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W6e

July 7, 2017

TO: California Coastal Commission and Interested Persons

FROM: John Ainsworth, Executive Director
Susan M. Hansch, Chief Deputy Director
Michelle Jesperson, Federal Programs Manager
Mary Matella, Environmental Scientist
Sea Level Rise Team Members

SUBJECT: Presentation on Sea Level Rise Products and Web Tool – Information Item Only

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Coastal Commission staff recently completed a series of sea level rise-related informational products and launched a new web page/web-tool to disseminate this information. This work was funded through a multi-year Coastal Impact Assistance Program grant administered by the US Fish and Wildlife Service and the California Natural Resources Agency. The Coastal Impact Assistance Program is a federally authorized program that provides funding to oil producing states to mitigate the impacts from offshore oil and gas production. This presentation will provide an opportunity to share the results of this effort – including highlighting the key findings contained in the statewide report and providing an overview of the web-tool – for the Commission and the public.

The purpose of the project is to enhance decision-making about long-term planning and management of critical coastal resources in light of climate change and sea level rise. The project seeks to do this by providing the Coastal Commission, staff and others with informational products to better understand sea level rise vulnerability throughout the state, and to provide additional guidance and resources on how to address sea level rise vulnerability in the Commission's planning and regulatory work. The project also supports achievement of the Commission Strategic Plan goals of addressing climate change through LCP planning, coastal permitting, interagency collaboration and public education, and specifically addresses the Commission's Strategic Plan actions to provide the public with information and guidance on climate change and sea level rise through workshops and presentations (Action 3.1.4) as well as updating LCPs to address climate change and sea level rise (Action 4.2.3).

The primary products developed through this project include:

1) A Statewide Sea Level Rise Vulnerability Synthesis Report which summarizes key findings of the analysis of existing vulnerability assessments for all 15 coastal counties with on the ground knowledge/expertise provided by Coastal Commission District staff;
2) Fifteen Coastal County Snapshots, which include: a synthesis of vulnerability information from a variety of sources including input from Coastal Commission staff in the Districts and review of completed local and regional vulnerability assessments; status of sea level rise planning for the county, and; Coastal Act management priorities based on the hazards and Coastal Act resource vulnerabilities identified;
3) Four LCP Case Studies from Marin County, City of Pacific Grove, City of Goleta, and City of Newport Beach. The case studies provide key lessons learned from land use planning efforts to address sea level rise hazards and vulnerabilities in LCPs;
4) A Vulnerability Assessments Memo, which provides guidance and information to assist local governments and others in conducting comprehensive and effective vulnerability assessments for future land use planning;
5) Updates in the organization and content of the Coastal Commission's climate change web pages; and
6) Creation of geographic-based map portal on the Coastal Commission website to download the Statewide Report, Coastal County Snapshots and Case Studies and to view a sub-set of the data and information provided in the Coastal County Snapshots in a more graphical and web-friendly format. This data set is also available to the public through an Application Program Interface (API) for download and additional use.

Products 1 – 3 and 6 can be found on the Coastal Commission's web site by following the link below. The key findings of the Statewide Vulnerability Synthesis Report, the Vulnerability Assessments Memo and screen shots of the website updates (products 4 – 5) are included in Exhibits 1 – 3.

https://www.coastal.ca.gov/climate/slr/vulnerability-adaptation/vulnerability/#/map

Development of these products required significant effort by members of the Coastal Commission's internal sea level rise team members (Carey Batha, Madeline Cavalieri, Kesley Ducklow, Dr. Lesley Ewing, Michelle Jesperson and Dr. Mary Matella) and included contributions from the Commission's current NOAA Coastal Management Fellow (Sumi Selvaraj) and former 2016-17 Sea Grant fellow (Melis Okter).

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Sea Level Rise Informational Products and Web Tool

July 12, 2017

EXHIBITS

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Key Findings

Ocean Economy: The Ocean Economy makes up a significant portion of California's total economy. Communities should analyze the impacts of sea level rise on economic livelihood and assess the related impacts to their local ocean economy, especially tourism and recreation.

Risks to Populations: The largest coastal zone populations vulnerable to flooding from a 100-year storm plus 55 inches sea level rise are in Los Angeles, Orange, and San Diego counties.

Environmental Justice and Social Vulnerability: Many vulnerability assessments did not account for the full range of social impacts linked to sea level rise. Vulnerability to hazards from sea level rise will have a disproportionate impact on communities with the least capacity to adapt; as such, a comprehensive approach to assessing social vulnerabilities should be used going forward to identify communities that may have higher vulnerabilities due to socio-economic factors and other risks that may be present in that community. Furthermore, as sea levels rise and public access points and recreational opportunities are lost, public access opportunities will become fewer and more limited for those who cannot afford to live at the coast.

Development and Shoreline Protective Devices: Despite many miles of existing armoring, erosion will continue to threaten existing developed areas in vulnerable communities, and this threat will increase with rising sea level.

Public Access and Recreation: Public access and recreational assets are threatened by sea level rise in every county. However, with planning, funding, and collaboration, local governments can lay the groundwork for resilient public access ways and preservation of beach areas, even as sea levels rise.

