September 15, 2023

Amanda Hansen
Deputy Secretary for Climate Change
California Natural Resources Agency
715 P Street - 20th Floor
Sacramento, CA 95814

Re: Public input on recommendations for implementing Assembly Bill 1757 (2022)

Dear Deputy Secretary Hansen:

On behalf of our organizations, thank you for the opportunity to provide input on the development of targets for natural climate solutions that mitigate greenhouse gas (GHG) emissions. These efforts support state goals to achieve carbon neutrality and foster climate adaptation and resilience, as required under AB 1757. We applaud the state's commitment to harnessing natural and working lands, including blue carbon habitats like tidally influenced wetlands and submerged aquatic vegetation, to advance California's climate goals.

Overview

Our interest in the natural and working lands sector, and the focus of our comments, is to advance protection and restoration of California's iconic and vital coastal ecosystems as a key component of the state's climate response policies. When healthy and intact, coastal "blue carbon" habitats—such as tidal wetlands and eelgrasses—sequester and store significant amounts of carbon relative to their spatial

footprint, in addition to providing significant benefits like flood mitigation,[1] shoreline protection,[2] improved water quality,[3] habitat for fish and wildlife,[4] and localized amelioration of ocean acidification.[5] Coastal wetlands also help to sustain local businesses, including commercial and recreational fisheries and tourism, and are vital for community well-being and culture.[6] Degradation and loss of these wetlands threaten these benefits; their ability to sequester and store carbon is reduced and they can even become net sources of GHG emissions.

Over the past century, California has lost approximately 90% of its wetland ecosystems, with coastal wetlands experiencing disproportionately higher rates of loss.[7] Despite regulatory protections and conservation incentives put in place over the last three decades, threats to coastal wetlands—including inadequately planned and mitigated development, barriers to water and sediment flows, pollution, and sea level rise—persist. The development of natural climate solutions targets can catalyze efforts to stem losses and expand recovery of tidal and submerged habitats, which in turn can reduce and avoid GHG emissions and enhance carbon sequestration and storage.

Recommendations

We urge the California Natural Resources Agency (CNRA) and partner agencies to consider the recommendations below with respect to target setting for coastal blue carbon habitats, particularly in relation to the approximately 57,000 acres of coastal wetlands (approximately 43,000 acres of saline tidal wetlands and 13,000 acres of eelgrass[8]) remaining in the state.

1. What targets do you think the state should set to increase meaningful, credible climate action on our natural and working lands?

We recommend the following overarching targets for reducing and avoiding GHG emissions as well as enhancing carbon sequestration and storage in coastal wetlands, as described in greater detail below:

- All 57,000 acres of remaining coastal wetlands protected from further loss;
- Resilience interventions in place to protect coastal wetlands from sea level rise;
- Increased restoration of degraded wetlands wherever feasible; and
- New research program for oceanic carbon.

1.1. All remaining coastal wetlands are protected from further loss.

Coastal wetlands are recognized as globally significant carbon sinks because of their measurable ability to efficiently capture and store carbon. The carbon stored in these habitats has been accumulating for hundreds if not thousands of years.[9] California's coastal wetlands currently store approximately 13.4 million metric tons (MMT) of carbon,[10] which likely represents a fraction of the carbon held in these habitats prior to European settlement. Once destroyed, this stored carbon is released back into the atmosphere. For example, San Francisco Estuary Institute estimates that in the Sacramento San Joaquin Delta Estuary system, approximately 140 MMT of carbon has been lost since the early 1800s due to

[1] https://www.scienceforconservation.org/products/Salt-Marsh-Flood-Benefits
[2] https://scc.ca.gov/climate-change/climate-ready-program/natural-infrastructure/
[3] https://ca.audubon.org/news/study-wetlands-restoration-can-improve-water-quality-central-valley
[4] https://www.fisheries.noaa.gov/west-coast/habitat-conservation/essential-fish-habitat-west-coast
[5] https://www.ucdavis.edu/climate/news/seagrasses-turn-back-the-clock-on-ocean-acidification
[6] https://www.ramsar.org/culture-wetlands
[7] https://mywaterquality.ca.gov/eco_health/wetlands/extent/loss.html
[8] Vaughn et al (2022) Leveraging Wetlands for a Better Climate Future (page 2)
[9] https://oceanservice.noaa.gov/ecosystems/coastal-blue-carbon/
[10] https://smithsonian.github.io/CCRCN-Pew-Project/analysis.html#california-state-report

diking and draining, which is analogous to clear-cutting over 3.5 million acres of forest or burning half a trillion pounds of coal.[11]

