

## Consideration of Sea Level Rise in Recent LCP Updates: Marin Case Study

### Introduction

In August of 2015, the Coastal Commission unanimously adopted its Sea Level Rise Policy Guidance, which provides recommendations for how to address sea level rise within the context of the Coastal Act. In particular, the document discusses the importance of addressing sea level rise in Local Coastal Programs (LCPs). LCPs are a critical tool for addressing sea level rise because they dictate the types, intensities, and locations of allowable land uses in the coastal zone, providing a framework for implementing proactive adaptation strategies to address sea level rise vulnerabilities. However, many LCPs were certified in the 1980s and 1990s and need to be updated to reflect changed conditions, new information and knowledge, and new programs and policies, especially as related to climate change and sea level rise.

To that end, the Coastal Commission, in coordination with other state agencies including the State Coastal Conservancy and the Ocean Protection Council, has provided significant grant funding to support LCP updates with a particular emphasis on addressing sea level rise. To date, the Coastal Commission has awarded 3 rounds of grants totaling approximately \$4.5 million to support the completion of sea level rise vulnerability assessments, adaptation plans, Land Use Plan (LUP) and Implementation Plan (IP) updates, and local adoption and Coastal Commission certification of LCPs. The first round of grants was completed in April of 2016.

Four jurisdictions with grants from the Coastal Commission were chosen as case studies to provide information on how sea level rise adaptation planning and related LCP policy development is carried out on a local scale. The four jurisdictions – Marin County, and the cities of Pacific Grove, Goleta, and Newport Beach, were chosen because they represent a variety of geographic areas as well as different planning approaches. These four case studies provide valuable information and lessons learned on topics such as finding the right level of detail for vulnerability assessments, the utility of including a specific adaptation planning step, and the importance of adaptive LCP policies. More information on these topics can be found in each of the individual case studies.

The schematic below shows a generalized ideal process for how to address sea level rise through an LCP update. As of January 2017, Marin County has completed a vulnerability assessment and has locally adopted updates to the LUP and IP. Commission staff provided the County with guidance at each step in the process, including providing suggested language for hazards related policies. The County then submitted the locally adopted LCP to the Commission for certification, and, as is common during the certification process, Commission staff provided suggested modifications, most of them reflecting the same advice provided to the County as it was processing the amendment locally. The Environmental Hazards chapter of the LCP was presented at the November 2016 Commission hearing, but action was postponed to allow for additional coordination between County and Commission staff to address remaining policy concerns related to hazards and sea level rise. The County is also continuing to work on its adaptation plan, and the additional time for consideration of the Environmental Hazards chapter of the LCP may allow for the adaptation plan to ‘catch up’ to LCP policy development.

Overall, Marin’s sea level rise planning effort provides a good example of a detailed vulnerability assessment process and report that provides important and actionable information for adaptation planning. However, remaining policy concerns and the lack of proactive policies to address some identified vulnerabilities suggests that the effort would have benefitted from additional adaptation planning time so that the County’s adaptation plan could be better reflected in its proposed LCP policies, as well as additional coordination with Commission staff to better address staff’s concerns prior to local adoption of the LCP.



Figure 1. Marin County sea level rise planning as of January 2017

## Background

Marin County is located north of San Francisco and has approximately 106 miles of ocean coastline from Sonoma County to Point Bonita near the Golden Gate Bridge. The coastal zone contains approximately 130 square miles of the County’s 520 square miles of total land area. Of this total, approximately 53 square miles are owned and managed by the federal government, mostly within either Point Reyes National Seashore or Golden Gate National Recreation Area.



Approximately 75 square miles comprise the County’s LCP jurisdiction. The protection of agriculture is a primary LCP concern -- nearly two-thirds of the County’s LCP jurisdictional area is zoned Coastal Agricultural Production Zone. In addition to the federally managed parklands, the County also has important public access and visitor serving locations, scenic resources, and beaches, wetlands, and other habitats throughout its coastal zone, including areas vulnerable to sea level rise in Dillon Beach, Tomales, Bolinas, Stinson Beach, and Muir Beach.