Beaches, Vulnerable Habitat and Open Space: Many communities have not yet addressed the vulnerability of their sandy beaches to rising sea levels. Of those assessments that did evaluate sediment management and beach replenishment to maintain beach area as sea levels rise, few examined the ecological consequences or the long-term economic feasibility of these responses.

Wetlands and Other Vulnerable Habitat: As sea levels rise, wetland habitat will be lost unless it can migrate inland or accrete upward. Thus, planning for wetland migration buffers and/or other adaptation strategies for sustaining wetlands will be vital to conserving the remaining wetland habitat area on the California coast.

Agricultural Resources: Sea level rise poses significant threats to agricultural resources where it can cause an increase in flooding and inundation of low-lying agricultural land, saltwater intrusion into agricultural water supplies, and/or a decrease in the amount of freshwater available for agricultural uses. Protecting agricultural resources in these cases will necessitate collaboration and long-term planning with all stakeholders, including local governments, utilities, landowners, state and federal agencies.

Energy and Other Infrastructure: Because of the interconnected nature of critical infrastructure, the high cost of networks and central facilities, and the long-term expectations for years of use, planning for sea level rise in infrastructure investments will be increasingly important. This planning will require proactive approaches, interagency collaboration, and funding to maintain community services in the most cost effective way.

Interagency Coordination: This statewide synthesis of sea level rise vulnerability assessments highlights the importance of interagency coordination for addressing sea level rise threats that cross boundaries of individual parcels, jurisdictions, and state and federal lands.

Lessons Learned from Local Coastal Program Planning Case Studies: LCP policies to address new development, known vulnerabilities, general hazard response, and future specific adaptation methods provide the mechanism to develop resilience to sea level rise. Communities should begin planning so that actions now do not preclude future adaptation options.

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To: Coastal Commission staff, local planners, and interested parties
From: Carey Batha, Coastal Commission Sea Level Rise Team
Date: Last updated: January 2017

Re: **Summary of the steps for conducting sea level rise vulnerability assessments and practical lessons learned**

Sea level rise and its potential impacts on coastal resources and development are important topics that should be addressed in Local Coastal Program (LCP) updates and new LCPs. The Coastal Commission's 2015 Sea Level Rise Policy Guidance (Guidance) describes the recommended step-by-step process for conducting sea level rise (SLR) vulnerability assessments, specifically in Chapter 5. Please refer to this chapter for a high level of detail on SLR vulnerability assessments.

This memo summarizes key points in Chapter 5 and shares some of the practical lessons that Coastal Commission staff have learned through their recent work with local governments on SLR vulnerability assessments. Consideration of these lessons may help expedite or improve future work by ensuring that the SLR vulnerability assessments are scoped and performed in such a way that effectively supports sea level rise adaptation planning, alternatives analysis, and LCP policy development.

Scoping the Vulnerability Assessment

Before a vulnerability assessment is actually conducted, the scope of the effort will be established. Coastal Commission staff broadly encourages using SLR vulnerability assessments to inform the development of LCPs, and the Guidance recognizes that vulnerability assessments should be tailored to fit the needs of individual communities and address their specific coastal resource and development issues. Below is a summary of the lessons Coastal Commission staff have learned about scoping vulnerability assessments.

PRACTICAL LESSONS LEARNED

- **Leverage existing resources**. Vulnerability assessments often vary in their level of detail for a number of reasons, including the availability of funding, the timing of the study, availability of informational resources, staff capacity, and consultant timelines. When resources are limited, it is important to consider leveraging existing resources to inform or supplement the effort, such as regional SLR models, vulnerability assessments with transferable methodologies, and adaptation strategies and policies that may that may serve as the foundation for more location-specific policy development. It also may be

appropriate to include policy language in the LCP update that calls for additional SLR studies and future LCP updates.

- **Include the maximum possible level of detail**. While logistical limitations should be acknowledged, the SLR vulnerability assessment should include the best available information and the maximum level of analysis possible. Furthermore, the SLR vulnerability assessment should, to the extent possible, include the topics that will be addressed specifically in the LCP. Ensuring that the hazards identified in the vulnerability assessment are addressed in LCP policies—and that the subjects of known policy gaps are scoped into the SLR vulnerability assessment—are actually some of the most common challenges in the SLR planning process yet also fundamental to its success.

- **Describe the implications of assumptions in the methodology.** Many vulnerability assessments contain assumptions and/or simplifications in data or methodology. Commonly, the vulnerability assessment will state these assumptions in the methodology section or in an appendix but not explain how those assumptions may have impacted the results of the analysis. Commission staff recommends explaining whether each assumption results in an overestimation or underestimation (or unknown effect) on the physical extent of coastal hazards and the associated community impacts identified in the report. This explanation is important because it may inform how a user of the vulnerability assessment weighs issues related to risk tolerance, the need for trigger-based or adaptive management, the efficacy of potential adaptation measures, or policy development. Therefore, a robust discussion of the implications of assumptions in the methodology should be scoped into the report.

  As an example, a vulnerability assessment that assumes that beach nourishment will continue at the historical rate should explain that this assumption could result in an underestimation of SLR hazards. If nourishment were to stop or become less effective, SLR hazards could be more intense than predicted by the vulnerability assessment.