Although restoration is critical, it does not compensate for these original losses of carbon. Accordingly, the most efficient and cost-effective implementation target for coastal blue carbon habitats is protecting all remaining coastal wetlands from further loss (i.e., "avoided conversion"). As noted above, despite the existence of regulatory protections, coastal wetlands still face threats. In addition, the "no-net-loss and long-term net gain policy" underpinning California's wetlands regulatory framework does not adequately account for losses of ecosystem function, such as carbon storage, and is not systematically tracked.

To address these challenges, specific implementation targets should:

- Enact protections for at-risk coastal wetlands on public and private lands through policy mechanisms such as protected area designations and conservation easements;
- Secure protections for submerged lands that currently or historically harbored eelgrass habitats through marine protected areas and similar designations, such as Areas of Special Biological Significance (ASBS)[12] and Environmentally Sensitive Habitat Areas (ESHAs);[13]
- Reduce upstream water quality threats through policy measures such as Outstanding National Resource Water designations;[14] and
- Establish new protective regulations and/or guidance policies, including adoption of a state standard for net gain of ecosystem function and associated tracking mechanism for wetlands inclusive of tidal wetlands and eelgrass.

1.2. Resilience interventions in place to protect coastal wetlands from sea level rise.

Maintaining intact, healthy coastal wetlands requires managing for future sea level rise. Some studies suggest that California's coastal wetlands are extremely vulnerable, with one study[15] estimating a 100% loss of state marshes under high sea level rise scenarios, absent interventions that build resilience. Coastal wetlands can adapt to rising sea levels in two major ways: (1) maintaining vertical elevation through accretion, and (2) migrating inland—or shoreward in the case of eelgrass. However, absent sufficient sediment resources and migration space, these habitats are susceptible to drowning. Experts currently believe that carbon stored in coastal wetlands converted to open water is entirely lost to the atmosphere, although this is an area of active research.[16]

To avoid these losses, implementation targets should be set to ensure adequate sediment supply to help wetlands maintain elevation and to ensure availability of undeveloped areas for migration space. Specific implementation targets should:

- Remove and/or upgrade aquatic barriers to restore water and sediment flows;
- Increase implementation of thin layer deposition of sediment projects;[17]
- Protect undeveloped land that can serve as migration space;[18] and

[11] Vaugh et al (2022) Delta Wetland Futures: Blue Carbon and Elevation Change.
[12] California State Water Resources Control Board. Areas of Special Biological Significance (ASBS). Accessed 8/19/2023.
[13] For ESHA underlying code, see Public Resources Code, Division 20, CA Coastal Act, 1976. Section 30107.5.
[14] Bardeen, Sarah, A new tool could help protect 30% of the state's waters by 2023, Public Policy Institute of California
[15] Thorne et al (2018) U.S. Pacific Coastal Wetland Resilience and Vulnerability to Sea Level Rise
[16] Macreadie et al (2019) The future of Blue Carbon science
[17] See: https://scc.ca.gov/2019/06/24/news-release-dredged-sediment-from-san-francisco-bay-to-be-used-for-wetland-restoration/
[18] Heady, W. at al (2018) Conserving California's Coastal Habitats: A Legacy and a Future with Sea Level Rise identified 200 km2 as migration space for coastal habitats (including but not limited to coastal wetlands).

- Restrict nearshore development in submerged areas through marine protected areas (or other protective designations) to create room for eelgrass migration into shallower waters.

1.3. Increased restoration of degraded wetlands

Alongside the conservation of existing coastal wetlands, restoration – particularly in high leverage areas that would afford multiple benefits such as GHG mitigation and flood protection– should be included in targets to address the legacy of extensive diking, draining, and conversion of these habitats. For implementation targets, we recommend:

- Ensuring implementation of the 60,000-acre restoration target for the Delta established in the 2022 Climate Change Scoping Plan, including setting interim acreage goals;
- Setting an additional 21,000-acre restoration goal for San Francisco Bay's tidal wetlands and eelgrass habitats, which would increase total wetland GHG benefits by 27,000 MT CO_2e per year;[19]
- Establishment of regional blue carbon restoration targets for the North Coast, Central Coast and South Coast regions in concert with existing wetland restoration programs that would leverage both climate mitigation and adaptation benefits; and
- Setting a target to restore tidal connections to impounded wetlands to diminish methane production.[20]

