SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION
50 California Street • Suite 2600 • San Francisco, California 94111 • (415) 352-3600 • Fax: (415) 352-3606 • www.bcdc.ca.gov

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TO: Commissioners and Alternates

FROM: Will Travis, Executive Director (415/352-3653 travis@bcdc.ca.gov)
Joe LaClair, Chief Planner (415/352-3656 joel@bcdc.ca.gov)

SUBJECT: Draft Staff Report and Preliminary Recommendation for Proposed Bay Plan Amendment 1-08 Concerning Climate Change
(For Commission Consideration on July 16, 2009)

Preliminary Staff Recommendations

The staff preliminarily recommends that the Commission:

1. Amend the Bay Plan by adding a new Climate Change policy section as identified under the heading, "Proposed Additions to Bay Plan Findings and Policies" (pp. 3 through 8).

2. Amend the Bay Plan Protection of the Shoreline, Safety of Fills, Tidal Marshes and Tidal Flats, and Public Access findings and policies as identified under the heading, "Proposed Changes to Existing Bay Plan Findings and Policies" (pp. 9 through 21).

Background

BCDC first became concerned about the impacts of climate change on the Bay twenty years ago, when the Commission undertook a pioneering study on accelerated sea level rise and developed findings and policies in the Safety of Fills section of the Bay Plan to account for sea level rise in all projects that involve fill in the Bay. Aside from the increasing annual rate of sea level rise, other changes in the last twenty years necessitate a broader approach that addresses the overall impacts of climate change on San Francisco Bay, including, but not limited to, accelerated sea level rise.

Perhaps the biggest change in those twenty years is the attention received by the international, consensus-based approach to delivering scientific conclusions for policy-makers instigated by the United Nations Intergovernmental Panel on Climate Change (IPCC). Because the IPCC represents a wide range of scientific opinion, its conclusions are generally conservative, but widely accepted. However, another important change in the last twenty years is that the effects of climate change are already being observed. Conclusions in both the IPCC and state-sponsored work are based, in part, on observed changes in global surface temperature, ocean water temperature, ocean acidification, and land and sea ice melt. Finally, what was lacking twenty years ago was conclusive evidence that climate change is caused largely by human actions—primarily the release of carbon dioxide into the atmosphere. Today, such evidence solidly links the significant human contribution to greenhouse gases, beginning with industrialization, to increases in global temperature.

In 2006, the state of California employed IPCC scenarios to develop a report on climate change impacts in the state. In that same year, the legislature passed the Global Warming Solutions Act requiring reductions in greenhouse gas emissions. The most recent update to the IPCC assessment reports was in 2007 and, in 2008, the state reported the results of an updated analysis of climate change scenarios. Both reports conclude that the reduction of greenhouse gases now will reduce the degree to which the world must adapt to the effects of climate change. However, it is inevitable that over the next century global temperatures will increase 1° to 3° C (1.8° to 5.4° F). To deal with this increase in temperature, adapting to climate change and its impacts is both unavoidable and essential.

Global warming is expected to result in sea level rise in San Francisco Bay of 16 inches (40 cm) by mid-century and 55 inches by the end of the century. The Pacific Institute estimated that the economic value of Bay Area shoreline development (buildings and their contents) at risk from a 55-inch rise in sea level is $62 billion—nearly double the estimated value of development vulnerable to sea level rise along California's Pacific Ocean coastline. An estimated 270,000 people in the Bay Area will be at risk of flooding, 98 percent more than are currently at risk from flooding. In those areas where lives and property are not directly vulnerable, the secondary and cumulative impacts of sea level rise will affect public health, economic security and quality of life.

By mid-century, 180,000 acres of Bay shoreline are vulnerable to flooding, and 213,000 acres are vulnerable by the end of the century. Vulnerability within today's 100-year floodplain will increase from a one percent chance of flooding per year to a 100 percent chance of flooding per year by mid-century. As a result of higher sea levels combined with storm activity, extreme storm events will cause most of the shoreline damage from flooding.

The scope of changes in the Bay and on its shoreline from climate change cut across multiple policy sections of the Bay Plan. Currently, sea level rise policies are located in Safety of Fills. In 2000, the Tidal Marshes and Tidal Flats policy section was amended, and the issue of sea level rise was included in a list of requirements for the analysis of restoration projects. The projected impacts of climate change affect nearly every policy section of the Bay Plan. One approach for addressing these impacts would be to amend every affected policy section. However, individual Bay Plan policies are never applied in isolation from other policies. Therefore, the most effective approach is to create a new Climate Change policy section that can be used with other policy sections of the Bay Plan and to update only those particular sections that require more specific clarity.