The Marin County LCP was originally certified in 1982. In recent years the County has been working to develop its first major update to the LCP, with extensive collaboration and input from Commission staff throughout the local process. In May of 2014, the Commission conditionally certified the LUP portion of the Update, and in April of 2015 considered the IP portion of the update. At that 2015 hearing, the County withdrew its proposed IP update in order to spend more time addressing their concerns with the Commission approved LUP and Commission staff’s

recommendations on the IP. The Commission's 2014 approval of the LUP lapsed and was not ultimately certified.



In addition to the ongoing effort to comprehensively update the LCP, the County was awarded a Round 1 LCP Grant ([LCP-13-01](#)) in January 2014 (\$54,000) to address coastal hazards and sea level rise. This grant from the Coastal Commission was added to a \$200,000 grant from the Ocean Protection Council to complete a sea level rise vulnerability assessment, an adaptation plan, and an LCP amendment, and to support public outreach. As initially envisioned, this effort was intended to result in targeted amendments to the updated LCP (*i.e.*, amendments to the LUP that was conditionally approved in May 2014 and to the IP that was heard but withdrawn at the April 2015 hearing) that would further refine coastal hazards policies based on the findings of the vulnerability assessment and adaptation planning work. Since the updated IP was withdrawn at the April 2015 hearing, this work effort has moved along concurrently with the larger effort to comprehensively update the LCP. Ultimately, the County-proposed hazard amendments were an essentially new hazards program that differed in significant ways from what the Commission had conditionally approved in 2014.

Throughout the two-year grant term (April 2014 to April 2016), the County developed an extensive public outreach program and completed a detailed sea level rise vulnerability assessment. The County also initiated an adaptation planning process, resulting in a draft adaptation plan that identifies, evaluates, and prioritizes adaptation needs and potential strategies. The County is continuing to meet with stakeholders and members of the public to refine this adaptation plan. Marin County also developed updated policies to address coastal hazards and sea level rise (included primarily within the Environmental Hazards sections of the LCP). The entirety of the updated LCP was heard by the Commission at the November 2016 hearing. Although the balance of the LCP update was conditionally approved, the hearing on the Environmental Hazards section was continued to allow County and Commission staff to address several remaining policy concerns. Coordination on these topics is ongoing.

## Vulnerability Assessment

In September 2015, Marin County completed the *Marin Ocean Coast Sea Level Rise Vulnerability Assessment* (materials available on the Collaboration: Sea-level Marin Adaptation Response Team (C-SMART) publications [website](#)). The report identifies assets within the

County that are vulnerable to sea level rise and storm impacts over time and evaluated assets' exposure, sensitivity, and adaptive capacity under various sea level rise and storm scenarios. The assessment was intended to inform and support the County's adaptation planning and LCP update effort, as called for in Program C-EH-22a of the County's LUP that was conditionally approved by the Commission in May 2014.

Sea Level Rise Scenario	Term
1 10 inches + Annual Storm	Near
2 10 inches + 20-year Storm	Near
3 20 inches + 20-year Storm	Medium
4 40 inches + 100-year Storm	Long- Low
5 80 inches + 100-year Storm <sup>1b</sup>	Long- High

Table 1. Marin SLR and storm scenarios. Near-term refers to approximately 2030; medium to 2050; and long to 2100.

Marin County benefitted from being able to leverage one of the most advanced sea level rise modeling and mapping tools available in the State, and its vulnerability assessment provides a good example of a highly detailed analysis. Specifically, the County used the Our Coast Our Future tool (OCOF). This tool utilizes the USGS's Coastal Storm Modeling System (CoSMoS) 2.0 to produce 40

different sea level rise and storm scenario combinations that include sea level rise, tides, storm surge, El Niño effects, wave set up, and wave run up. From these 40 combinations, the County identified 5 specific scenarios to focus on for the vulnerability assessment that cover a variety of time horizons and storm conditions as shown in Table 1. Maps showing the areas flooded under each of these scenarios are included in the report. The County also separately assessed increased erosion potential, as CoSMoS 2.0 does not include long-term erosion in its flood modeling. Accelerated erosion rates were developed for each of the sea level rise scenarios (not including storm scenarios), and the bluff and shoreline erosion layers were overlaid with asset layers to assess their vulnerability to erosion.

