**California Regional Water Quality Control Board**
**San Francisco Bay Region**

# Proposed Basin Plan Amendment:

## Climate Change and Aquatic Habitat Protection, Management, and Restoration

**June 29, 2022**

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD**

**SAN FRANCISCO BAY REGION**

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# Proposed Basin Plan Amendment

*The following revisions are proposed for Chapter 1: Introduction. Text in the March 2022 version proposed for deletion is in ~~strikeout~~; text in the March 2022 version proposed for addition is underlined. Text in the June 2022 version proposed for deletion is in ~~double strikeout~~; text in the June 2022 version proposed for addition is in double underline.*

## 1.1 THE SAN FRANCISCO BAY REGION

The San Francisco Bay Region (Region) is 4,603 square miles~~, roughly the size of the State of Connecticut,~~ and characterized by its dominant feature, 1,100 square miles of the 1,600 square mile San Francisco Bay Estuary (Estuary), the largest estuary on the west coast of the United States, where fresh waters from California's Central Valley mix with the saline waters of the Pacific Ocean. The Region also includes coastal portions of Marin and San Mateo counties, from Tomales Bay in the north to Pescadero and Butano Creeks in the south.

The Estuary conveys the waters of the Sacramento and San Joaquin rivers into the Pacific Ocean. Located on the central coast of California (**Figure 1-1)**, the Bay system functions as the only drainage outlet for waters of the Central Valley. It also marks natural topographic separation between the northern and southern coastal mountain ranges. The Region's waterways, wetlands, and bays form the centerpiece of the United States' fourth-largest metropolitan region, including all or major portions of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties.

Because of its highly dynamic and complex environmental conditions, the Bay system supports an extraordinarily diverse and productive ecosystem. Within each section of the Bay lie deepwater areas that are adjacent to large expanses of very shallow water. Salinity levels range from hypersaline to fresh water, and water temperature varies throughout the Bay system. These factors greatly increase the number of species that can live in the Estuary and enhance its biological stability.

The Bay system's deepwater channels, tidelands, marshlands, freshwater streams, and rivers provide a wide variety of habitats that have become increasingly vital to the survival of several plant and animal species as other estuaries are reduced in size, ~~or~~ lost to development, or altered by changes in the climate. These areas sustain rich communities of crabs, clams, fish, birds, and other aquatic life and serve both as important wintering sites for migrating waterfowl and as spawning areas for anadromous fish.

## 1.7 THE CHALLENGE OF CLIMATE CHANGE

Globally, climate change affects water quality and quantity from snowpack to freshwater streams to the ocean. Post-industrial human activity increases in greenhouse gas emissions and changes in land use have and will continue to cause an increase in global temperature, changes in precipitation patterns, rises in sea levels, changes in groundwater levels, and increases in the intensity and frequency of extreme weather events. Extreme weather events – such as drought, heat waves, and large storms – can increase the risk of catastrophic wildfires, decrease water supplies for communities/regions, and alter stream flows and sediment discharges. These changes in climate and weather impact aquatic systems through numerous mechanisms, including through increases in water temperatures, changes in streamflow and watershed sediment discharge that can impede drainage, increase flooding, mobilize contaminants, and desiccate headwater streams.

Climate change can also contribute to ocean acidification, changes in the extent and frequency of harmful algal blooms, hypoxia, and changes in aquatic species composition. Rising sea levels are increasing the risk of coastal flooding and erosion, especially where critical shoreline infrastructure and low-lying communities rely on tidal wetlands and mudflats to help protect them from the rising seas. Rising sea levels increase the risk of drowning coastal habitats, such as tidal wetlands and mudflats, especially where habitats cannot migrate upland/inland, and/or where there are inadequate sediment supplies to support accretion. Also, rising sea levels due to climate change are likely to cause increases in shallow groundwater levels, also called groundwater rise. This could lead to increases in saltwater or brackish water intrusion into utility corridors, basements, and crawl spaces; overland flooding from emergent groundwater; mobilization and spread of pollutants from nearshore cleanup sites into vulnerable areas; and vapor intrusion into buildings and homes.

Climate change acts on a landscape scale, and its effects are not limited by political or jurisdictional boundaries. Therefore, efforts to address climate change require regional, collaborative, cross-jurisdictional approaches to project planning, permitting, and implementation. This is especially true of shoreline adaptation and resilience projects, and related efforts to protect and enhance aquatic ecosystems and their interrelated functions.