- **Consider including analysis of fiscal impacts.** Analysis of the fiscal impacts associated with various SLR hazards in the vulnerability assessment is often a critical element needed to support effective decision-making. This information can be used to help compare the costs of alternative adaptation approaches—from engineered solutions to managed retreat. The information can also be a useful communication tool to illustrate the need for proactive adaptation planning to the public, stakeholders, and/or decision makers. See the City of Goleta's *Coastal Hazards and Fiscal Impacts Report* for an example of this type of fiscal analysis.

- **Address deferred analyses.** Some vulnerability assessments might overlook certain issues/geographic areas or earmark them for future analysis, but those issues often constitute the most significant SLR vulnerabilities. If those topics cannot be addressed with the time and resources available, it may be appropriate to identify in the LCP a specific timeline for when those studies will be completed, and to use sunset provisions in certain policies to ensure that the re-examination of the topics is triggered. Similarly, if a vulnerability assessment included assumptions or simplifications in its methodology

that limited its results (as described above), it may be appropriate to flag those topics for future analysis and policy development.

- **Ensure maximum public participation, particularly early on**. When scoping a project that includes a SLR vulnerability assessment, opportunities for public participation should be planned, funded, and scheduled with the intent to provide for maximum public input. Of particular importance is ensuring the public and stakeholders have the opportunity to provide input on the project from the start. Establishing this partnership early on and providing ongoing opportunities for involvement should facilitate and streamline the next steps in the planning process, including adaptation planning and LCP development. In addition to helping ensure a successful planning process, maximizing public participation is also a central mandate of the Coastal Act.

Step 1: Identify Sea Level Rise Projections

The first step in a vulnerability assessment is to identify sea level rise projections to carry through the analysis, which is discussed at length in the Guidance. Below is a summary of the content included in the Guidance, as well as a list of the lessons Coastal Commission staff have learned about this step.

SUMMARY OF STEP 1 OF CHAPTER 5 OF THE GUIDANCE

- Identify the best available, locally-relevant SLR projections. Currently, the projections from the National Research Council's 2012 report, *Sea-Level Rise for the Coasts of California, Oregon and Washington: Past, Present and Future* (NRC 2012) constitute the best available science on SLR projections in California. They include:

TIME PERIOD*	NORTH OF CAPE MENDOCINO	SOUTH OF CAPE MENDOCINO	
by 2030	-2 – 9 in (-4 – +23 cm)	2 – 12 in (4 – 30 cm)	
by 2050	-1 – 19 in (-3 – + 48 cm)	5 – 24 in (12 – 61 cm)	
by 2100	4 – 56 in (10 – 143 cm)	17 – 66 in (42 – 167 cm)	

*relative to year 2000

- Select planning horizons to examine (e.g., the years 2030, 2050, and 2100). Analyze time steps out to the year 2100, or further. To calculate SLR amounts for time steps other than those provided as ranges in the best available science (e.g., in NRC 2012), interpolate between the given data points using best fit equations (see Appendix B of the Guidance).
- For each planning horizon, identify the associated sea level rise projections. Use scenario-based analysis (described generally in Chapter 3 of the Guidance) by including

(at minimum) the medium and high value from the ranges in the table above. Include the high SLR scenario to account for a worse-case scenario.

PRACTICAL LESSONS LEARNED

- **Select SLR scenarios that achieve multiple planning objectives.** Sea level rise scenarios should be selected to complement the planning objectives relevant to the jurisdiction. For example, if a certain SLR scenario is similar to the water elevation used for the development of the Local Hazard Mitigation Plan, that scenario should be selected for its dual benefits.
- **Consider different approaches.** Note that there are two basic approaches to handling SLR scenarios. One approach is to pick specific *years* to examine and provide ranges (medium and high) of SLR amounts that occur by those years, as shown in the NRC 2012 table. Another approach is to pick *SLR amounts* to examine, and then use the rates of SLR from the medium and high projections to deduce the range of years during which that amount of SLR could occur. Both approaches are effective. There are SLR models and visualization tools that utilize both, so it helps to be aware that both approaches exist. Additionally, it is important to remember that the SLR rates predicted by NRC 2012 may be updated over time as research on the subject continues. Therefore, SLR vulnerability assessments that examine various SLR amounts should include a caveat that those amounts of SLR could happen sooner or potentially later than predicted by the current best available science.

Step 2: Analyze the physical effects of SLR

The second step in a vulnerability assessment is to analyze the physical effects of SLR, which is discussed at length in the Guidance. Below is a summary of the content in the Guidance, as well as a list of the lessons Coastal Commission staff have learned about this step.

SUMMARY OF STEP 2 OF CHAPTER 5 OF THE GUIDANCE:

- Analyze the following hazards under each SLR scenario:
    - Erosion of beaches, bluffs, cliffs, and other landforms
    - Tidal inundation of shoreline areas
    - Flooding (wave run-up and storm impacts)
    - Saltwater intrusion

PRACTICAL LESSONS LEARNED:

- **Use the best available tool for the area**. Several sea level rise visualization tools and datasets are available, but their level of complexity, methodologies, and underlying assumptions differ. It is important to identify the SLR visualization tool with the most advanced and best available methodology. For more information on existing tools, see the "Lifting the Fog" matrix, available here. Contact the Commission's SLR team for more information if you have questions about which tool is best for your area or the assumptions that underlie each tool. It may be appropriate to use an existing SLR

visualization tool, but to also recognize its limitations and supplement it with additional analysis to fill those gaps.