As with any modeling effort and vulnerability assessment work, it is important to note that there are certain simplifications and assumptions made during the modelling process that should be considered when analyzing vulnerability assessment findings. Because some assumptions can't always be avoided, Commission staff suggests that vulnerability assessments clearly explain what the assumptions are and the effect they have on identified vulnerabilities (*i.e.*, whether results are over- or underestimates of vulnerable assets). Although Marin's vulnerability assessment discussed some modelling assumptions, it could be improved by having a specific section that explains the assumptions more fully. Some of these considerations include the following.

- *Combination of flooding and erosion:* The CoSMoS 2.0 modeling does not include long-term erosion in its flood modeling, which prompted Marin to conduct additional analyses to identify erosion hazard areas. Although this additional information is helpful, the maps showing areas likely to be flooded may still be underestimating flood exposure because these two impacts aren't integrated together in the County's vulnerability assessment (in other words, the flood maps show areas that would be flooded based on the existing shoreline condition rather than areas that would be flooded after the shoreline erodes).
- *Shoreline protective devices and backshore structures:* The additional erosion analyses conducted by Marin assumed that erosion/inland migration would stop at any existing

seawalls, development, or backshore dunes. Because this assumes a persistence of the status quo rather than any changes in development patterns based on continued erosion and/or long-term adaptation planning, Commission staff recommends that modeling also show what would happen if seawalls and other structures or shoreline features are removed or eroded. Looking at both scenarios gives a more holistic picture of what different management approaches may entail.

- *Creek flooding*: The CoSMoS modeling doesn't incorporate any changes to creek dynamics or address how such changes may impact flooding. In particular, an increase in creek inputs (for example from more frequent or stronger precipitation events) may increase flood potential, while changes in dynamics of creek mouths or other features could change what areas are at risk from flooding.

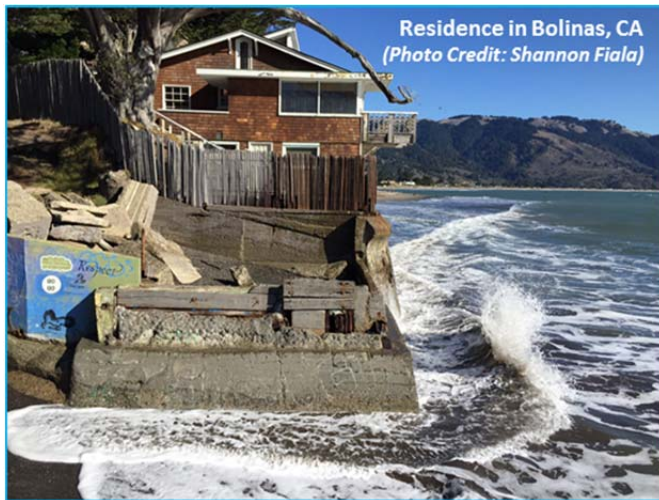
Despite some of these modeling limitations, the County completed a detailed inventory of assets that could be exposed to the different sea level rise and storm scenarios, and then further assessed assets' sensitivity and adaptive capacity to hazards such as inundation at regular high tides, extreme event flooding, erosion, wave run-up, saltwater intrusion, and habitat shifts. Exposure was determined based on overlays of assets and the various sea level rise and erosion scenarios, and sensitivity and adaptive capacity were assessed based on interviews with asset managers.

Results are organized in two main ways: 1) by asset types (sections on parcels and buildings; transportation; utilities; agriculture and aquaculture; natural resources; recreation and public access; emergency services; and historic and archaeological resources), and 2) by community (sections on Muir Beach, Stinson Beach, Bolinas, Inverness, Point Reyes Stations, East Shore, and Dillon Beach). They are also described both qualitatively and quantitatively. For example, each section includes brief summaries (in both narrative and table formats) that describe the vulnerabilities, including discussions of important considerations and consequences. Quantitative descriptions include tables that display information such as the flood depth each asset will be exposed to from each scenario (including distinguishing between the tidal flooding (mean higher high water) and storm flooding); potential monetary losses from buildings damaged by the scenarios (based on FEMA methodologies and modeling); anticipated beach widths and vulnerability index; and the number of assets (or linear/square mileage) of assets exposed (including as a percentage of the County total).

