

C-SMART: Collaboration: Seal-level Marin - Adaptation Response Team

Organization: Marin County Community Development Agency

Term of Project: April 30, 2014 – April 30, 2016

SCOPE OF WORK

A. PROJECT DESCRIPTION

The C-SMART project will develop a sound scientific and technical basis for assessing the potential changes, vulnerabilities, and impacts that sea level rise may bring to people, natural resources, access, and the built environment of Marin's ocean and Tomales Bay coast, will identify appropriate response and resilience strategies to address these effects, will coordinate with other agencies, and will plan for the implementation of such measures, including by integrating them into Marin's Local Coastal Program.

B. TASKS

TASK 1: PUBLIC INVOLVEMENT PROCESS, STAKEHOLDER AND TECHNICAL ADVISORY COMMITTEES

Task 1.1 Establish Public Process and Committees

An initial involvement strategy will be developed to address the publics affected by or concerned with sea level rise, including involved decision-makers, a Stakeholder Advisory Committee (SAC), a Technical Advisory Committee (TAC), and the wider interested public.

Decision-makers, including the local elected County Supervisor, the Superintendents of the Point Reyes National Seashore, GGNRA and Gulf of the Farallones National Marine Sanctuary, will be briefed on the project, its objectives and its schedule.

A ***Stakeholder Advisory Committee (SAC)*** will be established from among those who could be directly impacted by sea level rise and those with a broader interest in coastal resources and public finances, including citizen groups such as the Environmental Action Council of West Marin, planning groups such as the East Shore Planning Group, and affected individuals.

The ***Technical Advisory Committee (TAC)*** will be appointed to provide a foundation for the best available science with respect to sea-level rise impacts. It will continue and expand the County's relationships with the leading researchers, innovators, practitioners to be a source of data, analysis and contacts, guide development of critical new data, and provide expertise and ideas to make the project as productive and useful as possible.

Deliverable: A report including initial rosters of the TAC and SAC, and a tentative schedule of TAC, SAC and other public meetings.

Task 1.2 Carry Out the Public Involvement Process

The SAC, TAC and decision-maker group will work together to explore a range of potential future conditions and recommend those appropriate to evaluate through the vulnerability assessment. Workshops will engage participants in helping define potential impacts, develop creative and robust approaches for dealing with impacts, and to interactively develop a shared understanding of the efficacy, feasibility and cost of potential adaptation strategies.

Based on the groundwork laid by the SAC, TAC, consultants and staff, the broader public will be engaged in addressing issues throughout the process. In addition to general public meetings and meetings of the SAC and TAC, traditional media, social media, and the project website will all be employed to inform and learn from the public. Continuous contact and individual meetings with the public will also be used to assure full participation and understanding of the process. Both the Planning Commission and the Board of Supervisors will be brought along as the project proceeds so that they are informed and comfortable making decisions on potential SLR LCP Amendments.

Deliverable: A summary of the TAC, SAC and public meetings held to support the project objectives.

TASK 2: VULNERABILITY ASSESSMENT

Overview: In this assessment phase, project collaborators will work together to evaluate the full range of vulnerabilities from sea level rise, extreme events and geomorphic evolution.

The Our Coast–Our Future Project (OCOF) model, drawing on high resolution sophisticated scientific tools will identify areas that would be affected by sea level rise over time considering several scenarios. Data from OCOF modeling will be compared to information from FEMA’s CCAMP “Open Pacific Coast Study” critical analyses including statistical water level analysis, offshore and nearshore wave modeling, wave runup and overtopping assessments, and coastal erosion studies as they become available to strengthen the robustness of the project’s assessments. Project consultants will assess how potential geomorphic changes could affect impact patterns.

The project will also utilize data generated by the Marin County Department of Public Works Stinson Beach Flood Protection and Watershed Program (DPW) to assess the effects of sea level rise on riverine flooding (“combined flooding”). Additionally, the project will collaborate with the Natural Capital Project /Center for Ocean Solutions to apply the InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) toolbox to assess coastal vulnerabilities in a way that establishes the groundwork spatial and economic evaluation of risks to people, property and infrastructure from erosion and inundation due to climate impacts.