- **Distinguish inundation and flooding.** Some vulnerability assessments include storm events (usually a 100-year event) in all of the SLR scenarios selected to be analyzed in the vulnerability assessment. While storms are important to include, the vulnerability assessment should also examine non-storm scenarios in order to provide information on the "everyday" hazard conditions that may occur in the future with SLR. This analysis is particularly important for understanding future impacts on beaches and other coastal habitats and may lead to different adaptation approaches implemented through the LCP. For example, analysis of non-storm conditions may lead to the development of LCP policies on sediment management and trigger-based managed retreat of existing development and/or zoning changes, whereas analysis of storm flooding may lead to LCP policies that require flood proofing and other flood resiliency measures in areas expected to be impacted by future storm events.

  It is also often useful to include storm events of various return periods, such as annual, 10-year, 20-year, and/or 5-year storm events in addition to 100-year storm events in order to understand the hazards associated with storm events that are more common.

- **If possible, integrate the analysis of the various physical hazards**. For example, ensure that flood waters are being projected onto a coastline that reflects the erosion that is projected to occur over time with SLR. (Some SLR visualization tools do not do this.) If it is not possible to integrate these data layers, ensure that the combined effects of these hazards are qualitatively described in the Vulnerability Assessment report, and state whether the mapped hazards constitute a possible underestimation –or overestimation— of the physical extent of hazards.

- **Consider the SLR impacts with and without the presence of existing shoreline protective devices (SPDs) or major pieces of infrastructure**. The "with existing protective devices" scenario should include a description of the impacts of SLR seaward of the device—for example, what would happen to the sandy beach or other coastal land as sea levels rise. The "without existing protective devices" scenario should describe the impacts that would occur in the area, including landward of the device's location, if relevant. Together, these analyses will support alternatives analysis of management and land use options for both the protective device and the structure or area it is protecting.

- **Identify when impacts are expected to occur.** Information on the timing of impacts will become important in the adaptation planning stage, because adaptation strategies need to be implemented with enough lead time to address the hazard. Ideally, SLR vulnerability assessments should discuss the timing of impacts so that adaptation plans can explore the timeframes, funding and other resources necessary to implement the identified adaptation strategies. This would allow the LCP to define trigger points at which certain policies or programs would be implemented. This discussion should acknowledge that expected SLR rates may change as science and research on the subject advances.

Step 3: Assess Impacts to Community and Environmental Assets

The third step in a vulnerability assessment is to analyze impacts of community and environmental assets, which is discussed at length in the Guidance. Below is a summary of the content in the Guidance, as well as a list of the lessons Coastal Commission staff have learned about this step.

SUMMARY OF STEP 3 OF CHAPTER 5 OF THE GUIDANCE:

- Include assessment of:
    - Coastal Act resources (including but not limited to public access points, beaches, recreational areas, ESHA, wetlands, critical infrastructure, archaeological resources, visual resources, etc.)
    - Changes in tidal, inter-tidal, shoreline and upland habitats
    - Public tidelands
    - Secondary and/or cumulative impacts
    - Specific assets of key local importance to the community, such as popular recreational areas
    - Coastal-dependent development, residential communities or key infrastructure.

PRACTICAL LESSONS LEARNED:

- **Incorporate socioeconomic considerations, including environmental justice concerns**. Vulnerability assessments should determine whether physical hazards and coastal resource impacts affect certain demographics disproportionately, or whether the costs of different adaptation alternatives could fall disproportionately upon different segments of the population. It is important to consider not only the impacts upon the local constituency, but also impacts to those who live outside the coastal zone and instead travel there to recreate, work, and/or visit. In addition, the assessment should determine the expected impacts on cultural and archaeological resources and the potential implications for Native American groups or others. This analysis should consider not only residential, commercial and infrastructure assets, but also recreational and other resource assets, including beaches and wetlands, as well as archeological and cultural resources.
- **As described above, analyze the long-term consequences of maintaining existing legally permitted protective devices,** including impacts to the resources that exist seaward of the protective device such as beaches and wetlands. It is critical to analyze the ecological, economic, and other implications of this loss, and identify any associated impacts to public access, recreational opportunities, or other coastal resources.
- **Analyze "coastal squeeze" of beaches and other coastal resources.** "Coastal squeeze" refers to the incremental loss of recreational beach area and other shoreline habitats that lie seaward of hardened shorelines due to the inability of these habitats to naturally migrate inland. As mentioned above, exploring the impacts of SLR on beaches, dunes and wetlands, along with the associated impacts to coastal resources like access and recreation, is crucial. These resources are protected by the Coastal Act and comprise important components of coastal economies. If possible, the SLR vulnerability

assessment should generate information about the timeframes over which beaches could be narrowed or lost under different management scenarios –e.g., with and without development preventing the landward migration of the beach; or with or without sediment management practices such as nourishment.