Some of the most vulnerable assets identified by the assessment (in order of timing and flood depth) are listed below.

- Near-term (Scenarios 1 and 2, by approximately 2030):
  - Beaches, underground on-site wastewater treatment systems (OWTS), buildings, and streets in Stinson Beach
  - Shoreline Highway between Stinson Beach and Bolinas, at Green Bridge in Point Reyes Station, the Walker Creek crossing in Marshall, and bridges on Middle Road and Valley Ford Lincoln School Road
  - Beaches, beach front and downtown buildings and streets in Bolinas
  - Septic systems, beaches, marshes, and buildings along the eastern and western shores of Tomales bay on the East Shore and in Inverness

- Water distribution pipe extending underneath Shoreline Highway and Sir Francis Drake serving Inverness residents
- Intertidal rocky lands in Muir Beach and Agate Beach (Duxbury Reef)
- Fire service facilities and tsunami evacuation routes in Stinson Beach
- Recreational facilities at Dillon Beach Resort and Lawson’s Landing
- Bluff top buildings in Muir Beach, Bolinas, and Dillon Beach (may be vulnerable to accelerated erosion)
- Medium-term (Scenario 3, approximately 2050)
  - Olema-Bolinas Road, the only access road to Bolinas
  - Further north into downtown Bolinas, including the historic district
  - Bolinas Public Utilities District lift station
  - Shoreline Highway in Pt. Reyes Station Sir Francis Drake Blvd. in Inverness
- Long-term (Scenarios 4 and 5, approximately 2100)
  - Shoreline Highway along the East Shore in the medium and long-terms
  - Buildings in Inverness west of Sir Francis Drake Blvd
  - Downtown Bolinas up to Bridgton Road along Olema-Bolinas Road, including the market, library, community center, gas station, museum, and several other valued places



Marin’s vulnerability assessment work provides a good example of how a more advanced sea level rise modeling and mapping tool (combined with some additional technical analyses) can be used to develop a highly detailed report with critical information that can be used for adaptation planning at a variety of scales. For example, broadly identifying major vulnerabilities and including information on when different assets are likely to become impacted, and what the consequences of those impacts would be, helps to provide information on how to prioritize the

implementation of different adaptation actions throughout the entire county. On a smaller scale, detailed information, such as the anticipated flood depth at specific assets under various scenarios or the anticipated width of beaches over time, helps to provide site-specific information that could be used for creating adaptation strategies for individual assets.

Relatedly, Marin’s vulnerability assessment provides a good example for how to provide information that can be useful for a variety of audiences. For example, including narrative sections that briefly describe the vulnerabilities and potential consequences, including concise “at a glance” sections, and including economic impact information all help to lay out a story that engages members of the public who are not well-versed in these topics. Conversely, including highly detailed information on specific assets is important for asset managers who can use that

information to identify adaptation approaches. Additionally, organizing the report by both assets and communities allows readers to quickly and easily identify vulnerability information of most interest to them. For example, Caltrans or other roadway managers could look to the Transportation section and see all of the roads that are vulnerable to various sea level rise scenarios throughout the County; whereas a resident or visitor could look at the Stinson Beach or other community sections to understand what is at risk in the community they care about.



## Adaptation Plan

As part of its initial grant program, Marin intended to complete an adaptation planning effort that included public outreach and drafting of an adaptation plan that would prioritize adaptive needs, identify potential adaptation strategies, evaluate and prioritize adaptation strategies, and lay out a preliminary implementation phasing plan prior to completing the updates to the Environmental Hazards chapter of the LCP. In general, Commission staff supports and encourages this approach of including a distinct adaptation planning phase in between completing a vulnerability assessment and developing updated LCP policy language. Such a process allows for identification of and buy-in by the public and decision-makers for a specific approach or set of strategies without the complex and sometimes contentious step of determining specific policy language.

Unfortunately, delays and a variety of other factors resulted in the County essentially completing some parts of the adaptation planning process either concurrently with the development of the proposed LCP or following much of the policy development. Although this is not ideal, and in this case partially led to the hazards component of the LCP being postponed (as described above), Commission staff recognizes that there will likely be instances in which jurisdictions complete a first round of LCP updates to address some sea level rise concerns, followed by another phase of adaptation planning and future LCP updates.