*The following revisions are proposed for Chapter 2: Beneficial Uses. Text in the March 2022 version proposed for deletion is in ~~strikeout~~; text in the March 2022 version proposed for addition is underlined. Text in the June 2022 version proposed for deletion is in ~~double strikeout~~; text in the June 2022 version proposed for addition is in double underline.*

## 2.2.3 WETLANDS

Federal administrative law (e.g., 40 CFR Part 122.2, revised December 22, 1993) defines wetlands as waters of the United States. National waters include waters of the State of California, defined by the Porter-Cologne Act as “any water, surface or underground, including saline waters, within the boundaries of the State” (California Water Code §13050[e]). Wetland water quality control is therefore clearly within the jurisdiction of the State Water Board and Regional Water Boards.

Wetlands are further defined in 40 CFR 122.2 as “those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.”

The Water Board recognizes that wetlands frequently include areas commonly referred to as saltwater marshes, freshwater marshes, open or closed brackish water marshes, mudflats, sandflats, unvegetated seasonally ponded areas, vegetated shallows, sloughs, wet meadows, playa lakes, natural ponds, vernal pools, diked baylands, seasonal wetlands, floodplains, and riparian woodlands.

Mudflats make up one of the largest and most important habitat types in the Estuary. Snails, clams, worms, and other animals convert the rich organic matter in the mud bottom to food for fish, crabs, and birds.

Mudflats generally support a variety of edible shellfish, and many species of fish rely heavily on the mudflats during at least a part of their life cycle. Additionally, San Francisco Bay mudflats are one of the most important habitats on the coast of California for millions of migrating shorebirds.

Another important characteristic of the Estuary is the fresh, brackish, and salt water marshes around the Bay’s margins. These highly complex communities are recognized as vital components of the Bay system’s ecology. Most marshes around the Bay have been destroyed through filling and development. The protection, preservation, and restoration of the remaining marsh communities are essential for maintaining the ecological integrity of the Estuary.

Identifying wetlands may be complicated by such factors as the seasonality of rainfall in the Region. Therefore, in identifying wetlands considered waters of the United States, the Water Board will consider such indicators as hydrology, hydrophytic plants, and/or hydric soils for the purpose of mapping and inventorying wetlands. The Water Board will, in general, rely on the federal manual for wetland delineation in the Region when issuing Clean Water Act Section 401 water quality certifications (U.S. Army Corps of Engineers (Corps) Wetlands Delineation Manual, 1987). In the rare cases where the U.S. EPA and Corps guidelines disagree on the boundaries for federal jurisdictional wetlands, the Water Board will rely on the wetlands delineation made by the U.S. EPA or the California Department of Fish and ~~Game~~ Wildlife (~~CDFG~~CDFW). For the purpose of mapping and inventorying wetlands, the Water Board will rely on the protocols and naming conventions of the National Wetlands Inventory (NWI) prepared by the U.S. Fish and Wildlife Service (USFWS).

Many individual wetlands provide multiple benefits depending on the wetland type and location. There are many potential beneficial uses of wetlands, including Wildlife Habitat (WILD); Preservation of Rare and Endangered Species (RARE); Shellfish Harvesting (SHELL); Water Contact Recreation (REC1); Noncontact Water Recreation (REC2); Commercial, and Sport Fishing (COMM); Marine Habitat (MAR); Fish Migration (MIGR); Fish Spawning (SPAWN); and Estuarine Habitat (EST). Some of these general beneficial uses can be further described in terms of their component wetland function. For example, many wetlands that provide groundwater recharge (GWR) also provide flood control, pollution control, erosion control, and stream baseflow.

Table 2-3 shows how beneficial uses are associated with different wetland types. Table 2-4 lists and specifies beneficial uses for 34 significant wetland areas within the Region; generalized locations of these wetlands are shown in Figure 2-11. It should be noted that most of the wetlands listed in Table 2-4 are saltwater marshes, and that the list is not comprehensive.