Summary

The information from Steps 1 through 3 comes together to form the basic content of a SLR vulnerability assessment. Again, please consult Chapter 5 of the Guidance for more detailed information on these steps. The Guidance also describes the next phase of the SLR planning process—adaptation planning and LCP policy development—in which adaptation measures are developed to address the identified vulnerabilities.

For more information on sea level rise vulnerability assessments, please consult the 2015 Sea Level Rise Policy Guidance. Appendix B provides a detailed description of how to perform key analyses relevant to a vulnerability assessment, and Appendix C contains extensive lists of additional resources and examples.

For more information, please contact:

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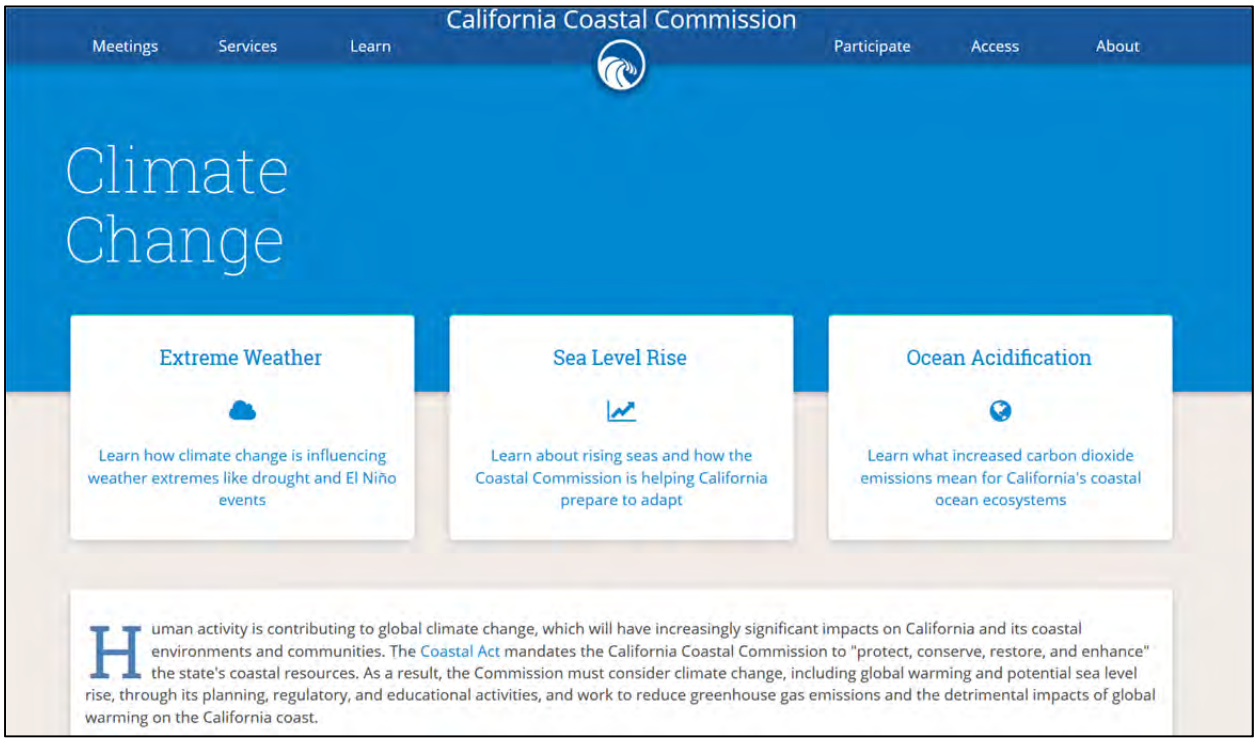
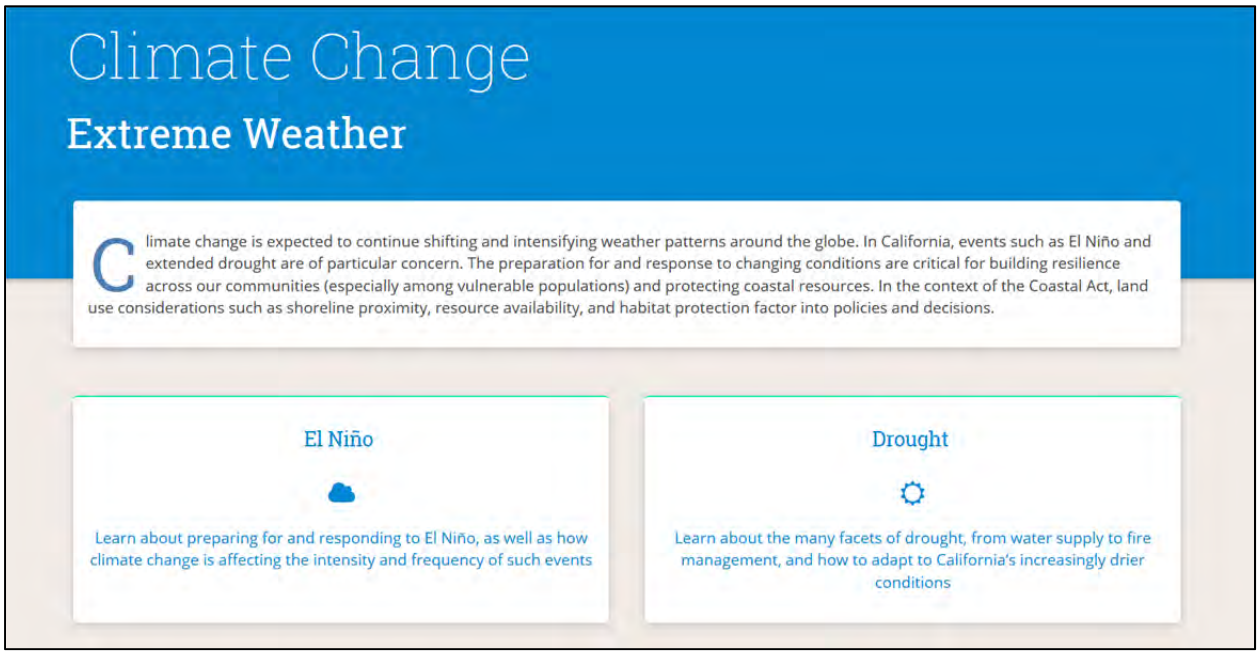
Carey.Batha@coastal.ca.gov