Regardless of the specific process, Marin did complete a draft Adaptation Report that was submitted as one of the final grant deliverables. The report discusses potential actions to accommodate, protect against, or retreat from the threats of sea level rise and coastal hazards, and reflects input from a public outreach effort. However, the report should not be considered a final adaptation plan as the County intends to continue to work with stakeholders on further adaptation planning, and will need to develop policies and other actions to implement the preferred adaptation strategies that are ultimately identified.

In its current form, the adaptation planning report lays out the priority planning needs, establishes guiding principles and prioritization criteria, and identifies possible adaptation strategies to address the vulnerabilities identified in the sea level rise vulnerability assessment

(like the vulnerability assessment, adaptation strategies are organized both by asset type and community). The report also includes some information about how strategies could be implemented in a phased manner over time. However, the report broadly discusses adaptation options rather than including specific detail about what strategies should be used in specific circumstances or at specific times. As the County continues its adaptation planning process, it should work to identify and include additional specific detail on these topics in its final adaptation plan, and should translate those strategies into actual policy language that can be used to guide coastal development through the LCP. Absent this final step, the adaptation plan serves only limited utility in terms of coastal zone planning, permitting, and adaptation over time.

Broadly, the report currently states that the recommended adaptation approach for West Marin is to accommodate development with elevation and other retrofits, and protect assets with nature-based strategies in the near- to medium-term, while planning for other adaptation measures, including managed retreat, in the long-term. Some additional findings and recommendations stated within the draft adaptation planning report include the following:

- The County should support ongoing efforts to elevate or otherwise protect electrical, fuel, sewage management and water systems from high tide levels and new public capital improvement projects should account for 3 feet of sea level rise. Other adaptation strategies may include retrofits to water meter connections to withstand salt water and retrofitting septic systems to meet current regulations. The County should also consider forming a task force with representatives from PG&E and local service providers to identify long-term, coordinated approaches for adapting utilities.

- Roads vulnerable to temporary flooding will continue to be subject to temporary closures, in some cases preventing emergency access. The Marin County Department of Public Works should continue to evaluate costs and feasibility of various adaptation approaches and work to collaborate with Caltrans to identify opportunities for adaptive management.



Additional recommendations

include ensuring that Capital Improvement Projects and road repairs account for sea level rise and to evaluate the feasibility of relocating critical access roads upland.

- Natural resources should be monitored to better understand the impacts of sea level rise to beaches, wetlands, and other habitat areas. The County and key partners should continue to support and pursue funding opportunities for innovative living shorelines approaches to sea level rise protection, such as dune and wetland restoration, horizontal levees, oyster beds, eelgrass, and bluff vegetation.

Overall, the draft adaptation report is a good start and provides a good example for how such plans could be organized. The report clearly explains the County's various adaptation needs, including providing details on assets that need adaptation strategies now, assets that need further studies to assess potential impacts and needs, and assets that should be monitored to assess impacts now; broadly describes a range of adaptation options, including discussion of the costs and benefits of various strategies; and starts to provide detail on options for specific assets and when such strategies could be implemented. This adaptation plan currently falls short in providing a clear approach for what the County intends to do, but this shortcoming is a result of the fact that the County is currently in the middle of its adaptation planning process and is continuing to work with stakeholders to identify a preferred set of strategies. Similarly, it will need to account for the final step identified above of translating potential strategies into actual LCP policy language that can guide coastal development and planning moving forward.

## Development of the LCP Update

Marin County has worked on developing coastal hazards and sea level rise policies for many years, including throughout early 2016 following the initial Commission consideration of its LUP update, as described above. During this time, Coastal Commission staff met regularly with County staff to discuss potential policies and to voice concerns. Despite this ongoing coordination, Marin County completed the local adoption process for the updated LCP prior to completing its adaptation planning efforts and prior to reaching agreement on several critical sea level rise related policies. As explained above, when the LCP update was presented at the Coastal Commission hearing in November 2016, the County asked the Commission to postpone a vote on the Environmental Hazards sections of the LCP to allow time for additional coordination with stakeholders and Commission staff, and to allow for the complementary adaptation planning efforts to 'catch up' to the LCP policy development efforts.