The Water Board has participated in completing the Baylands Ecosystem Habitat Goals Report (1999) and the Baylands Ecosystem Species and Community Profiles (2000), which were written by scientists and managers in the Region in order to recommend sound wetland restoration strategies. The 2015 Baylands Ecosystem Habitat Goals Update: Climate Change - What We Can Do updates these strategies to respond to climate change. Other efforts around the Bay to locate wetland sites include the San Francisco Estuary Institute's (SFEI) EcoAtlas ~~Baylands Maps (Baylands Maps) and Bay Area Wetlands Project Tracker (Wetlands Tracker), and the Wetland Tracker managed by the San Francisco Bay Joint Venture~~. Because of the large number of small and non-contiguous wetlands, it is not practical to delineate and specify beneficial uses of every wetland area. Therefore, beneficial uses may be determined site specifically, as needed. Chapter 4 of this Plan contains additional information on the process used to determine beneficial uses for specific wetland sites.

*The following revisions are proposed for Chapter 4: Implementation Plans. Text proposed for deletion in the March 2022 version is in strikeout; text proposed for addition in the March 2022 version is underlined. Text proposed for deletion in the June 2022 version is in double strikeout; text proposed for addition in the June 2022 version is in double underline.*

## 4.23 WETLAND PROTECTION AND MANAGEMENT

Wetlands and related habitats comprise some of the Region's most valuable natural resources. Wetlands provide critical habitats for hundreds of species of fish, birds, and other wildlife; offer open space; and provide many recreational opportunities. Wetlands also serve to enhance water quality, through such natural functions as flood control and erosion control, stream bank stabilization, and filtration and purification of surface water.

The Water Board will refer to the following for guidance when permitting or otherwise acting on wetland issues:

- Governor's Executive Order W-59-93 (signed August 23, 1993; also known as the California Wetlands Conservation Policy, or the "No Net Loss" policy);
- Senate Concurrent Resolution No. 28; and
- Water Code Section 13142.5 (applies to coastal marine wetlands).

The goals of the California Wetlands Conservation Policy include ensuring "no overall net loss," achieving a "long-term net gain in the quantity, quality, and permanence of wetlands acreage and values ...", and reducing "procedural complexity in the administration of state and federal wetlands conservation programs."

Senate Concurrent Resolution No. 28 states, "It is the intent of the legislature to preserve, protect, restore, and enhance California's wetlands and the multiple resources which depend on them for the benefit of the people of the state."

Water Code Section 13142.5 states, "Highest priority shall be given to improving or eliminating discharges that adversely affect ... wetlands, estuaries, and other biologically sensitive sites."

The Water Board may also refer to the most recent version of the San Francisco Estuary ~~Project's Comprehensive Conservation and Management Plan (2007)~~ Partnership's Estuary Blueprint: Comprehensive Conservation and Management Plan (CCMP) for recommendations on how to effectively participate in a Region-wide, multiple-agency wetlands management program.

### 4.23.1 Baylands Ecosystem Habitat Goals

Consistent with the California Wetlands Conservation Policy, the Water Board participated in the preparation of ~~two~~ three planning documents for wetland restoration around the Estuary: Baylands Ecosystem Habitat Goals (1999), ~~and Baylands Ecosystem Species and Community Profiles (2000)~~Baylands Ecosystem Species and Community Profiles (2000), and The Baylands and Climate Change: What We Can Do (2015), together known as the Habitat Goals reports. The 1999 Habitat Goals report articulated the values of different bayland habitats and established an ambitious goal of protecting and restoring 100,000 acres of tidal wetlands around the Bay. The 2015 report emphasized the importance of establishing complete tidal wetland systems with robust physical and ecological connections between the Bay, tidal wetlands, estuarine-terrestrial transition zones (often called ecotones), and watersheds to sustain healthy, resilient habitats in the face of climate change.

The Habitat Goals reports provide a starting point for coordinating and integrating wetland planning and regulatory activities around the Estuary. The Habitat Goals reports identify and specify the beneficial uses and/or functions of existing wetlands and suggest wetland habitat goals for the baylands, defined in the Habitat Goals reports as shallow water habitats around the San Francisco Bay between maximum and minimum elevations of the tides. The baylands ecosystem includes the baylands, adjacent habitats, and their associated plants and animals. The boundaries of the ecosystem vary with the bayward and landward movements of fish and wildlife that depend upon the baylands for survival. The Habitat Goals reports were the non-regulatory component of a conceptual regional wetlands management plan from that began in the mid-1990's.