California Coastal Commission Website Updates

https://www.coastal.ca.gov/climate/climatechange.html





El Niño

Although El Niño events are part of a natural climatological cycle, shifts in global atmospheric and oceanographic patterns are expected to affect their nature. Research suggests that as the ocean surface continues to warm, particularly in the eastern Pacific, both the frequency and intensity of El Niño events could change significantly in the future. When combined with sea level rise, flooding and other impacts associated with storms will also begin to reach further inland.

Coinciding with the 2015/16 winter season, a powerful El Niño event continues to develop in the tropical Pacific, and its peak influence on the Northern Hemisphere is anticipated for the December-February period. To prepare for impacts due to flooding, unusually large waves, heavy precipitation, and erosion, coastal Californians can begin to take measured steps now. Below is a collection of checklists for various audiences as well as some basic information about El Niño. The Commission is encouraging coastal residents to inspect their property prior to the onset of storms and to do what is possible to minimize potential damage associated with storm hazards. Certain types of preparation (and response) may require a permit – please consult with Commission staff if you have any questions or concerns.

Commission staff will continue to add relevant information to this page throughout the season – please check back for updated information on a regular basis.

Resources

El Niño Q&A

Community Preparedness Checklist

General Property Preparedness Checklist

Shoreline Property Preparedness Checklist

Contacts

Local governments and property owners are encouraged to assess their situations or properties in preparation for the winter and to reach out for consultation or direction. If there is a certified Local Coastal Program, property owners should contact the local government staff directly. If the work involves any shoreline protection or bluff work, property owners should contact *both* local government staff and Commission staff.

Climate Change

Sea Level Rise

Science & Consequences

Learn about sea level rise science, its physical impacts, and their conseqences for coastal resources and communities

Planning & Permitting

Visualize the steps for adressing Sea Level Rise in Local Coastal Programs & Coastal Development Permits

Vulnerability & Adaptation

Learn about vulnerabilities to sea level rise and adaptation strategies to incorporate in Local Coastal Programs & Coastal Development Permits

Tools & Resources

Access a collection videos, documents, tools, and other materials about sea level rise

In the past century, global mean sea level has increased by 7 to 8 inches and it is extremely likely (>95% probability) that human influence has been the dominant cause of observed atmospheric and oceanic warming. Given current trends in greenhouse gas emissions and increasing global temperatures, sea level rise is expected to accelerate in the coming decades, with scientists projecting as much as a 66-inch increase in sea level along segments of California's coast by the year 2100. While over the next few decades, the most damaging events are likely to be dominated by large El Niño - driven storm events in combination with high tides

Legal Authority & Legislation

The Coastal Act mandates the California Coastal Commission to "protect, conserve, restore, and enhance" the state's coastal resources. Policies on hazard avoidance and coastal resource protection provide the basis for the Commission to consider the impacts of sea level rise. The Commission has long

Sea Level Rise

Vulnerability & Adaptation

Consequences of sea level rise on coastal resources are often evaluated using vulnerability assessments. Local, regional, and statewide vulnerabilities can be addressed using adaptation strategies. Click on the sections below to learn more about these different steps useful for sea level rise adaptation planning and how they can be used in Local Coastal Programs and Coastal Development Permits.

Vulnerability Synthesis

Access products that summarize available information on sea level rise vulnerability for California's coastal counties and four recent sea level rise planning efforts.

Adaptation Strategy

Learn about different types of adaptation strategies to address sea level rise vulnerabilities and examples of options for protecting Coastal Act resources.

Adaptation Strategies

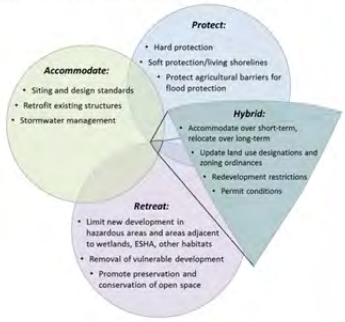
Given the range of impacts that could occur as a result of sea level rise, adaptation strategies will need to be used in order to effectively address coastal hazard risks and protect coastal resources. There are many types of adaptation options that can help minimize the adverse impacts of sea level rise. For example, adaptation strategies may involve project modifications, permit conditions to trigger future actions, retrofits to existing structures, or updates to land use plans or other planning documents to better ensure avoidance or minimization of risks and the protection of coastal resources over time. Some strategies might focus on how to address longer-run impacts now, such as ensuring that critical infrastructure is built to last a long time without being put in danger, while other actions may address a short-term risk while long-term adaptation planning is carried out. Despite the various types of available approaches, adaptation strategies should be chosen based on the specific risks and vulnerabilities of a region or project site and the applicable Coastal Act and Local Coastal Program (LCP) requirements, with due consideration of local priorities and goals.