Overall, Commission staff's concerns emanate from staff's assessment that the proposed LCP lacked adequate adaptation policies to address identified vulnerabilities. This is potentially a result of the fact that the County had not completed its adaptation planning efforts when it developed its proposed LCP policies. It should be noted that this type of issue is not confined to the Marin LCP – Commission staff's experience so far has been that many proposed LCP policies that attempt to address sea level rise adaptation lack the detail necessary to provide for specific adaptation actions. There are a variety of reasons for this problem, but much of it derives from the fact that adaptation planning often presents contentious and complex issues that are difficult to address. Sea level rise adaptation raises significant questions related to community vision, including the potentially conflicting interplay among public resources, infrastructure, and private development, as well as the costs and benefits of various strategies over time. These are very difficult questions, and as a result many LCP proposals do not reach conclusions on these points. Many of them, like Marin's proposal, defer significant planning to future efforts. This is a common theme up and down the state, and a significant problem impeding the success of LCP updates designed to address sea level rise.

The County and Commission staff are continuing to refine possible draft coastal hazards policies. It should be noted that despite some disagreements, Commission staff supported the intention of many of the initially proposed policies. For example, Marin's draft LCP included policies that directly link to some of the findings of the vulnerability assessment and that are reflective of the

specific conditions in Marin County. The proposed LCP also included some policies and programs that would encourage additional planning and research on ways to address sea level rise. Commission staff agrees that this approach of developing an initial set of policies, when combined with additional adaptation planning and future LCP updates, will help the County address the impacts of sea level rise.

However, Commission staff did suggest a number of modifications to address certain policy concerns. In many cases, these edits were to provide clarity or to update certain policy language to more closely match some of the evolving ways that the Commission has been addressing similar issues. Other edits were meant to add policies to more explicitly address structures in hazardous areas to ensure that development is safe, that coastal resources are protected over time, and that property owners clearly understand and absorb the risks of building in a hazardous area. Commission staff will continue to coordinate with the County and local stakeholders in hopes of reaching agreement on these policies and ensuring that Marin will have a strong, forward-thinking LCP that fully addresses sea level rise concerns.

## Next Steps

To date, Marin County has completed a detailed vulnerability assessment, begun working on an adaptation plan, and completed a draft LCP that was locally adopted by the County. Although the LCP contained many polices designed to respond to findings in the vulnerability assessment and to address sea level rise, Commission staff had a number of suggested modifications, including edits to add policies to address major concerns regarding protection of coastal resources and ensuring clarity regarding what will happen to development that is allowed in hazardous areas. Given these concerns, adoption of the Environmental Hazards sections of the LCP was postponed to allow for more coordination between Coastal Commission and County staff, and to allow more time for the County's complementary adaptation planning efforts.

This case study underscores the importance of collaboration between local jurisdictions and Commission staff as early and often as possible in the planning process in order to reach consensus on proposed LCP policies that address sea level rise. It also points to the importance of developing adaption plans before drafting critical hazards policies so that the policies can be reflective of the vision of the plans, and can provide the appropriate policy framework to carry out the plans in the coastal zone. All of this takes time, and it is best accommodated in the local process as opposed to the Commission process, including so that plans can be appropriately vetted and developed through community forums and hearings in the affected local area.

Commission staff looks forward to continuing to work with the County and will seek to reach agreement on several main policy topics including:

- Redevelopment
- Ensuring that there is a clear approach for removing development in hazardous areas when it is no longer safe and/or it results in negative impacts to other coastal resources (*e.g.*, it encroaches on public trust land)
- Addressing existing but unnecessary shoreline protective devices

- Ensuring that future adaptation planning will specifically identify options for protection of beaches (and their associated access, recreation, and habitat values).

Commission staff will also continue to engage with the County as it continues its broader adaptation planning process. Significant issues the County should address include transportation vulnerabilities, identification of funding or other options to assist with managed retreat programs, and ensuring that the needs of both homeowners in vulnerable areas as well as non-local users of beaches and other recreation areas are met in a fair and equitable manner.

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