### 4.23.2 Determination of Applicable Beneficial Uses for Wetlands

Beneficial uses of water are defined in Chapter 2 Beneficial Uses and are applicable throughout the Region. Chapter 2 also identifies and specifies the beneficial uses of 34 significant marshes within the Region (Table 2-3Table 2-4). Chapter 2 indicates that the listing is not comprehensive and that beneficial uses may be determined site-specifically. In making those site-specific determinations, the Water Board will consider the Habitat Goals reports, which provide a technical assessment of wetlands in the Region and their existing and potential beneficial uses. In addition to the wetland areas identified in Chapter 2, the Habitat Goals reports identified additional wetlands in the Region as having important habitat functions. Because of the large number of small and non-contiguous wetlands within the Region, it is not practical to specify beneficial uses for every wetland area. Therefore, beneficial uses will frequently be specified as needed for a particular site. This section provides guidance on how beneficial uses will be determined for wetlands within the Region.

Information contained in the Bay Area Aquatic Resource Inventory (BAARI) prepared by the San Francisco Estuary Institute, Habitat Goals reports, the National Wetlands Inventory (NWI) prepared by the U.S. Fish and Wildlife Service (USFWS), and in the scientific literature regarding the location and areal extent of different wetland types will be used as initial references for any necessary beneficial use designation. The NWI is the updated version of the USFWS's Classification of Wetlands and Deepwater Habitats of the United States (Cowardin, et al. 1979), which is incorporated by reference into this plan, and was previously used by the Water Board to identify specific wetland systems and their locations. BAARI, The the updated NWI, or other appropriate methods will continue to be used to locate and identify wetlands in the Region. A matrix of the potential beneficial uses that may be supported by each USFWS wetland system type is presented in Table 2-4Table 2-3.

It should be noted that, while BAARI, the Habitat Goals reports, and USFWS's NWI wetlands classification system are useful tools for helping to establish beneficial uses for a wetland site, it is not suggested that these tools be used to formally delineate wetlands.

### 4.23.3 Hydrology

Hydrology is a major factor affecting the beneficial uses of wetlands. To protect the beneficial uses and water quality of wetlands from impacts due to hydrologic modifications, the Water Board will carefully review proposed water diversions and transfers (including groundwater pumping proposals) and require or recommend control measures and/or mitigation as necessary and applicable.

### 4.23.4 Wetland Dredge or Fill

The beneficial uses of waters of the state, including wetlands, are frequently affected by dredging, diking, and filling. Pursuant to Section 404 of the Clean Water Act, discharge of dredged or fill material to waters of the United States must be performed in conformance with a permit obtained from the U.S. Army Corps of Engineers (Corps) prior to commencement of the fill activity. Under Section 401 of the Clean Water Act, the state must certify that any permit issued by the Corps pursuant to Section 404 will comply with water quality standards established by the state (e.g., Basin Plans or statewide plans), or can deny such certification, with or without prejudice. In California, the State and Regional Water Boards are charged with implementing Section 401. California's Section 401 regulations are at Title 23, CCR, Division 3, Chap. 28, Sections 3830-3869. The State Water Resources Control Board's "Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State" supplements these regulations and applies to most discharges of dredged or fill material to waters of the state. Pursuant to these regulations, the Water Board and/or the Water Board's Executive Officer have the authority to issue or deny Section 401 water quality certification. The certification may be issued with or without conditions to protect water quality.

The Water Board has independent authority under the Water Code to regulate discharges of waste to wetlands (waters of the )state, including wetlands, that would adversely affect the beneficial uses of those wetlandswaters through waste discharge requirements or other orders. The Water Board may choose to exercise its independent authority under the Water Code in situations where there is a conflict between the state and the Corps, such as over a jurisdictional determination or in instances where the Corps may not have jurisdiction. In situations where there is a conflict between the state and the Corps, such as over a jurisdictional determination or in instances where the Corps may not have jurisdiction, the Water Board may choose to exercise its independent authority under the Water Code.