1.4. New research program for oceanic carbon

The Intergovernmental Panel on Climate Change (IPCC) recognizes the climate mitigation contribution of tidal wetlands and seagrasses and has issued guidance for incorporating these ecosystems into GHG inventories.[21] Similar accounting methodologies do not yet exist for oceanic carbon like kelp forests and marine sediments. With its extensive coastline measuring approximately 3,427 shoreline miles[22] under state management, California may be able to leverage additional climate mitigation benefits in its marine areas. The Biden Administration recently committed to expanding research into oceanic carbon as part of its Ocean Climate Action Plan,[23] presenting an opportunity for partnership and resource-sharing with federal agencies like the National Oceanic and Atmospheric Administration. The state Marine Protected Area network and the four (potentially five with the proposed Chumash designation) National Marine Sanctuaries could potentially be tapped for this research. We recommend establishment of a goal to stand up a statewide research program for oceanic carbon. As an example, Oregon's Natural and Working Lands proposal[24] recommends more consistent mapping of kelp in state waters, as well as research to better understand sequestration benefits of protecting/restoring kelp forests.

2. For each target you propose, how do you suggest the state best measure progress on achieving such targets?

Coastal wetland mapping and blue carbon assessments, including carbon stock and GHG flux measurements, are foundational for maintaining and enhancing the climate mitigation benefits of these habitats. As the state establishes infrastructure for "measurement, monitoring, reporting and verification" (MMRV) around natural climate solutions, we recommend specific MMRV goals for blue

[19] Vaughn et al (2022) Leveraging Wetlands for a Better Climate Future (page 2)
[20] Holmquist, J.R., M. Eagle, R.L. Molinari, S. Nick, L.C. Stachowicz, and K. Kroeger. 2022. Blue Carbon-based Natural Climate Solutions, Priority Maps for the U.S., 2006-2011. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2091
[21] IPCC 2014, 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands
[22] https://coast.noaa.gov/data/docs/states/shorelines.pdf
[23] See https://www.whitehouse.gov/ostp/news-updates/2023/03/21/ocean-climate-action-plan/
[24] Oregon Global Warming Commission (2021), Natural and Working Lands Proposal

carbon habitats. Vaughn et al. (2022) identifies key areas that could be included in implementation targets to support MMRV, including mapping, biogeochemical data, and modeling.

Also, given the important role of the statewide GHG Inventory for setting targets and measuring progress, we recommend investing in improvements to the state's Natural and Working Lands GHG inventory, particularly for carbon associated with tidal wetlands and eelgrass. The Coastal Wetland Greenhouse Gas Inventory for San Francisco Bay Estuary (Beers and Crooks)[25] provides a model for improving the state inventory's accounting of coastal wetlands.

With respect to recommendation 1.1, we recommend:

- Establishing a tracking mechanism, such as a biannual "status and trends" program and report, to account for loss and gain of wetland extent and function. This action will help California understand its progress toward the existing wetlands no-net-loss and long-term net gain policy[26] and provide a key scientific underpinning for achieving other state goals relative to the biodiversity and climate crisis as detailed under question 3. A 2015 pilot study[27] in California can serve as a foundation to achieve this goal, and other states have similar programs worth consideration.[28,29]
- Leveraging tracking mechanisms established via the 30x30 program for accounting for new protected area designations.[30]

With respect to 1.2, we recommend leveraging monitoring and reporting frameworks created through state and local adaptation plans. For example, CNRA could cross walk indicators for tracking and measuring progress between AB 1757 implementation and the California Climate Adaptation Strategy.

With respect to 1.3, we recommend establishing a statewide program to quantify impacts of restoration on coastal wetland health and carbon services, similar to the program recently launched in Louisiana.[31] In the near term, we recommend investing in the San Francisco Estuary Institute's Habitat Restoration Project Tracking system, specifically expanding the system statewide and supporting regular updates. This tool can be utilized to assess progress and associated climate mitigation impacts of coastal wetland restoration projects. In addition, there may also be opportunities to leverage the carbon sequestration and climate resiliency project registry currently under development. The state should also consider investing in the development of a blue carbon calculator, incorporating input from Oregon and Massachusetts.