To learn more about adaptation strategies to consider in LCP and Coastal Development Permit (CDP) planning and review processes, explore the sections on this page by clicking on headers to view expanded content.

For more detailed discussions, including a library of possible adaptation strategies, see the Adaptation Strategies chapter of the adopted Sea Level Rise Policy Guidance.

General Strategies

There are a number of options for how to address the risks and impacts associated with sea level rise. Choosing to "do nothing" or following a policy of "non-intervention" may be considered an adaptive response, but in most cases, the strategies for addressing sea level rise hazards will require proactive planning to ensure protection of coastal resources and development. Proactive adaptation strategies generally fall into three main categories: **protect, accommodate, and retreat**. In many cases, a **hybrid approach** that uses strategies from multiple categories will be necessary, and the suite of strategies chosen may need to change over time. **For purposes of implementing the Coastal Act, no single category or even specific strategy should be considered the "best" option as a rule.** Appropriate adaptation strategies will differ by each location based on local hazard management and resource protection goals and the legal context.



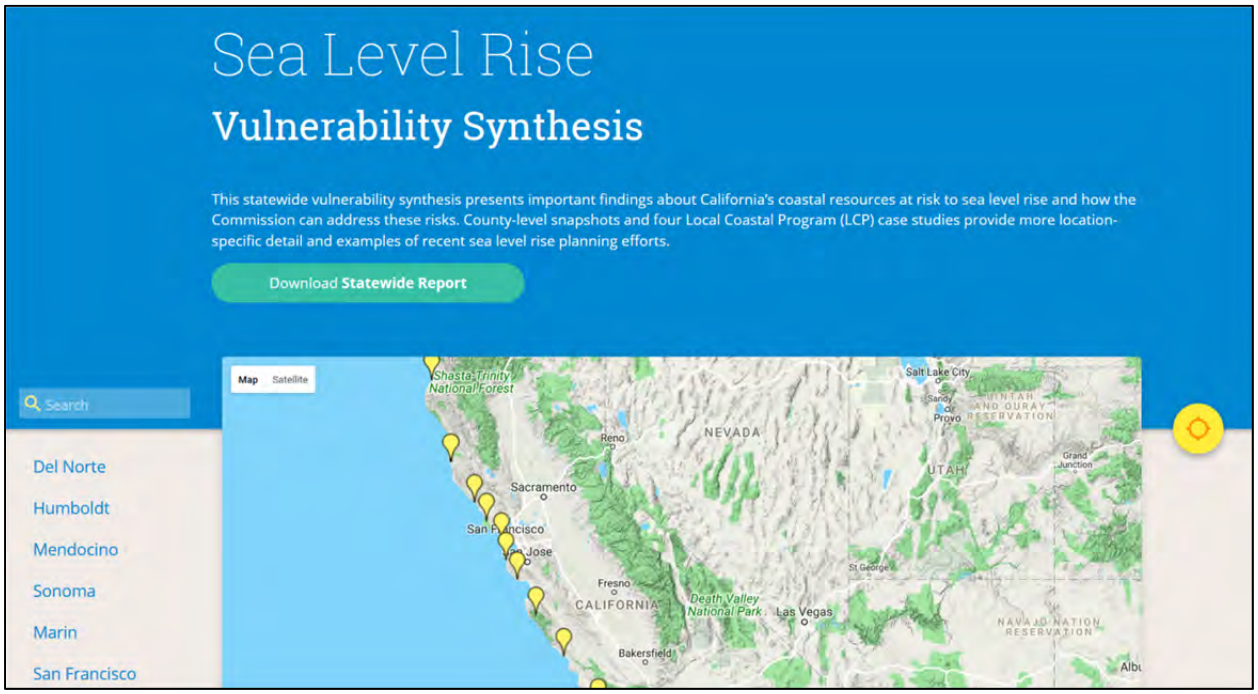
Specific Strategies for LCP & CDP Processes