The regulation of "isolated" waters determined not to be waters of the U.S. is one such instance where the Corps does not have jurisdiction. The U. S. Supreme Court, in its 2001 decision in Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers (the "SWANCC decision") determined that certain isolated, non-navigable waters are not waters of the U.S., but are the province of the states to regulate. The Water Code provides the State and Regional Water Boards clear authority to regulate such isolated, non-navigable waters of the state, including wetlands. To address the impacts of the SWANCC decision on the waters of the state, the State Water Board issued Order No. 2004-0004-DWQ in 2004, General WDRs for dredged or fill discharges to waters deemed by the Corps to be outside of federal jurisdiction. It is the intent of these General WDRs to regulate a subset of the discharges that have been determined not to fall within federal jurisdiction, particularly those projects involving impacts to small acreage or linear feet and those involving a small volume of dredged material.

Order No. 2004-004-DWQ does not address all instances where the Water Board may need to exercise its independent authority under the Water Code. In such instances, dischargers and/or affected parties will be notified with 60 days of the Water Board's determination and be required to file a report of waste discharge.

For proposed dredge or fill activities deemed to require mitigation, the Water Board will require the applicant to locate the mitigation project within the same section of the Region, wherever feasible. The Water Board will evaluate both the project and the proposed mitigation together to ensure that there will be no net loss of wetland acreage and no net loss of wetland functions. The Water Board may consider such sources as the Habitat Goals reports, the San Francisco Estuary Project's

Comprehensive Conservation and Management Plan, Partnership's Estuary Blueprint/CCMP, the San Francisco Bay Shoreline Adaptation Atlas, the Aquatic Resource Type Conversion Evaluation Framework, or other approved watershed management planstechnical guidance when determining appropriate "out-of-kind" mitigation.

The Water Board uses the U.S. EPA's Section 404(b)(1), "Guidelines for Specification of Disposal Sites for Dredge or Fill Material," dated December 24, 1980, which is incorporated by reference into this plan, in determining the circumstances under which wetlands filling may be permitted.

In general, it is preferable to avoid wetland disturbance. When this is not possible, disturbance should be minimized. Mitigation for lost wetland acreage and functions through restoration or creation should only be considered after disturbance has been minimized. Complete mitigation projects should be assessed using established wetland compliance and ecological assessment methods, such as the Wetland Ecological Assessment (WEA) and the California Rapid Assessment Method (CRAM).

## 4.27 CLIMATE CHANGE AND AQUATIC HABITAT PROTECTION, MANAGEMENT, AND RESTORATION

Climate change adversely impacts aquatic habitats within the San Francisco Bay Region and their beneficial uses through multiple mechanisms including rising sea and groundwater levels, changes in watershed flows of freshwater and sediment, more frequent and severe storm surges, floods, and droughts, and wetland drowning and downshifting. Efforts to prevent or minimize these impacts to the natural and built environment with traditional, static armoring and infrastructure such as levees, seawalls, and rock revetments (collectively referred to as "grey" infrastructure) can in some circumstances exacerbate erosion, flooding, and habitat loss. These risks are especially acute in and near the baylands and low-lying areas of the Pacific Ocean shoreline, where climate change impacts to watersheds are likely to be compounded by impacts from rising sea and groundwater levels.

To help assess these risks and support the long-term resilience and beneficial uses of aquatic habitats in the region, the Water Board has participated in the development of multiple collaborative regional science and guidance documents, including the 1999 and 2015 Baylands Goals reports (see Section 4.23.1), the San Francisco Bay Subtidal Habitat Goals Report, and the San Francisco Bay Shoreline Adaptation Atlas. The Adaptation Atlas delineates the Bay's shoreline areas into cross-jurisdictional landscape units, called operational landscape units, that consider both watershed and bayland conditions, and pairs each unit with a suite of technically feasible nature-based climate change adaptation approaches to support the resilience of the Bay's natural and built communities. Collectively, these reports and their supporting scientific literature are informative resources related to the protection and improvement of beneficial uses in the region's coastal waters. Though these reports focus on San Francisco Estuary habitats, their underlying scientific principles and resulting management recommendations are broadly applicable to coastal and estuarine habitats on the Pacific coast.