3. What policies, tools, frameworks, collaborations and/or investment are needed to deliver on the targets?

The recommendations proposed in this letter for maintaining and enhancing California's blue carbon habitats are consistent with several existing state policies, plans and frameworks. We recommend investing in and leveraging implementation of these state programs:

[25] L. Beers and S. Crooks (2022), Coastal Wetland Greenhouse Gas Inventory for the San Francisco Bay Estuary
[26] Governor Pete Wilson. California Executive Order 59-93. August 23, 1993.
[27] Stein, E.D., P. Pendleton, K. O'Connor, C. Endris, J. Adalaars, M. Salomon, K. Cayce, and A. Jong. 2015. Demonstrating the California Wetland Status and Trends Program: A Probabilistic Approach for Estimating Statewide Aquatic Resource Extent, Distribution and Change over Time – Pilot Study Results. Technical Report #859. Southern California Coastal Water Research Project. Costa Mesa, CA.
[28] Pennsylvania Department of Environmental Protection. Net Gain of Wetland Resources Strategy. Accessed 8/19/2023.
[29] Washington Department of Ecology. Shoreline Master Program Handbook: Chapter 4: No Net Loss of Shoreline Ecological Functions. Publication Number: 11-06-010. Revised June 2017.
[30] CA Natural Resources Agency. CA Nature Data Portal. Accessed 8/19/2023.
[31] See LA-2023-009[1].pdf (noaa.gov)

- CNRA's Pathways to 30 x 30: One of this strategy's six main Conservation Priorities to Protect and Restore Biodiversity is to "Restore degraded habitats, especially for rare ecosystems and wetlands."
- 2022 Climate Change Scoping Plan: The Plan includes a 60,000-acre restoration target for the Sacramento San Joaquin Delta wetlands.
- CNRA's Natural and Working Lands Climate Smart Strategy: The Strategy calls for protecting against habitat loss, degradation, and fragmentation to maintain carbon sequestration, protect biodiversity and culturally significant species, reduce climate risks, and increase climate resilience. It includes recommendations for blue carbon in two areas – wetlands and seagrasses and seaweeds.
- Ocean Protection Council and Coastal Conservancy 2023-2027 Strategic Plans: Each seeks to protect and expand wetlands, including protecting, restoring, or creating 10,000 acres of coastal wetlands by 2025, and increasing the acreage by 20% by 2030 and 50% by 2040.
- The Delta Conservancy's 2022-2027 Strategic Plan provides a roadmap for enhancing the ecosystem and economy of the Delta and Suisun Marsh.
- The Cutting the Green Tape Initiative and "Bay Fill" amendment (which could be replicated in other regions) should be leveraged to accelerate coastal wetland restoration, particularly in areas like Suisun Marsh where the window for restoration may be closing due to sea level rise and subsidence.

With respect to collaborations, we recommend the state invest in a California blue carbon "science to policy network," similar to the Pacific Northwest Blue Carbon Working Group. The foundation for collaboration has been laid by groups like Coastal Quest, WILDCOAST, California Ocean Science Trust, and the San Francisco Estuary Institute.

4. For each target you propose, please share any relevant support background (ex. data, studies, experience, etc.)

The following studies and reports inform the recommendations presented in this letter:

Cross-Cutting

- Howard et al (2023) Blue carbon pathways for climate mitigation: Known, emerging and unlikely
- Kauffman et al (2020) Total ecosystem carbon stocks at the marine-terrestrial interface: Blue Carbon of the Pacific Northwest Coast, United States
- Point Blue (2023) Evidence for the multiple benefits of wetland conservation in North America: Carbon, biodiversity and beyond
- Vaughn et al (2022) Leveraging wetlands for a better climate future: Incorporating blue carbon into California's climate planning

Protection

- Cook-Patton et al (2021) Protect, manage and then restore lands for climate mitigation
- Trulio and Callaway, To Fight Climate Change, We Need the Newark Baylands, Bay Nature, August 2023

Resilience

- Heady, W. at al (2018) Conserving California's Coastal Habitats: A Legacy and a Future with Sea Level Rise.
- Thorne et al (2018) U.S. Pacific Coastal Wetland Resilience and Vulnerability to Sea Level Rise

Restoration

- Brophy et al (2019) Insights into Estuary Habitat Loss in the Western United States using a New Method for Mapping Maximum Extent of Tidal Wetlands
- Holmquist, J.R., M. Eagle, R.L. Molinari, S. Nick, L.C. Stachowicz, and K. Kroeger (2022) Blue Carbon-based Natural Climate Solutions, Priority Maps for the U.S
- Vaugh et al (2022) Delta Wetland Futures: Blue Carbon and Elevation Change