Background material for the proposed amendment is presented in the staff background report entitled, *Living with a Rising Bay: Vulnerability and Adaptation in San Francisco Bay and on its Shoreline,* dated April 7, 2009, that provides the information for the staff's proposed changes to the Bay Plan that follow in this staff report and preliminary recommendation.

Preliminary Recommendation

The staff preliminarily recommends that the Commission amend the Bay Plan as follows:

1. **Proposed Additions to Bay Plan Findings and Policies**

   a. Create a climate change policy section of the Bay Plan that addresses the following:

      (1) Updating sea level rise scenarios and using them in the permitting process;

      (2) Developing a long-term strategy to address sea level rise and storm activity and other Bay-related impacts of climate change in a way that protects the shoreline and the Bay; and

      (3) Working with the Joint Policy Committee (JPC) and other agencies to integrate regionally mitigation and adaptation strategies and adaptation responses of multiple government agencies, to analyze and support environmental justice issues, and to support research that provides useful climate change information and tools.

2. **Proposed Changes to Existing Bay Plan Findings and Policies**

   a. Amend findings and policies on public access to provide public access that is sited, designed and managed to avoid significant adverse impacts from sea level rise and ensure long-term maintenance of public access areas.

   b. Amend findings and policies on tidal marshes and tidal flats to ensure that buffer zones are incorporated into restoration projects where feasible and sediment issues related to sustaining tidal marshes are addressed.

   c. Amend the policies on safety of fills by updating the findings and policies on sea level rise and moving some to the new climate change section of the Bay Plan.

   d. Amend the policies on protection of the shoreline to address protection from future flooding.

Proposed Additions to Bay Plan Findings and Policies

Proposed additions in language are shown as underlined, while proposed language deletions are shown as ~~struck through.~~ Reasons for the proposed changes are included in the Staff Analysis in the right column.

Climate Change. The staff preliminarily recommends the Commission add a new Bay Plan "Climate Change" policy section at the beginning of Part IV of the Plan - Developing the Bay and its Shoreline - and include the proposed findings and policies below.

Climate Change	
Findings	**Staff Analysis**
Add underlined language as follows: a. Greenhouse gases naturally reside in the earth's atmosphere, absorb heat emitted from the earth's surface and radiate heat back to the surface causing the planet to warm. This natural process is called the "greenhouse effect." The planet is warming at an accelerated rate due largely to the rapid release through human activities and subsequent accumulation of greenhouse gases in the atmosphere since industrialization.	The new finding describes the causes of climate change.
Add underlined language as follows: b. The future extent of global warming is uncertain. The United Nations Intergovernmental Panel on Climate Change developed a series of scenarios that describe a range of global development pathways and estimate greenhouse gas emissions for each scenario. Those scenarios have been used in global climate models to develop projections of climate change impacts, including sea level rise.	The new finding describes how United Nations scenarios are used to address uncertainty regarding future global development and the corresponding impacts climate change.
Add underlined language as follows: c. Global warming is accelerating the rate of sea level rise worldwide through thermal expansion of ocean waters and melting of land-based ice (e.g. glaciers). Melting of the Greenland and Antarctic ice sheets would cause even higher rates of sea level rise. Bay water levels are likely to experience a corresponding rise in water level. In the last century, sea level in the Bay rose nearly eight inches. The Commission is responsible for protecting the public and ecosystem from exposure to the substantial risk of flooding, which is best achieved through cautious or risk-averse planning, such as by using a higher-emissions scenario for climate change. Based on such a scenario, scientists project that global warming will cause sea level to increase by 16 inches near mid-century and 55 inches near the end of the century. As new information on climate change becomes available, future sea level rise projections are likely to change.	The new finding explains the connection between global warming and sea level rise. It describes the Commission's responsibility to use a risk-averse approach to protect the public from flooding and to protect the Bay ecosystem from climate change impacts. This finding also explains the sound science that supports such an approach.