Task 2.1 Exposure Assessment

Task 2.1 will identify potential climate change effects on the Marin coast, using OCOF outputs to integrate wind, wave and surge conditions into an exposure assessment, including factors such as water levels, wave heights, flooding, and erosion. Specific OCOF assets that will be used include a seamless Digital Elevation Model derived from recent LIDAR and multibeam bathymetry, a suite of 40 dynamic coastal flooding projections in 25cm increments with four storm scenarios ranging from daily to 100-year return levels. OCOF's interactive maps overlays and a user-friendly interface will be used to help convey the results to promote public understanding. Additionally, we will share our experience with the Coastal Storm Modeling System (CoSMoS) models used in the OCOF tool to assist those who are applying these models in other areas throughout the state.

The Exposure Assessment will also explicitly address three additional aspects of sea level rise risk:

Extreme events (OCO F): As noted by Heberger, *et al.* (2009), “the majority of studies on climate change have emphasized changes in average conditions, yet the greatest socio-economic impacts tend to occur as a result of extreme events...” . While the NOAA Sea Level Rise Viewer currently does not include such events, OCOF modeling does, providing an important new dimension and value to this project. In addition, the collaboration with FEMA will ensure that this project is consistent with their analyses of extreme events and the corresponding mapping data that will become the regulatory basis for Marin County through the National Flood Insurance Program.

Combined flooding (County Flood, OCO F): Heberger also found that “higher sea levels... can also worsen flooding in nearby rivers as higher water surface elevations at the downstream end of a river causes water to back up and increase upstream flooding.” Marin DPW has completed extensive watershed analysis and hydraulic modeling of flooding in Easkoot Creek which flows out to Bolinas Lagoon through Stinson Beach. The Creek drains directly into Bolinas Lagoon, and the preliminary modeling indicates sea level rise in the Lagoon will retard drainage and worsen flooding from the landward side at the same time that it increases from the ocean side. C-SMART will examine this important, potentially widespread, yet poorly studied vulnerability.

Geomorphic evolution: Patterns and rates of erosion and deposition on the coast will change as sea level rises, extreme events increase and runoff changes. Over a period of decades we expect to see significant changes in the morphology of the coast that in itself may threaten resources, such as the erosion of bluffs. This may also change the extent of hazard zones by allowing large areas to become inundated as they are eroded. Few assessments have considered the geomorphic response to sea level rise, but C-SMART will describe these qualitatively and their influence on inundation and flooding based upon previous work undertaken for the Pacific Institute (Heberger, 2009).

Deliverable: A report section of the changes projected in flooding during extreme events, combined flooding and geomorphic change due to climate impacts, focusing on three future years spanning the end of the century will be written. This will leverage existing studies to the

extent feasible. It will include GIS maps developed by CDA indicating the location and extent of the hazard areas.

Task 2.2 Sensitivity Assessment

Task 2.2 will determine what resources of the coast (functions, structures, and populations) will be affected by the impacts. Using the tools available from OCOF and others, this part of the project will specifically map resources and assets, identify their level of criticality, and evaluate the degree that these and other assets are susceptible to damage from a range of sea level rise and storm surge scenarios in order to develop a sharper picture of the sensitive resources.

For example, Marin's coastal zone is exceptionally rich in resources, including public beaches, recreational and visitor-serving opportunities, wetlands, diverse wildlife and sensitive habitats, and productive agricultural lands. People and their support systems also crowd the shore – homes on sandspits and low-lying areas with nothing but shifting sands separating them from the sea. Other homes already sit on piles above the water itself. These dwellings rely on septic systems to cleanse their wastewater before it rejoins the ocean; but the effect of a rising ocean on the water table and the viability of those systems has not been measured. Saltwater intrusion into low lying areas also has the potential to foul vital public and private drinking water sources. On hot, sunny days (which are likely to increase) thousands of people from throughout the Bay Area and beyond come here for respite and recreation, relying on the sole north-south artery of Highway One. The analysis will evaluate how susceptible the Highway is to inundation and, potentially cutting people off from the coast.

This data will be combined with the County's parcel level GIS land use data and additional data developed through the public involvement process to assess the sensitivity of natural systems such as coastal wetlands, beaches, dunes and oyster beds, and critical coastal and community assets including visitor accommodations, Highway 1, public facilities, businesses and homes.