Tracking/Monitoring (GHG inventory)

- Beers et al (2021) Incorporating Coastal Blue Carbon Data and Approaches in Oregon's First Generation Natural and Working Lands Proposal
- Beers et al (2022) Coastal Wetland Greenhouse Gas Inventory for the San Francisco Bay Estuary
- Holmquist et al (2021), Coastal Carbon Research Network Blue Carbon Inventory
- IPCC 2014, 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands

Conclusion

Finally, setting and implementing ambitious targets for natural climate solutions will require partnerships spanning local, regional, state, and federal agencies and constituencies. Engagement and coordination with federal agencies whose purview includes coastal wetlands—such as the National Oceanic and Atmospheric Administration, the Environmental Protection Agency, the U.S. Department of Agriculture, and the Department of Defense (through coastal installations and Sentinel Landscape designations) will leverage additional expertise, resources, and durability of solutions.

Thank you for the opportunity to provide input into the development of targets for natural climate solutions. Given the urgency of the climate crisis, and the ability of natural climate solutions to "multi-task" for both climate mitigation and adaption, we encourage you to set ambitious targets for the natural and working lands sector, inclusive of coastal blue carbon ecosystems.

Sincerely,

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Delta and Blue Carbon Targets

Vaughn et al 2022

Actions			*Implementation Target*		*Objectives*	*Objectives*	*Pathways*
Practice	**Practice Description**	**References for climate mitigation benefits (not exhaustive)**	**Potential to Scale on CA Wetlands**	**Justification for Potential to Scale**	**Co-Benefits**	**Synergies with other State Priorities**	**Strategies or Infrastructure Needed to Scale**
Delta Restoration	Implement the 60,000 acre restoration target for the Delta included in the 2022 climate change scoping plan (scenario 3). Set interim targets to achieve acreage goals over the next 7-10 years	DSC 2013 Goals Project 1999 Goals Project 2015 Subtidal Goals 2010 Vaughn et al 2022	103,000 acres	The current proposed scenario sets a 60,000 acre restoration target for the Delta. Significant information exists to incorporate a target to protect an additional 43,000 acres of tidal marsh and tidal scrub/shrub wetlands outside of the Delta (current extent). These currently unaccounted for tidal wetlands would sequester an estimated 15,000 MT carbon annually.	Increase carbon sequestration Reduce short-lived climate pollutants Reverse land subsidence Provide value to lands facing loss of ag productivity Lessen the impacts of storm surges and flooding Provide critical habitat Increase resistance to wildfire Improve water quality Support for fisheries and tourism Cultural services Reduce shoreline erosion	30x30 No Net Loss NWL Climate Smart Strategy Delta Stewardship Council - performance measures California Sustainable Insurance Roadmap OPC Strategic Plan	Centralized mapping Streamlined permitting MMRV infrastructure
Saline Wetland conservation/ restoration	Leverage and/or establish regional acreage restoration target for saline wetlands	Beers and Crooks 2022 DSC 2013 Goals Project 1999 Goals Project 2015 Subtidal Goals 2010 Vaughn et al 2022	18,000 acres in San Francisco Bay, TBD in North Coast, Central Coast & South Coast	Adding restoring an additional 18,000 acres of saline tidal wetland in San Francisco Bay to the Scoping Plan proposed scenario would increase total wetland GHG benefits by 23,220 MT CO2e per year. Additional research is needed to set target for outside of the Bay.	Increase carbon sequestration For tidal reconnection, reduce methane emissions Increase resistance to wildfire Improve water quality Provide value to lands facing loss of ag productivity Support for fisheries and tourism Cultural services Lessen the impacts of storm surges and flooding Reduce shoreline erosion	30x30 No Net Loss NWL Climate Smart Strategy OPC Strategic Plan	Centralized mapping Streamlined permitting MMRV infrastructure
Eelgrass Meadows conservation/ restoration	Set acreage protection and restoration target for eelgrass meadows	DSC 2013 Goals Project 1999 Goals Project 2015 Subtidal Goals 2010 Vaughn et al 2022 PMEP Eelgrass Restoration Synthesis	13,000 acres	Significant information exists to incorporate protection of 13,000 acres of eelgrass meadows into state targets. In addition, restoring 3,000 additional acres would sequester an estimated 5,000 MT carbon annually.	Increase carbon sequestration Improve water quality Support for fisheries and tourism Cultural services Wave attenuation Reduce shoreline erosion Lessen the impacts of storm surges and flooding Mitigate ocean acidification	30x30 No Net Loss California Eelgrass Mitigation Policy NWL Climate Smart Strategy OPC Strategic Plan	Centralized mapping Streamlined permitting