Climate Change	
Findings	**Staff Analysis**
Add underlined language as follows: d. The shoreline area currently designated as the 100-year floodplain by the Federal Emergency Management Agency is vulnerable to a one-hundred percent chance of flooding by mid-century. Much of the developed shoreline would require new or upgraded shoreline protection to reduce damage from flooding. Structural shoreline protection can adversely affect the Bay ecosystem, block visual access, adversely impact physical public access and create a false sense of security. Shoreline areas that have subsided are especially vulnerable to sea level rise and may require more extensive structural shoreline protection.	The new finding describes the potential need for new shoreline protection and the potential adverse effects of structural shoreline protection.
Add underlined language as follows: e. Most shoreline impacts will occur from flooding caused by the combined effects of storm activity and higher water level due to sea level rise. During a storm, low air pressure causes a rapid rise in sea level, called storm surge. Water levels are also elevated by rain runoff and extreme high tides, which occur more often in the winter when storms are more frequent. The coincidence of these events is also more likely to occur during El Niño years, which are becoming more frequent. High winds produce waves, which when generated on elevated water, run further up on the land surface causing more damage than they otherwise would. The combination of higher global sea level and runoff from early Sierra Nevada snowmelt can prolong the duration of higher water levels from storm surge. The combined effects of sea level rise, storm surge, tributary flooding, high tides, high winds, and El Niño events will likely cause severe flooding and erosion long before shoreline areas are permanently inundated by sea level rise alone.	The new finding makes the important point that most flooding will occur during storm events before sea level rise inundates shoreline areas. The finding describes in detail how sea level rise and storm activity combine to cause flooding.

Climate Change	
Findings	**Staff Analysis**
Add underlined language as follows: f. A system, such as a socio-economic system, an ecosystem, or a residential community, is resilient when it can absorb and rebound from the impacts from weather extremes or climate change and continue functioning without substantial outside assistance. Depending on a system's adaptive capacity, it may adjust to these changes by moderating potential damages, taking advantage of new opportunities arising from climate change, or accommodating the impacts. Systems that are currently under stress or overly challenged have lower adaptive capacity.	The new finding defines two important concepts in climate adaptation planning: shoreline resilience and adaptive capacity.
Add underlined language as follows: g. Mitigation of climate change refers to actions that reduce greenhouse gas emissions. Adaptation refers to actions taken to address potential impacts or experienced impacts of climate change that lead to a reduction in risks. Adaptation actions can include moving structures outside of flood and inundation zones, protecting shorelines, or designing new construction to be resilient to sea level rise. Some actions, such as restoring tidal marshes that both sequester carbon and provide flood protection, serve as both adaptation and mitigation. Adaptation and mitigation measures that are implemented before sea level rises may protect lives, property and ecosystems.	The new finding defines mitigation as it is commonly used to address climate change. The finding further defines adaptation, points out that mitigation and adaptation efforts should be integrated, and describes the benefits of beginning adaptation planning immediately.
Add underlined language as follows: h. Shoreline residences, development, and infrastructure, all critical to public health and the region's economy, are vulnerable to flooding from sea level rise and storm activity. Public safety may be compromised and personal property may be damaged or lost during floods. Important public shoreline infrastructure, such as airports, ports, regional transportation, and wastewater treatment facilities are at risk of flood damage that could require costly repairs and result in the interruption or loss of vital services.	The new finding describes the impacts of flooding on the developed shoreline.

Climate Change	
Findings	**Staff Analysis**
Add underlined language as follows: i. Because they are located immediately adjacent to the Bay, waterfront parks, beaches, public access sites, and the Bay Trail are particularly vulnerable to flooding from sea level rise and storm activity. Flooding of, or damage to these areas could result in the loss of important public spaces and recreational opportunities, adversely affecting the region's quality of life.	The new finding describes the impacts of flooding on shoreline recreation areas.
Add underlined language as follows: j. The Bay ecosystem contains diverse and unique plants and animals and provides many benefits to humans. For example, tidal wetlands provide critical flood protection, improve water quality, and sequester carbon. The ecosystem is already stressed by human activities that lower its adaptive capacity, such as diversion of freshwater inflow and loss of tidal wetlands. Climate change will further alter the ecosystem by inundating or eroding wetlands and ecotones, changing sediment demand, altering species composition, changing freshwater inflow and salinity, altering the food web, and impairing water quality, all of which may overwhelm the system's ability to rebound and continue functioning. Moreover, further loss of tidal wetlands will increase the risk of shoreline flooding.	The new finding describes some of the benefits humans derive from the Bay and the impacts of climate change on the Bay ecosystem.
Add underlined language as follows: k. Residential communities, particularly low-income communities, lack the resources to respond effectively to the impacts of sea level rise and storm activity. Financial and other assistance is necessary to create resilient shoreline communities in areas where resources are scarce.	The new finding describes the particular vulnerabilities of residential communities to flooding, especially low-income residents.