When Under existing law, when permitting dredge or fill activities in waters of the state, including wetlands, the Water Board must consider how numerous factors, including but not limited to climate change, influence the direct, indirect, and cumulative impacts of dredge or fill activities on ecosystem functions. The following questions may be relevant and can help the Water Board consider the reasonably foreseeable influence of climate change and related factors in project permitting and assess if the project's adverse impacts to waters of the state have been appropriately avoided, minimized, and compensated where required. The questions are meant to promote thought on both climate change and adaptation strategies for minimizing adverse impacts to the aquatic ecosystem. The questions are not intended to and cannot be construed as modifying how dredge or fill activities are permitted under the State Water Resources Control Board's "Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State" and U.S. EPA's Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredge or Fill Material or augmenting the authority of the Water Board in permitting dredge or fill activities.

1. **Is the proposed project design, as well as assessment of its near-term and long-term impacts at site- and landscape-scales, based on the best available science describing climate change and its influence on the environment?** Projects should be based on the best available science on the anticipated future conditions over the life of the project, including but not limited to any reasonably foreseeable changes in (1) sea levels and nearshore groundwater levels; (2) the timing, frequency, intensity, and duration of seasonal precipitation, watershed runoff, Delta outflow, and wave events; and (3) the supply of sediment available to maintain healthy coastal habitats. Projects should be designed to avoid/minimize direct, indirect, and cumulative impacts by accommodating existing and likely future physical and ecological drivers and conditions at the project site. Sometimes, future conditions are presented in probabilistic risk aversion categories. In such cases, a project should be based on the appropriately protective risk aversion approach to ensure that water quality impacts from project performance are avoided and minimized where practicable.

2. **Is the proposed project designed as part of a phased adaptation strategy that anticipates ~~potential future~~ reasonably foreseeable projects and accommodates these projects in a manner that protects future beneficial uses of the site and its landscape?** Phased adaptation strategies are actions to provide flood protection at different climate change thresholds over time. Initial actions are designed to provide flood protection in the near-term while allowing for a range of future actions to address uncertainty and allow flexibility over the long term. ~~Preferable actions will~~ Actions that maintain long-term lines of flood defense ~~along San Francisco Bay and the Pacific Ocean~~ as far landward as practicable are more likely to avoid or minimize direct, indirect, and cumulative impacts to aquatic resources than actions that do not. This is because these actions can help ~~to~~ minimize the isolation of wetlands and waters behind flood management infrastructure, reduce the risk of flooding of low-lying areas by surface water or groundwater, and create space for the restoration of complete estuarine wetland systems and other nature-based adaptation measures.

3. **Is the proposed project designed within a landscape-scale, cross-jurisdictional framework, such as an operational landscape unit?** Climate change operates on a landscape-scale. Therefore, strategies to address climate change are more likely to be successful in the long-term and avoid maladaptation if they are planned, designed, permitted, and implemented on a landscape-scale, and not limited by political boundaries. Projects designed to consider current and anticipated future conditions not just at the project site, but also the broader landscape within which it is embedded are likely to have fewer long-term direct, indirect, and cumulative impacts than projects that only address near-term, site-specific conditions. In some cases, the least impacting project may be one that spans multiple jurisdictions, such as parcel or municipal boundaries. Projects that avoid or minimize direct impacts at the project site only to trigger indirect and/or cumulative impacts off-site ~~are not preferable~~ may have greater adverse impacts to aquatic resources.

4. **Does the proposed project utilize practicable natural and/or nature-based design features, or a combination of traditional and nature-based (hybrid) features?** Nature-based design features, often called "living shorelines" or "green infrastructure", facilitate and/or leverage natural physical and ecological forms and processes to achieve design goals. When, Pproperly designed and sited, and developed within projects that facilitate and/or leverage natural physical and ecological forms and processes in the long-term, and on a landscape-scale frameworks, these types of approaches are more likely to avoid or minimize direct, indirect, and cumulative impacts to aquatic resources than traditionally engineered "grey" approaches. They are also more likely to support beneficial uses presently and in the future than designs that impede those natural processes. Preferred nNature-based design features include, but are not limited, to, the following:

   a. **Projects that conserve, enhance, create, and restore subtidal habitats, Living shorelines,** which in the Region typically include shallow subtidal elements, such as nearshore oyster reefs, beds of submerged aquatic vegetation, and combinations thereof that attenuate wave energy along shorelines, help stabilize nearshore sediment, provide valuable subtidal nursery habitat for estuarine fish and invertebrates, and support pelagic food webs. Living shorelines These approaches are best suited for areas of San Francisco Bay, and Tomales Bay, and similar embayments with appropriate depths, salinities, substrates, and turbidity to support target species (e.g., including but not limited to native oysters (*Ostrea lurida*), eelgrass (*Zostera marina*), sago pondweed (*Stuckenia pectinata*), and widgeongrass (*Ruppia maritima*)).