Deliverable: A report section describing the assets within the hazard area identified in Task 2.1. It will include GIS maps developed by CDA indicating the location and criticality of the assets.

Task 2.3 Potential Impacts

Task 2.3 will investigate how sensitive the vulnerable resources identified in Task 2.2 are to the climate change drivers identified in Task 2.1. This part of the assessment will evaluate how changing conditions will impact the resources at risk in terms of specific characteristics of the resource, magnitude of the impact, its persistence or growth over time, and the degree it disrupts the normal functioning of the community or resources.

In this process we will also account for the inherent uncertainty of models and predictions of expected change, and seek to prepare robust scenarios to strengthen the willingness to make decisions despite a lack of all the desired information.

Deliverable: A report section describing the potential impacts to the assets within the hazard area identified in Task.2.1. It will include an assessment of potential impacts for each asset,

rated low, medium or high. It will include tables developed by CDA indicating the location and impact rating.

Task 2.4 Adaptive Capacity

This task will evaluate and characterize the structures and mechanisms that are currently available to respond to the identified potential impacts identified in Task 2.3, such as flood risk management levees and structures, flood-proofing and raising homes, evacuation plans, flood insurance, etc. Marin's demonstrated record on environmental innovation and leadership, combined with the creativity, foresight and accomplishment of other C-SMART partners, lay a solid foundation for this task.

Deliverable: A report section describing the adaptive capacity of assets within the hazard area identified in Task 2.1. The report section will be written by CDA with contributions from County DPW, Geomorphology/Hydrology expert and OCOF. It will include an assessment of the current capacity to address each of the potential impacts for each asset, rated low, medium or high. It will include tables developed by CDA indicating the location and adaptive capacity rating.

Task 2.5 Risk and Onset

This task assesses how likely and how quickly the impacts identified in Task 2.3 will occur. This assessment, integrating the likelihood of each impact and the expected level of damage and the timing of their occurrence will allow us to formulate priorities among the impacts to be addressed. Secondary impacts will be similarly assessed.

Deliverable: A report section describing the certainty and timing of impacts to assets within the hazard area identified in Task 2.1. The report section will be written by CDA with contributions from project partners. Each potential impact will be rated low, medium, or high based on certainty and rated near-term, mid-term, or long-term based on onset. It will include tables developed by CDA indicating the location and certainty and timing ratings. A report of the vulnerabilities assessment (Task 2) will be prepared by CDA that summarizes the results of the work above for review by the SAC and TAC.

TASK 3: ADAPTATION STRATEGY DEVELOPMENT

Task 3 translates the climate vulnerability and risk identified in Task 2 into implementable actions as described in the *California Adaptation Planning Guide*.

Task 3.1 Prioritize Adaptive Needs: (CDA lead)

Based upon the potential impacts (Task 2.3), the existing adaptive capacity (Task 2.4) and the risk and onset profile (Task 2.5) identified by the Vulnerability Assessment, the County, with input from the SAC and TAC, will formulate priorities for development of adaptation strategies. For example, higher priority will go to strategies addressing impacts with greater potential severity, longer ramp-up times or easy, generally accepted and inexpensive solutions. Impacts that are already well controlled or predicted to arise further in the future (offering more time to mobilize a response) would rank with relatively lower priority.

Deliverable: A report section listing the potential impacts divided into three categories: (1) need to develop adaptation strategies (2) evaluate further to assess impacts and needs, and (3) continue to monitor to assess impacts. It will include tables indicating the prioritization ratings.

Task 3.2 Identify Strategies

Task 3.2 will assess which impacts require actions to address them and will identify which strategies should be pursued to address the adaptation needs. In coordination with the Coastal Commission, the project will develop a range of flexible, cost-effective multi-objective strategies which include both structural and non-structural responses. These may include those that work with natural processes such as dune or wetland restoration, sea grass and kelp beds, oyster reefs and racks and other living shoreline approaches, engineered solutions such as seawalls, rip-rap, and raising/flood-proofing of structures, and planning, zoning, and legal adaptation alternatives such as planned retreat/relocation, rolling easements, and an evaluation of the flexibility local governments have to maintain or relinquish public facilities over the next 25-30 years in the face of encroaching seas. A targeted effort will be made to build upon Cal-Adapt's *Identifying Adaptation Strategies* and identify suitable strategies on a statewide and even global scale to capitalize on lessons learned by others. This should increase confidence and reduce the time from idea to implementation. We would like to coordinate this work with other grantees for an efficient division of labor. Strategies will be evaluated to identify those providing the most robust response over a spectrum of possible future conditions. The results of this effort will also strengthen the transferability value of our project.