Climate Change	
Findings	**Staff Analysis**
Add underlined language as follows: l. There are multiple local, state, federal, and regional government agencies with authority over the Bay and shoreline. Local governments have broad authority over shoreline land use, but limited resources to address climate change adaptation. Working collaboratively can optimize scarce resources and create the flexibility needed to plan amidst a high degree of uncertainty.	The new finding describes the patchwork of government authority over the Bay and shoreline. It further describes the difficult position of local governments in addressing climate change.
Add underlined language as follows: m. Climate change impacts will occur on a regional scale. Government jurisdictional boundaries and authorities over the Bay and shoreline are incongruent with the scale and nature of climate-related challenges. A framework for regional decision-making to address climate change is needed. The Joint Policy Committee is comprised of regional agencies that collaborate to develop consistent and effective region-wide policy and local government assistance and incentives.	The new finding describes the need to provide a framework for decision-making that resembles the scale of climate change impacts, but retains a manageable scope.
Policies	**Staff Analysis**
Add underlined language as follows: 1. Measures to address the future effects of climate change should use a risk-averse scenario of sea level rise that is regularly updated based on current scientific understanding. To minimize the adverse effects of sea level rise and storm activity on all projects and to guide the permitting of shoreline protection projects, the Commission should use this scenario to: (a) encourage new projects on the shoreline to be set back from the edge of the shore above a 100-year flood level that takes future sea level rise into account for the expected life of the project, or otherwise be specifically designed to tolerate sea level rise and storms and to minimize environmental impacts; (b) discourage new projects that will require new structural shoreline protection during the expected life of the project, especially where no shoreline protection currently exits; (c) determine whether alternative measures that would involve less fill or impacts to the Bay are feasible; (d) require an assessment of risks from a 100-year flood that takes future sea level rise into account for the expected life of the project; and (e) require that where shoreline protection is necessary, ecosystem impacts are minimized.	The new policy requires consideration of sea level rise scenarios in the permit review process and provides specific direction for permitting shoreline protection projects and is, therefore, a companion policy to the policies in the "Protection of the Shoreline" section of the Bay Plan. The policy also recognizes the Commission's limited authority on the shoreline by including specific direction to encourage or discourage where the Commission's authority is limited.

Climate Change	
Policies	**Staff Analysis**
Add underlined language as follows: 2. The Commission, in collaboration with the Joint Policy Committee, other regional, state and federal agencies, local governments, and the general public, should formulate a regional climate change adaptation strategy for creating resilient Bay and shoreline systems and increasing their adaptive capacity. The strategy should be updated regularly to reflect changing conditions and information, and should include a map of shoreline areas that are vulnerable to flooding based on current sea level rise and shoreline flooding scenarios. The goals of the strategy should be to: a. protect the shoreline environment with particular emphasis on existing development, public safety and infrastructure critical to public health or the region's economy, such as airports, ports, regional transportation, wastewater treatment facilities, public access and recreation areas; b. protect the Bay ecosystem (e.g., Bay habitats, fish, wildlife and other aquatic organisms) with particular emphasis on identifying opportunities for tidal wetlands and tidal flats to migrate landward, managing adequate volumes of sediment for marsh accretion, developing and planning for natural flood protection, and maintaining sufficient upland buffer areas around tidal wetlands; c. integrate the protection of the shoreline environment with the enhancement of the Bay ecosystem by emphasizing shoreline protection measures that incorporate natural Bay habitat for flood control and erosion; d. identify a framework for integrating the adaptation responses of multiple government agencies; e. identify mechanisms for integrating mitigation and adaptation measures through the Joint Policy Committee; f. address environmental justice; g. support research that delivers useful information for planning and policy development on the impacts of climate change on the Bay, particularly those related to shoreline flooding; h. identify actions to prepare and implement the strategy, including any needed changes in law; and i. identify mechanisms to provide information, tools, and financial resources to local governments to assist them with climate change adaptation planning.	The new policy provides guidance for developing and updating a regional strategy to adapt the Bay-related impacts of climate change. The policy suggests a framework is needed to organize multiple jurisdictions and allow for the type of adaptive planning that is necessary with a high degree of uncertainty, limited resources, and relatively rapid release of new scientific information.