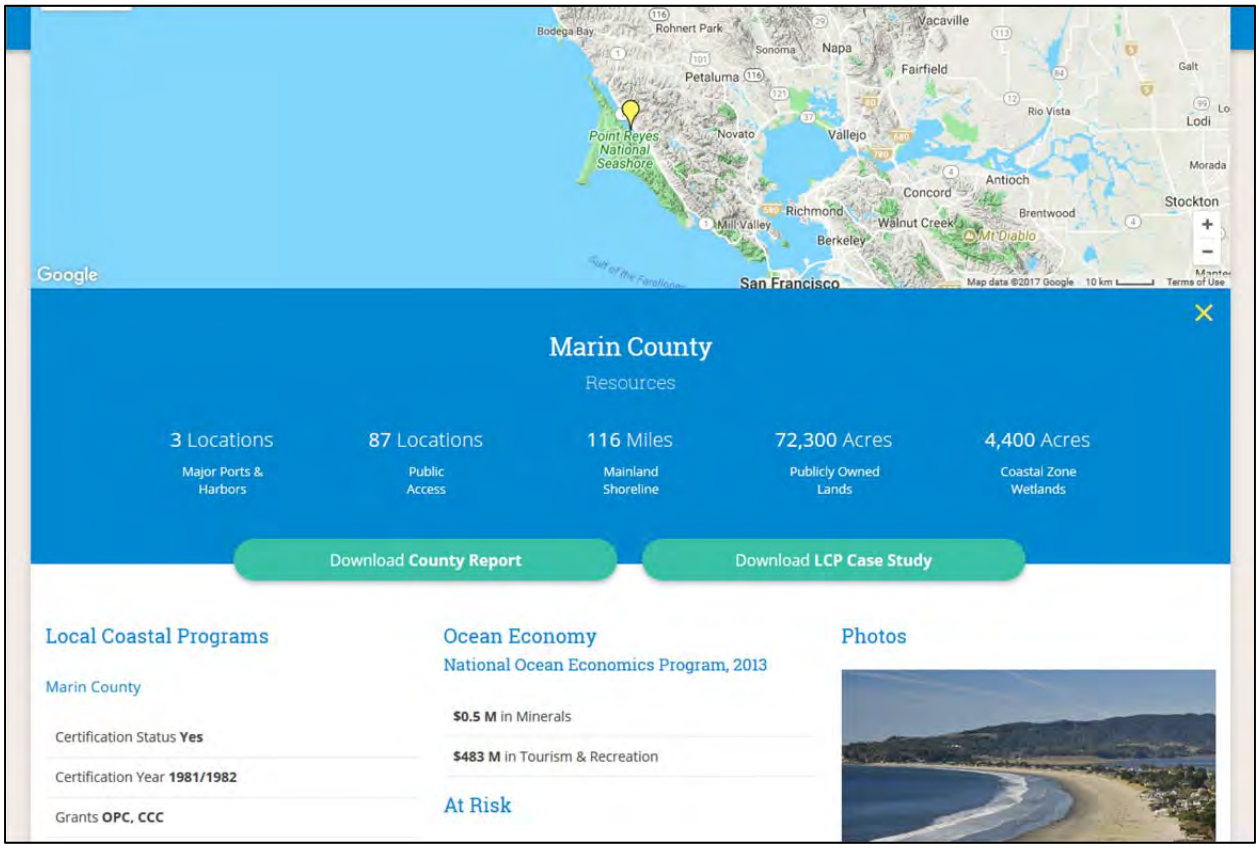
Local governments should use adaptation measures that best implement the statewide resource protection and hazard policies of the Coastal Act at the local level given the diverse geography and conditions of different areas. Some adaptation strategies will need to be implemented incrementally over time as conditions change, and many strategies will need to be implemented through both the LCP and CDP processes to be effective. Additionally, sea level rise planning may involve a number of trade-offs among various competing interests, and no single adaptation strategy will be able to accomplish all planning objectives. The important point is to analyze current and future risks from sea level rise, determine local priorities and goals for protection of coastal resources and development in light of Coastal Act requirements, and identify what land use designations, zoning ordinances, and other adaptation strategies can be used to meet those goals.

Click on each of the coastal resource categories below for examples of adaptation strategies that local governments and coastal planners should consider including in their LCPs or individual CDPs. For additional information on adaptation strategies, see Chapter 7 of the Sea Level Rise Policy Guidance.

Coastal Development & Hazards

Public Access & Recreation


Sea Level Rise
Vulnerability Synthesis
This statewide vulnerability synthesis presents important findings about California's coastal resources at risk to sea level rise and how the Commission can address these risks. County-level snapshots and four Local Coastal Program (LCP) case studies provide more location-specific detail and examples of recent sea level rise planning efforts.
Download Statewide Report
Search
Del Norte
Humboldt
Mendocino
Sonoma
Marin
San Francisco
Map
Satellite
Shasta-Trinity National Forest
Reno
NEVADA
Salt Lake City
UTAH
Sacramento
San Francisco
San Jose
Fresno
CALIFORNIA
Death Valley National Park
Las Vegas
Bakersfield
St George
Grand Junction


Bodega Bay
Rohnert Park
Sonoma
Napa
Vacaville
Fairfield
Petaluma
Rio Vista
Lodi
Point Reyes National Seashore
Novato
Vallejo
Antioch
Concord
Stockton
Brentwood
Richmond
Walnut Creek
Mt Diablo
Mill Valley
Berkeley
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Marin County
Resources
3 Locations
Major Ports & Harbors
87 Locations
Public Access
116 Miles
Mainland Shoreline
72,300 Acres
Publicly Owned Lands
4,400 Acres
Coastal Zone Wetlands
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Local Coastal Programs
Marin County
Certification Status Yes
Certification Year 1981/1982
Grants OPC, CCC
Ocean Economy
National Ocean Economics Program, 2013
$0.5 M in Minerals
$483 M in Tourism & Recreation
At Risk
Photos