Strenghten No Net Loss / Net Gain Policy - track implementation, move to no-net loss of ecosystem function, move to net ecological gain	New policy (EO or legislation) updating California's no net loss of wetlands goals to (1) short term – "no net loss of both function and acreage, (2) long-term goal increase both extent and function (quantity and quality) of the state's wetlands	Robertson 2002 Turner et al 2001 Zedler 2004 zu Ermgassen et al 2019	457,000 acres	400,000 acres of wetland within the Delta and 57,000 acres outside of the Delta. Moving to no net loss of ecosystem function and ideally net ecological gain will account for/enhance carbon sequestration services. Current state policy, via Executive Order W-59-93: "no overall net loss and long-term net gain in the quantity, quality, and permanence of wetlands acreage and values in California."	Increase carbon sequestration Avoid emissions occuring from wetland losses Lessen the impacts of storm surges and flooding Provide critical habitat Increase resistance to wildfire Improve water quality Support for fisheries and tourism Cultural services Reduce shoreline erosion Mitigate ocean acidification Wave attenuation	Executive Order W59 93 State Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State STATE WATER RESOURCES CONTROL BOARD	Centralized mapping Cooperative management agreements
Protect Migration Space for tidal wetlands and eelgrass habitats	Develop and implement by 2030 plans to protect buffer areas that will serve as migration space for coastal wetlands/eelgrass - can contribute to 30x30 goals (e.g., X acreage of future wetland habitats protected)	Heady et al. 2018 Miller et al. 2008 Robinson et al. 2016 SFEI and Spur 2019 Thorne et al. 2018 Vaughn et al 2022	TBD	Coastal wetlands naturally migrate inland and upland as sea levels rise. At high rates of SLR, coastal wetlands will be better able to persist through inland migration than through vertical accretion. Opportunities for wetland migration, however, are often constrained by infrastructure and existing land uses (Orr and Sheehan 2012, Heady et al. 2018). A modeling study of the US Pacific Coast, for example, predicts that with existing migration opportunities (excluding hard infrastructure and other development constraints), 59% of existing tidal wetlands will be lost by 2110 under high SLR scenarios (56" for Washington and Oregon, and 65" for California) (Thorne et al. 2018). Underscoring the importance of migration opportunities, this same study predicts that without migration, 99% of existing vegetated tidal wetlands would drown.	Increase carbon sequestration Avoid emissions occuring from wetland drowning Lessen the impacts of storm surges and flooding Provide value to lands facing loss of ag productivity Provide critical habitat Increase resistance to wildfire Improve water quality	Climate Adaptation Strategy OST Sea Level Rise Task Force Sea Level Rise Policy Guidance State Parks Sea Level Rise Adaptation Strategy NWL Climate Smart Strategy California Sustainable Insurance Roadmap OPC Strategic Plan	Centralized mapping Salinity mapping Land acquisitions rights/cooperative management agreements Statewide sea level rise forecasts
Set Resilience Targets (inclusive of migration space, other interventions like sediment delivery/application	Set and implement specific resilience targets related to X acres of living shorelines; X sediment augmentation projects	Arias-Ortiz et al. 2021 Baldocchi 2014 Brown 2019 Byrd et al. 2020 California Natural Resources Agency and California Ocean Callaway et al. 2012 Chmura et al. 2003 Dreszler et al. 2009 Hemes et al. 2019 Mcleod et al. 2011 Ricart et al. 2021 Vaughn et al 2022 Ward et al. 2021 Weis et al. 2001	TBD	A suite of actions need to be taken to build resilience of tidal wetlands and eelgrass habitats to climate change impacts such as sea level rise. These include migration pathways, restoring sediment flows and adding sediment to maintain elevation, reducing other stressors.	Increase carbon sequestration Avoid emissions Reverse land subsidence Lessen the impacts of storm surges and flooding Provide critical habitat Increase resistance to wildfire Improve water quality Support for fisheries and tourism Cultural services Reduce shoreline erosion Mitigate ocean acidification Wave attenuation	Assembly Bill 1482 Climate Adaptation Strategy OPC Strategic Plan	Centralized list of current projects Centralized mapping