Proposed Changes to Existing Bay Plan Findings and Policies

Protection of the Shoreline. The staff preliminarily recommends that the Commission rename the "Protection of the Shoreline" policy section to the "Shoreline Protection" policy section and revise the findings and policies as shown below.

More context on how other findings and policies in this section of the Bay Plan, especially those that the staff is not proposing to change, relate to the proposed changes is available at http://www.bcdc.ca.gov/laws_plans/plans/sfbay_plan.shtml

~~Protection of the~~ Shoreline Protection	
Findings	**Staff Analysis**
Add underlined language as follows: a. Well designed shoreline protection projects, such as levees, wetlands, or riprap, can prevent shoreline erosion and damage from flooding.	The new finding expands the use of the term "shoreline protection" to include flooding in addition to erosion and to include natural forms of shoreline protection in the description.
Add underlined language and delete struck-through language as follows: ~~a.~~ b. ~~Erosion control~~ Because vast shoreline areas are vulnerable to flooding and because much of the shoreline consists of soft, easily eroded soils, shoreline protection projects are often needed to ~~protect~~ reduce damage to shoreline property and improvements ~~from erosion~~. ~~Because so much shoreline consists of soft, easily eroded soils, protective structures are usually required to stabilize and establish a permanent shoreline. These structures~~ Structural shoreline protection, such as riprap, levees, and seawalls, often requires periodic maintenance and reconstruction.	The finding has been updated to reflect the broader use of the term "shoreline protection" by adding language about the need to reduce damage from flooding. The updated language clarifies the common types of structural shoreline protection by providing examples.
Add underlined language and delete struck-through language as follows: ~~b.~~ c. Most ~~erosion control~~ structural shoreline protection projects involve some fill, which can adversely affect natural resources such as water surface area and volume, tidal circulation, and wildlife use. ~~marshes, and mudflats.~~ Structural shoreline protection can further cause erosion of tidal wetlands and tidal flats, prevent wetland migration to accommodate sea level rise, and create a barrier to physical and visual public access to the Bay, and may have cumulative impacts. As the rate of sea level rise accelerates and the potential for shoreline flooding increases, the demand for new shoreline protection projects will likely increase. Some projects may involve extensive amounts of fill.	The finding has been updated and significantly expanded to reflect new information regarding the full suite of impacts from structural shoreline protection.

~~Protection of the~~ Shoreline Protection	
Findings	**Staff Analysis**
Add underlined language and delete struck-through language as follows: ~~e~~. d. Structural shoreline protection ~~structures, such as riprap and sea walls, are~~ is most effective and less damaging to natural resources if ~~they are~~ it is the appropriate kind of structure for the project site and erosion and flood problem, and ~~are~~ is properly designed, constructed, and maintained. Because factors affecting erosion and flooding vary considerably, no single protective method or structure is appropriate in all situations. When a structure is not appropriate or improperly designed and constructed to meet the unique site characteristics, flood conditions, and erosion forces at a project site, the structure is more likely to fail, require additional fill to repair, have higher long-term maintenance costs because of higher frequency of repair, and cause greater disturbance and displacement of the site's natural resources.	The finding has been updated to incorporate flooding and to clarify the challenges accompanying structural shoreline protection projects.
Add underlined language as follows: e. Addressing the impacts of sea level rise and shoreline flooding may require large-scale flood protection projects, including some that extend across jurisdictional or property boundaries. Coordination with adjacent property owners or jurisdictions to create contiguous, effective shoreline protection is critical when planning and constructing flood protection projects. Failure to coordinate may result in inadequate shoreline protection (e.g., a protection system with gaps or one that causes accelerated erosion in adjacent areas).	The new finding anticipates the desire for new and extensive shoreline protection as sea level rises and describes some of the issues that can arise where shoreline protection projects extend across jurisdictional and property boundaries.
Add underlined language and delete struck-through language as follows: ~~d~~ f. Nonstructural ~~erosion control~~ shoreline protection methods, such as tidal marshes ~~marsh plantings~~, can provide effective flood control but are typically effective for erosion control only in areas experiencing mild erosion. ~~However, i~~ In some instances, it may be possible to combine ~~marsh~~ habitat restoration with structural approaches to provide protection from flooding and control shoreline erosion, thereby minimizing the ~~erosion control~~ shoreline protection project's impact on natural resources.	The finding has been updated to be consistent with the language used in other findings and to reflect current information regarding flood protection provided by tidal marshes.