Deliverable: A report section describing in conceptual terms a set of strategies to address each adaptation need identified for strategy development. This would include indicative costs and identification of co-benefits.

Task 3.3 Evaluate and Prioritize

This task seeks to identify which of the strategies in Task 3.2 should be implemented first. Strategies will be prioritized based upon the number of criteria determined by the County, with input from the SAC and TAC. The criteria could include the projected onset of impacts, indicative costs (both initial and ongoing), calculated effectiveness, the timing and duration of the strategy, the full spectrum of benefits, including corollary gains beyond those related to sea level, (including "co-benefits" to habitat, public access and permitting), and legal, political and community acceptability. A general cost-benefit analysis will be performed on various alternative scenarios based on knowledge of adaptation cost planning using a published range of costs in order to provide a basis of evaluation of next steps.

Deliverable: A report section will be written that will identify, for each strategy, implementation timing: (near-term, mid-term, and long-term); indicative cost (low, medium, and high both for capital and maintenance); likely range of effectiveness, and barriers to implementation and uncertainty.

Task 3.4 Plan Implementation Phasing

A preliminary implementation plan will be prepared to describe the phasing of strategies and their component projects, and to recommend responsibilities for who would carry out each strategy. Potential funding mechanisms will be identified and strategies to secure appropriate funding suggested, according to the implementation schedule. A monitoring and evaluation table, including adaptive management, where applicable, will be outlined for each broad strategy to address the performance and effectiveness of the strategies. A monitoring protocol will also be outlined to evaluate changes in the rate and extent of sea level rise and related climate factors, and their conformance or divergence from the predictions upon which the adaptation strategies are based. Finally, periodic reviews will be included to allow re-calibrating accepted strategies in the light of the evolving science of understanding and responding to sea level rise.

Deliverable: A report section will be written that will identify a conceptual implementation plan and monitoring program for the identified strategies.

A final report of the adaptation strategy development (Task 3) will be prepared that summarizes the results of the work above for review by the SAC and TAC. This report will include a section describing lessons learned written for the dissemination of knowledge gained during this project.

TASK 4: LCP AMENDMENT

One of the principal means of implementing the project will be updating the Marin County Local Coastal Program to incorporate the applicable measures to address sea-level rise and other climate change impacts. Concurrent with the development of Task 3.4, the County will develop the appropriate LCP Amendments based on the results of the sea level rise study, to address sea level rise and climate change impacts.

A preliminary list of such measures is currently proposed in the County's draft LCPA (Program C-EH-22a). The County will work in close partnership with the Coastal Commission to develop an LCP Amendment, and to assure that the LCP Amendment fully carry out the Coastal Act, are highly effective, and are in a transferrable format to provide the greatest assistance to other coastal jurisdictions.

The development of the LCP Amendment will include at least one public meeting, and coordination meetings with the Coastal Commission every other month. Once a draft is complete, the County will submit it to the Planning Commission and Board of Supervisors for approval.

After approval by the Planning Commission and Board of Supervisors, the County will submit the LCP Amendment to the Coastal Commission for review.

Deliverable: Submittal of LCP Amendment to Coastal Commission

TASK 5: TRANSFER LESSONS

We will create or participate in a network of all recipients of this and related funding opportunities to share experiences and lessons as they are learned across sectors and geographies. This network will be coordinated by the CCC, OPC and/or through the project's OCOF team members who already act as conveners and communication strategists for multiple local, regional, and state adaptation efforts. This activity was part of our original grant proposal, and will also incorporate the condition the Coastal Commission placed upon the grant award:

Sea level rise work completed under the grant program shall be coordinated regionally to the extent feasible between other jurisdictions and entities working on sea level rise within the same county or broader regional area relevant for sea level rise adaptation, such as the watershed, littoral cell, or area with similar geologic characteristics. Coordination includes early coordination meetings among the different entities, sharing of technical analyses and lessons learned, and consideration of regional adaptation policies.