Kelp conservation/ restoration	Leverage state MPAs to conduct research on climate mitigation potential of kelp	Bayley et al. 2021 Filbee-Dexter & Wernberg 2020 Pessarrodona et al. 2023	TBD	As many as 20 different species of kelp comprise California's kelp forests. Current spatial distribution and ability of each species to sequester carbon is unknown. A current project being undertaken through a partnership among SeaTrees, Coastal Quest, and WILDCOAST is creating a state of the science, which will include a potential scientific forum in 2024 to fill these gaps. The Smith Lab at the Scripps Institution of Oceanography, among others, is currently conducting research on climate mitigation potential of kelp.	Increase carbon sequestration Improve water quality Support for fisheries and tourism Cultural services Wave attenuation Reduce shoreline erosion Lessen the impacts of storm surges and flooding Mitigate ocean acidification	AB 1241 Kelp Restoration and Management Plan (KRMP) *in progress Marine Life Management Act	Consensus on the degree to which kelp conservation/restoration represents an "actionable" strategy for GHG mitigation More research on carbon storage and potential emission by kelp forests Project team and scientific advisory committee to create the KRMP
Mapping	Create centralized map of wetlands in California	The Landscape Scenario Planning Tool (LSPT) BAARI The Bay Area Aquatic Resources Inventory (BAARI) Bernstein et al. 2011 Gilkerson and Merkel 2019 Merkel & Associates 2016 NOAA Fisheries 2014 NOAA's Coastal Change Analysis Program (C-CAP) San Francisco Bay Eelgrass Inventory The California Aquatic Resources Inventory (CARI) The Delta Aquatic Resources Inventory (DARI) Vaughn et al 2022	Statewide	A challenge for statewide blue carbon analysis is that no single dataset currently exists that offers statewide coverage with both a high level of detail/accuracy and the consistent re-mapping needed to detect change over time. Instead, a set of statewide and regional mapping datasets exists for California, with varying levels of detail in wetland type classification, spatial resolution, and ability to track change over time. This section provides an overview of how these existing mapping resources can be knit together to quantify current extents and rates of change in the area of California's blue carbon ecosystems. Six statewide or regional mapping datasets are recommended for use with best-available emission factors or biogeochemical models to quantify blue carbon stocks and GHG emissions statewide. Together, these datasets offer statewide coverage of saline wetland and eelgrass	Indirectly will provide co-benefits by informing restoration and management	30x30 Climate Adaptation Strategy No Net Loss OPC Strategic Plan	Technical assistance to centralize databases
Carbon Stock Research	Design improved methodology for measuring carbon stock of coastal wetlands that extends beyond 30cm in depth and is more specific than "global emission factors and a standard formula."	Callaway 2012 CARB 2018 Nahlik 2016 Owers et al 2022 Villa 2018	134,000 acres	CARB currently measures carbon stock in wetlands using a Tier 1 approach for "Soil Organic Carbon." Under this approach, global emission factors are paired with "country"-specific data and a standard formula is applied to calculate the carbon stored in the top 30cm of soil across all wetland types and locations. Research suggests that carbon sequestration and storage varies greatly by wetland type and that much of that carbon is stored beyond 30cm due to accretion so current estimates for how much carbon is stored in California wetlands is likely vastly undervalued. Potential to scale includes proposed 60,000 acres of restoration in the Delta and recommended additional 43,000 acres of tidal marsh and tidal scrub/shrub wetlands outside of the Delta, 18,000 acres of saline tidal wetland in San Francisco Bay, and 13,000 acres of eelgrass meadows.	Indirectly will provide co-benefits by informing restoration and management	30x30 Climate Adaptation Strategy No Net Loss	Scientific advisory committee to develop methodology Support California blue carbon collaborative

Other potential practices not included above:

Further development and validation of SUBCALC2, SEDCALC, PEPRMT, and CWEM models for CA coastal wetlands

Development of vegetation-corrected LiDAR-derived digital elevation models statewide

Ongoing biogeochemical data collection with a focus on underrepresented wetland types to better parameterize and validate models

Investments in model usability, such as development of an integrated platform to run models across the state or specific regions

Coordinated reporting on restoration progress to enable regional targets to be updated over time and inform state-level processes