~~Protection of the~~ Shoreline Protection	
Findings	**Staff Analysis**
Add underlined language and delete struck-through language as follows: e.g. Loose dirt, concrete slabs, asphalt, bricks, scrap wood and other kinds of debris, are generally ineffective in halting shoreline erosion or preventing flooding and may lead to increased fill. Although providing some short-term shoreline protection, protective structures constructed of such debris materials typically fail rapidly in storm conditions because the material slides bayward or is washed offshore. Repairing these ineffective structures requires additional material to be placed along the shoreline, leading to unnecessary fill and disturbance of natural resources.	The finding has been updated to include flood protection.

~~Protection of the~~ Shoreline Protection	
Policies	**Staff Analysis**
Add underlined language and delete struck-through language as follows: 1. New shoreline ~~erosion control~~ protection projects and the maintenance or reconstruction of existing ~~erosion control facilities~~ projects should be authorized if: (a) the project is necessary to protect the shoreline from erosion or to protect shoreline development from flooding; (b) the type of the protective structure is appropriate for the project site, the uses to be protected, and the erosion and flooding conditions at the site; ~~and~~ (c) the project is properly engineered to provide erosion control and flood protection for the expected life of the project based on a 100-year flood event that takes future sea level rise into account; (d) the project is properly designed and constructed to prevent significant impediments to physical and visual public access; and (e) the protection is integrated with adjacent shoreline protection measures. Professionals knowledgeable of the Commission's concerns, such as civil engineers experienced in coastal processes should participate in the design.	The policy has been updated and expanded to reflect the potential need to provide protection from flooding due to sea level rise and storm activity. The update includes specific guidance regarding the circumstances for which a shoreline protection structure is allowable at a given location. General guidance on when a shoreline protection structure is allowable is included in Policy 1 of the proposed Climate Change section of the Bay Plan, making this a companion to that policy.

~~Protection of the~~ Shoreline Protection	
Findings	**Staff Analysis**
Add underlined language and delete struck-through language as follows: 2. Riprap revetments, the most common shoreline protective structure, should be constructed of properly sized and placed material that meet sound engineering criteria for durability, density, and porosity. Armor materials used in the revetment should be placed according to accepted engineering practice, and be free of extraneous material, such as debris and reinforcing steel. Generally, only engineered quarrystone or concrete pieces that have either been specially cast, are free of extraneous materials from demolition debris, or carefully selected for size, density, and durability~~, and freedom of extraneous materials from demolition debris~~ will meet these requirements. Riprap revetments constructed out of other debris materials should not be authorized.	The policy has been updated to more clearly identify appropriate riprap materials.
Add underlined language and delete struck-through language as follows: 3. Authorized protective projects should be regularly maintained according to a long-term maintenance program to assure that the shoreline will be protected from tidal erosion and flooding and that the effects of the ~~erosion control~~ shoreline protection project on natural resources during the life of the project will be the minimum necessary.	The policy has been updated to incorporate shoreline flooding.
Add underlined language as follows: 5. Adverse impacts to natural resources and public access from shoreline protection should be avoided. Where such impacts cannot be avoided, mitigation or alternative public access should be provided.	The new policy requires mitigation and/or the provision of alternative public access when adverse impacts to natural resources and/or public access from shoreline protection are unavoidable.

Safety of Fills. The staff preliminarily recommends the Commission revise the findings and policies in the "Safety of Fills" policy section as shown below.