   b. **Beaches** composed of sand, shell, gravel, cobble, or combinations thereof, held in place by either natural or artificial headlands (groins). Beaches dissipate wave energy, respond dynamically to changing wave conditions, naturally armor shorelines from erosion, and provide valuable habitat for estuarine plants and wildlife. Beaches are generally well-suited for wave-exposed areas and can be combined with other nature-based approaches such as living shorelines and wetland restoration.

   c. **Estuarine wetland protection, enhancement, and restoration** that supports the health and resilience of the Region's natural and built communities. Estuarine wetlands attenuate wave energy, provide temporary storage for floodwaters, support local groundwater recharge, transform and/or sequester pollutants in the water column, sequester carbon, provide habitat for a broad range of plants, fish, and wildlife, and support recreational and educational opportunities. Estuarine wetland restoration projects should be located and designed to maximize the connectivity and resilience of complete wetland habitats that span supratidal, intertidal, and subtidal habitats. Project designs should account for the physical and ecological processes that support accretion of mineral and organic sediment, native plant diversity and succession, the provision of internal (within-wetland) and external (along the edge of the wetland) high tide refugia, and connectivity to subtidal, fluvial/floodplain, and terrestrial habitats.

   d. **Estuary-watershed reconnection** actions that connect estuarine wetlands and mudflats with the rivers, creeks, and flood management channels that drain their adjacent upslope watersheds, as well as actions to reduce or eliminate obstacles to the downstream flow of freshwater and sediment (e.g., dam removal). Estuarine-watershed reconnection helps foster resilient, diverse habitats by supplying freshwater and sediment to estuarine wetlands and mudflats, restoring estuarine-fluvial-terrestrial transition zones, and creating space and mechanisms for plants, fish, and wildlife to move between estuarine, floodplain, and riparian ecosystems.

e. **Strategic sediment placement** that helps estuarine and coastal wetlands, and mudflats, and beaches keep pace with rising sea levels by artificially supplementing the volume of sediment available to support accretion, and/or providing coarse sediment to support habitat features such as beaches. These approaches can be especially useful in locations with limited estuarine and/or watershed sediment supplies, and where mudflats, and wetlands, and beaches at risk of drowning provide critical ecosystem services.

f. **Ecotone and treated-wastewater horizontal levees** with gradually sloped (typically 15:1 horizontal to vertical ratio or greater) bayward sides that can increase the footprint and functions of the estuarine-terrestrial transition zone at the landward edge of tidal wetlands. Ecotone levees are levees that support estuarine-terrestrial transition zone habitats. When designed to include the subsurface seepage of treated wastewater, they are often called horizontal levees. Ecotone levees create estuarine-terrestrial transition zones and attenuate wave energy; horizontal levees can perform these functions and restore freshwater-brackish-saline wetland gradients that have largely been lost throughout the Estuary. Ecotone and horizontal levees are best suited for locations where they will be fronted by tidal wetlands, both to improve landscape-scale ecological functions and to reduce the risk of erosion of the levee toe. They typically require considerable volumes of material to construct, and therefore should be built as far landward as feasible to minimize settling and maximize the footprint of in-estuary habitat restoration. Both levee types should be carefully monitored and, if needed, adaptively managed to ensure their long-term resilience and functionality.

g. **Migration space preparation** that facilitates the long-term, sea level rise-driven transgression of estuarine wetland habitats over adjacent uplands. These areas can be protected, enhanced, or restored to improve the ecosystem functions of wetlands and the estuarine-terrestrial transition zone under existing and anticipated future conditions (i.e., with sea level rise). This approach is especially important in less intensively urbanized areas of the Region, such as the north shore of San Pablo Bay, Suisun Marsh, and rural Marin and San Mateo Pacific coasts, where estuarine habitats can be reconnected to rivers and creeks (see estuary-watershed reconnection approach above) as well as terrestrial habitats.