Deliverable: A summary document of lessons learned from each funding recipient will be prepared in order to inform future iterations of this funding opportunity and of other policy initiatives. Team members will prepare this report in consultation with state agencies including the Coastal Commission and the Coastal Conservancy to ensure that information in the document is actionable and relevant to existing planning and policy processes, including LCP updates.

C.SCHEDULE

Project begin/end dates:

Task I. Public Involvement Process, Technical and Stakeholder Committees	Begin date: 6/1/14 End Date: Ongoing
1.1 Establish Committees	Begin date: 6/1/14 End Date: 8/15/14
2.1 Conduct Involvement Process (4 public meetings, including the forth public meeting on the LCPA)	Begin date: 6/1/14 End Date: 4/30/16
Deliverable: Public Outreach Summary Report	Completion Date: 4/30/16
Task 2. Vulnerability Assessment	Begin date: Contract date* End Date: 4/30/15
2.1 Exposure Assessment	Begin date: Contract date* End Date: 8/29/14
2.2 Sensitivity Assessment	Begin date: 6/1/14 End Date: 2/27/15
2.3 Potential Impact Assessment	Begin date: 6/1/14 End Date: 2/27/15
2.4 Adaptive Capacity Assessment	Begin date: 6/1/14 End Date: 2/27/15
2.5 Risk and Onset	Begin date: 6/1/14 End Date: 4/30/15
Deliverable: Vulnerability Assessment	Complete Date: 4/30/15

Report	
Task 3. Adaptation Strategy Development	Begin date: 3/1/15 End Date: 4/30/16
3.1 Prioritize Adaptive Needs	Begin date: 3/1/15 End Date: 8/30/15
3.2 Identify Strategies	Begin date: 3/1/15 End Date: 9/30/15
3.3 Evaluate and Prioritize	Begin date: 8/1/15 End Date: 1/30/16
3.4 Plan Implementation Phasing	Begin date: 3/1/15 End Date: 1/30/16
Deliverable: Adaptation Strategy Report	Complete Date: 2/28/16
Task 4. LCPA Development	
Coordination meetings with CCC (Every other month)	Begin date: 3/1/15 End Date: 2/28/16
Complete draft Amendment	Begin date: 3/1/15 End Date: 2/28/16
Planning Commission Action – Proposed LCPAs	Completion Date: 2/29/16
Board Action – Proposed LCP Amendments	Completion Date: 4/30/16
Deliverable: Submittal to CCC	4/30/2016
Task 5. Transfer Lessons	Begin date: 6/1/14 End Date: 4/30/16
Deliverable: A summary document of lessons learned	Completion Date: 4/30/16
Final Deliverable: Final Report, Submittal of LCPA to Coastal Commission	Complete Date: 4/30/16

**The start date for any work covered by OPC & CCC contracts is the date those agencies authorize their respective contracts.*

D. BENCHMARK SCHEDULE

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ACTIVITY	COMPLETION DATE
Establish SAC and TAC	Completion Date: 8/15/14
First General Public Meeting (Project Process)	Completion Date: 8/15/14
Progress Report to SAC, TAC, PC, BOS	Completion Date: 10/31/14
Second Public Meeting-Progress Update	Completion Date: 11/28/14
SAC, TAC Review- Vulnerability Report	Completion Date:

	3/31/15
Third Public Meeting/ Brief Plan. Comm./ Bd.Sups.	Completion Date: 5/18/15
SAC, TAC Prioritize Adaptation Strategies	Completion Date: 11/13/15
Fourth Public Meeting - Proposed LCPAs	Completion Date: 2/29/16
Planning Commission Action –Proposed LCPAs	Completion Date: 2/29/16
Board Action – Proposed LCP Amendments	Completion Date: 4/30/16
Submittal of LCPA to Coastal Commission	Completion Date: 4/30/16

E. EVALUATION AND REPORTING

The Grantee shall submit a progress report at least every 6 months, subject to the Coastal Commission Executive Director’s review and approval, and a final progress report upon completion of the grant project. The progress report shall include a description of work tasks and deliverables completed to date, and a description of completed benchmarks, or progress toward completing benchmarks.

Progress reports will be due on the following dates:

- October 30, 2014
- April 30, 2015
- October 30, 2015
- April 30th, 2016

Final deliverable and progress report are due on April 30, 2016.