More context on how other findings and policies in this section of the Bay Plan, especially those that the staff is not proposing to change, relate to the proposed changes is available at http://www.bcdc.ca.gov/laws_plans/plans/sfbay_plan.shtml

Safety of Fills	
Findings	**Staff Analysis**
Add underlined language and delete struck-through language as follows: f. Flood damage to fills and shoreline areas can result from a combination of sea level rise, storm surge, ~~heavy~~ rainfall, high tides, and winds blowing onshore. The most effective way ~~T~~to prevent such damage, is to locate projects and facilities ~~structures~~ on fill or near the shoreline ~~should be~~ above ~~the~~ a ~~highest expected water level~~ 100-year flood level that takes future sea level rise into account, during the expected life of the project. ~~or should be protected for the expected life of the project by~~ Other approaches that can reduce flood damage include protecting structures with levees, ~~of an adequate height~~ seawalls, tidal marshes, or other protective measures and employing innovative design concepts, such as building structures that can be easily relocated, tolerate periodic flooding, or float.	The finding was updated to be consistent with language in the proposed Climate Change section of the Bay Plan and to include new ideas for shoreline development that might accommodate rising waters levels.
Add underlined language and delete struck-through language as follows: g. ~~Bay water levels are likely to increase in the future because of a relative rise in sea level. Relative rise in sea level is the sum of: (1) a rise in global sea level and (2) land elevation change (lifting or subsidence) around the Bay. If historic trends continue, global sea level should increase between four and five inches in the Bay in the next 50 years and could increase approximately one and one-half to five feet by the year 2100 depending on the rate of accelerated rise in sea level caused by the "greenhouse effect," the long-term warming of the earth's surface from heat radiated off the earth and trapped in the earth's atmosphere by gases released into the atmosphere. The warming would bring about an accelerated rise in sea level worldwide through thermal expansion of the upper layers of the oceans and melting of some of the earth's glaciers and polar ice packs.~~ Sea level is rising at an accelerated rate due to global climate	The finding has been revised to update and relocate substantial portions of text regarding climate change and sea level rise to the proposed Climate Change section of the Bay Plan.

Safety of Fills	
Policies	**Staff Analysis**
change. Land elevation change caused by tectonic (geologic, including seismic) activity, consolidation or compaction of soft soils such as Bay muds, and extraction of subsurface groundwater or natural gas extraction, is variable around the Bay. Consequently, some parts of the Bay will experience a greater relative rise in sea level than other areas. Relative rise in sea level is the sum of: (1) a rise in global sea level and (2) land elevation change (lifting or subsidence) around the Bay. ~~For example, in Sausalito, the land area has been gradually lifting while in the South Bay excessive pumping from underground fresh water reservoirs has caused extensive subsidence of the ground surface in the San Jose area and as far north as Dumbarton Bridge (map of Generalized Subsidence and Fault Zones shows subsidence from 1934 to 1967). Indications are that if heavy groundwater pumping is continued indefinitely in the South Bay area, land in the Alviso area (which has already subsided about seven feet since 1912) could subside up to seven feet more; if this~~ Where subsidence occurs, more extensive ~~levees~~ shoreline protection and wetland restoration projects may be needed to minimize ~~prevent inundation~~ flooding of low-lying areas by the extreme high water levels.	
Add underlined language and delete struck-through language as follows: 3. To provide vitally-needed information on the effects of earthquakes on all kinds of soils, installation of strong-motion seismographs should be required on all future major land fills. In addition, the Commission encourages installation of strong-motion seismographs in other developments on problem soils, and in other areas recommended by the U.S. ~~Coast and Geodetic~~ Geological Survey, for purposes of data comparison and evaluation.	The policy has been updated to include the correct name of the U.S. Geological Survey.
Add underlined language and delete struck-through language as follows: 4. Adequate measures should be provided ~~T~~to prevent damage from sea level rise and storm activity ~~flooding,~~ that may occur ~~structures~~ on fill or near the shoreline over the expected life of a project. ~~should have adequate flood protection including consideration of future relative sea level rise as determined by competent engineers. As a general rule,~~ The Commission may approve fill that is needed to provide flood protection for existing	