The Water Board considers cumulative impacts to the aquatic ecosystem when permitting dredge or fill discharges. Projects that maximize the use of nature-based features and minimize reliance on grey infrastructure, such as rip-rap, revetments, traditional (non-ecotone or horizontal) levees, seawalls, bulkheads, armored channels, and other non-nature-based approaches, generally have fewer cumulative impacts than grey infrastructure. As a result, nature-based or hybrid features that combine nature-based measures will are generally preferable to alternatives result in fewer adverse impacts than alternatives that only include traditional shoreline hardening through grey infrastructure. Nature-based climate change adaptation projects along the Pacific Ocean shoreline will be subject to more intensive and sustained wave action than projects in smaller and shallower embayments such as San Francisco and Tomales Bays. In addition, many estuarine wetlands in the Region along the Pacific are located landward of sandbars/beach berms that seasonally open and close in response to waves and watershed flows; they are functionally different from tidal wetlands in the San Francisco baylands. Nature-based climate change adaptation features should be appropriate to the physical setting in which they are located.

5. **For a proposed dredge or fill activity, what are the near- and long-term direct, indirect, and cumulative impacts to the acreage, functions, and values of waters of the state when considering the reasonably foreseeable conditions from climate change?** Some

dredge or fill activities, such as the construction of rip-rap or other similar grey infrastructure, can avoid near-term impacts to the acreage, functions, and values of waters of the state only to cause long-term impacts within the context of climate change. Other dredge or fill activities, such as the construction of natural and nature-based features described above under question 4, can generate near-term impacts to the acreage, functions, and values of waters of the state, but over the long term have less impacts within the context of climate change. In fact, these projects can have long-term benefits. Thus, understanding both the near- and long-term impacts of dredge or fill activities when considering the reasonably foreseeable conditions from climate change is important to assess the totality of impacts. Assessing long-term impacts under climate change conditions can be difficult, especially considering uncertainties about future rates of sea level rise, the influence of extreme events, local and regional planning decisions, and how landscapes could change in response to these and other factors. To reduce uncertainties and help identify the circumstances under which proposed dredge or fill discharges appropriately avoid, minimize, or compensate for impacts to waters of the state, the following questions may be helpful:

a. **Environmental drivers:**

   i. What are the primary hydrologic, geomorphic, and ecological drivers of beneficial uses and habitat resilience at the site- and landscape-scale, and how are they likely to influence the landscape in the near- and long-term?

   ii. Where and how are processes such as upland migration (transgression), erosion, progradation, accretion, and/or drowning likely to impact the condition, location, and distribution of different habitat types?

   iii. How might the proposed dredge or fill activities influence these drivers?

b. **Impacts of no action:**

   i. How would the affected landscapes be likely to evolve in the absence of the proposed dredge or fill activities?

   ii. Given the likely range of anticipated environmental drivers, would the absence of the proposed activities likely result in less diverse, resilient, and/or complete habitats in the long-term?

c. **Coherent landscapes:**

   i. Are the proposed dredge or fill activities geographically and geomorphically situated and designed to work with both site-scale and landscape-scale natural processes, such as the movement of water and sediment, shifts in plant communities, and the movement of fish and wildlife between different habitats?

   ii. Will the proposed activities enhance or impede the ability of these natural processes to exert work on the landscape?

d. **Type conversions:** Some dredge or fill activities may convert one type of water of the state to another (e.g., salt pond to tidal flat/tidal wetland), or convert one component of the estuarine wetland ecosystem to another (e.g., tidal wetland to estuarine-terrestrial zone, tidal wetland to high tide refugia, ~~or~~ tidal wetland to tidal channel, or mudflat to oyster reef or sandflat). The overall impacts of proposed wetland type conversions can be assessed using technical guidance such as the Aquatic Resource Type Conversion Evaluation Framework.

i. Does the landscape setting, including but not limited to local climate, hydrology, sediment supply, degree of urbanization, habitat connectivity, and geomorphic setting, support the intended habitat type?

ii. Does the intended habitat type require intensive management that will have to be funded and implemented in the long-term?

iii. What ecosystem functions will be gained or lost through type conversion, and what is the potential timing and magnitude of these changes? How are these changes likely to influence ecosystem functions within the broader landscape?

iv. Is the proposed type conversion consistent with strategies developed by collaborations of stakeholders to achieve regional goals such as enhancing water quality, recovering rare and/or historic habitat types, improving landscape connectivity/complexity, and/or supporting long-term habitat resilience?