serve the Town's climate resilience goals, while also providing diverse housing choices for current and future Corte Madera residents, increasing economic activity, and improving residents' quality of life.

Decision-makers should also consider development location and housing patterns in their land-use planning. This can have important implications for the susceptibility of a community to wildfire. For example, "leapfrog development" - low housing density and large numbers of small, isolated clusters of development that are filled in over time - is shown to have the most elevated fire risk in comparison to others.¹⁶¹

Norfolk, Virginia

In 2016, Norfolk finished its Vision2100 plan, which makes resilience part of its brand, billing itself as "the coastal community of the future." The words in its preface set the tone for the plan, stating that climate change is "not ... a dilemma, [it's] an opportunity — an opportunity to reimagine the city for the 22nd century."¹⁶²

Fundamental to Norfolk's approach is a concept called Resilient Zoning. Part of this approach allows developers to choose specific design elements from a menu of features in order to reach project approval. The Resilient Zoning concept uses a "resilience quotient," a points-based matrix that allows developers to choose from a menu of building features — ranging from green roofs to backup power systems — to reach a threshold required for project approval.¹⁶³ Norfolk's Resilient Zoning also includes a more complex initiative (though still much cheaper than armoring the coastline). This new initiative revised the zoning code to require a three-foot "free-board" (elevation of the ground floor above grade) and pervious parking surfaces in the most flood-prone areas. It also incentivizes high-density development in more flood-safe upland areas by streamlining the permit and approval processes.



PREVENT

Corte Madera faces decisions on how to most effectively invest money into retrofitting existing infrastructure or building new infrastructure to accommodate stormwater runoff. Taken holistically, the stormwater drainage system is a combination of natural assets (trees, detention ponds, creeks and canals) and hard infrastructure (storm drains, pipes, and pumps) throughout the Town. Since severe flooding closed roads and inundated storefronts in 1982, the Corte Madera has invested more than \$30 million to improve the stormwater system.¹⁶⁴

There are a number of interrelated concerns tied to stormwater in the central portion of the Town and need to be addressed for the community to successfully prepare for climate change. This includes better accommodating the extreme precipitation events that are affecting the town more and more frequently, to understanding how rising groundwater will affect hydrologic conditions across the Town.

As a bayfront community, groundwater levels in the Town fluctuate over time due to variations in rainfall,

water levels in nearby lagoons and ponds, and tides. Geotechnical investigations and borings done throughout the community indicate that groundwater levels are generally only five to 10 feet below the surface and can be as shallow as four feet after heavy rains.¹⁶⁵ When groundwater levels are high, it can seep into structures through foundations causing property damage. Geologic or hydrologic studies could identify where shallow coastal aquifers and groundwater are located as well as areas that have the potential for temporary and/or long term underground water storage.

The first step in ensuring the effectiveness of a stormwater system is to decrease peak water flows. Green infrastructure offers a suite of cost-effective solutions that can help improve the Town's resilience by managing flows and floods. Additional prevention can be done at the individual parcel level through investments in not only green infrastructure, but also by elevating buildings, roadways, and critical infrastructure above flood levels. Strategic siting of infrastructure (such as new higher density housing or new businesses) can help prevent flooding and limit impacts.



FEATURED ACTIONS: PREVENT

Promote regional efforts to analyze feasibility and effectiveness of additional green infrastructure on commercial and residential properties in mitigating stormwater runoff.

Project

Lead: TBD

Green infrastructure can reduce the strain on stormwater infrastructure by reducing the amount of water needed to be pumped to the Bay during high precipitation events. In order to determine the efficacy of additional green infrastructure, the Town needs to analyze current capacity and potential sites for additional infrastructure (see Figure 5.1). While green infrastructure cannot solve all of Corte Madera's flooding woes on its own, it is an effective flood solution when coupled with improved traditional stormwater infrastructure.



Figure 5.1. Suitable areas within Corte Madera for green infrastructure (permeable pavement, vegetated swales, or bioretention). Source: Kass et al, 2011

Address flooding issues on Casa Buena Drive.

Project

Lead: Corte Madera Department of Public Works

Subject to flooding during extreme precipitation events, Casa Buena Drive is a significant surface street for the town, connecting residential areas and small businesses to Tamalpias Drive. The first step to ensure the safety of residents and access to this section of town, is upgrading the storm drain system along the roadway to ensure that it has the capacity to handle the larger precipitation events already occurring almost annually (~\$200,000). Over the longer-term, the drive should be added to a list of important roadways to elevate to ensure functionality during extreme weather events especially as sea levels rise (~\$500,000).





Case Study: Rotterdam, The Netherlands

One of Rotterdam's 'climate-proofing' measures includes the use of rooftop greenery. The City's many flat roofs are a resource for making buildings more climate resilient, healthier, and more attractive by covering them with soil and vegetation. These green roofs absorb rainwater and down-pours have less impact on the city's storm sewers and drainage system. The green roofs, together with tree-lined infiltration zones along streets, help limit heat stress by making the city shadier and cooler. Green roofs also help insulate buildings, reducing the need for air conditioning or heating.¹⁶⁶

Provide policy incentives, such as fast-track permitting, to property owners for green infrastructure and stormwater projects that adhere to a stricter set of requirements.

Policy

Lead: TBD

Reducing the time and effort required to adhere to existing requirements incentivizes property owners to not only comply with the green infrastructure requirements, but to exceed them. The exact policy incentives can be expanded or further explored by the Town and should also include feedback from property owners as to what incentives would be most effective.

Develop a "Homeowners and Small Business Guide to Stormwater Management" to educate home and small business owners on regulations, and highlight the role that engaged residents can play to assist with community-based stormwater management.

Project

Lead: TBD

Providing homeowners and small business owners a consolidated guide on current stormwater regulations and best practices can aid in compliance. Simply informing residents and business owners of their responsibility and the role they play in reducing stormwater runoff can potentially aid in the success of reducing runoff.

Update the Storm Drainage Master Plan to include an assessment of current infrastructure and its ability to handle projected extreme precipitation and sea level rise. Effectively reevaluate the stormwater infrastructure and flood control systems.

Project

Lead: Corte Madera Public Works

It is time to invest in updating the Storm Drainage Master Plan and to specifically include an analysis of the stormwater and flood control system infrastructure capacity to accommodate increasing sea levels and runoff from heavy precipitation events.





Stormwater/Drainage Master Plan Updates

A lot has changed since Corte Madera developed a stormwater management system 50 years ago. Despite major investments in the last 20 years, climate driven heavy precipitation and stormwater continues to disrupt homes, businesses, and transportation networks.

It is time to update to the Storm Drainage Master Plan. This climate smart update will assess current system capacity and help the Town plan for and manage intensifying precipitation, stormwater, and sea level rise.

The updated Storm Drainage Master Plan will include an analysis of the Town's detention and retention basins, pumping infrastructure, pipes, and the storm drain network; it will also provide current and recommended capacities that consider climate projections.

The plan aims to identify a combination of nature-based and, where necessary, hard infrastructure solutions to upgrade the existing flood control system's capacity to handle the compounding, near- and long term impacts of larger flood events and higher sea levels. Potential strategies include:

- Analyzing current stormwater system capacity.
- Identifying desired flood protection levels in 25, 50, and 100 years.
- Identifying appropriate green, nature-based, and non-structural approaches to flood mitigation
- Upsizing pumps to effectively manage increased precipitation, runoff water levels, and water pressure.
- Assess whether dredging projects can achieve desired future flood protection levels.