Safety of Fills	
Policies	**Staff Analysis**
projects. New projects ~~structures~~ on fill or near the shoreline should either be ~~above the wave runup level or sufficiently~~ set back from the edge of the shore so that the project ~~structure is~~ will not be subject to dynamic wave energy~~.~~, be built so ~~In all cases,~~ the bottom floor level of structures ~~should~~ will be above a ~~the highest estimated tide~~ 100-year flood elevation that takes future sea level rise into account for the expected life of the project~~.~~, be ~~Exceptions to the general height rule may be made for developments~~ specifically designed to tolerate periodic flooding, or employ other effective means of addressing the impacts of future sea level rise and storm activity. Rights-of-way for levees or other structures protecting inland areas from tidal flooding should be sufficiently wide on the upland side to allow for future levee widening to support additional levee height so that no fill for levee widening is placed in the Bay.	The policy has been updated for clarity and consistency with new language in other areas of the Bay Plan. The policy also makes it explicit that fill can be approved for shoreline protection—a practice in which the Commission has engaged for most of its existence, consistent with provisions in Section 66605 of the McAteer-Petris Act, which allow fill to establish a permanent shoreline, minimal amounts of fill to improve shoreline appearance, and fill for water-oriented uses.
Add underlined language and delete struck-through language as follows: 5. ~~To minimize the potential hazard to Bay fill projects and bayside development from subsidence, all proposed developments should be sufficiently high above the highest estimated tide level for the expected life of the project or sufficiently protected by levees to allow for the effects of additional subsidence for the expected life of the project, utilizing the latest information available from the U.S. Geological Survey and the National Ocean Service. Rights-of-way for levees protecting inland areas from tidal flooding should be sufficiently wide on the upland side to allow for future levee widening to support additional levee height so that no fill for levee widening is placed in the Bay.~~	The first part of the policy has been deleted and the last sentence of the policy has been moved to Policy 4. Proposed policy language in the Climate Change policy section and the Shoreline Protection section of the Bay Plan were inconsistent with the first part of this policy.
Add underlined language and delete struck-through language as follows: 6. ~~Local governments and special districts with responsibilities for flood protection should assure that their requirements and criteria reflect future relative sea level rise and should assure that new structures and uses attracting people are not approved in flood prone areas or in areas that will become flood prone in the future, and that structures and uses that are approvable will be built at stable elevations to assure long-term protection from flood hazards.~~	The policy was deleted to reflect the current state-of-knowledge and commitment of local governments on the issue of climate change.

Tidal Marshes and Tidal Flats. The staff preliminarily recommends the Commission revise the findings and policies in the "Tidal Marshes and Tidal Flats" policy section as shown below.

More context on how other findings and policies in this section of the Bay Plan, especially those that the staff is not proposing to change, relate to the proposed changes is available at http://www.bcdc.ca.gov/laws_plans/plans/sfbay_plan.shtml

Tidal Marshes and Tidal Flats	
Findings	**Staff Analysis**
Add underlined language and delete struck-through language as follows: g. The Baylands Ecosystem Habitat Goals report provides a regional vision of the types, amounts, and distribution of wetlands and related habitats that are needed to restore and sustain a healthy Bay ecosystem, including-restoration of 65,000 acres of tidal marsh. These recommendations were based on conditions of tidal inundation, salinity, and sedimentation in the 1990s. While achieving the regional vision would help promote a healthy, resilient Bay ecosystem, global climate change and sea level rise are expected to alter ecosystem processes in ways that require new, regional goals for types, amounts, and distribution of habitats.	The finding has been updated to reflect the currency of the Habitat Goals and the potential need to update them in light of new information regarding climate change.
Add underlined language and delete struck-through language as follows: i. Tidal marshes are an interconnected and essential part of the Bay's food web. Decomposed plant and animal material and seeds from tidal marshes wash onto surrounding tidal flats and into subtidal areas, providing food for numerous animals, such as the Northern pintail. In addition, tidal marshes provide habitat for insects, crabs and small fish, which in turn, are food for larger animals, such as the salt marsh song sparrow, harbor seal and great blue heron. Diking and filling have fragmented the remaining tidal marshes, degrading the quality of habitat and resulting in a loss of species and an altered community structure.	The finding has been updated to include impacts from past activities that will affect the sustainability of tidal marshes as sea level rises.
Add underlined language as follows: k. As sea level rises, high-energy waves erode inorganic mud from tidal flats and deposit that sediment onto adjacent tidal marshes. Marsh plants trap sediment and contribute additional sediment from the accumulation of material. Tidal habitats respond to sea level rise by moving landward, a process referred to as transgression or migration. Low sedimentation rates, natural topography, and shoreline protection can block wetland migration.	The new finding describes the process of marsh migration—essential to sustain marshes as sea level rises—and further elaborates on the roles of plants and sediment in that process.

Tidal Marshes and Tidal Flats	
Findings	**Staff Analysis**
Add underlined language and delete struck-through language as follows: ~~k~~ l. Sedimentation is an essential factor in the creation, maintenance and growth of tidal marsh and tidal flat habitat. ~~However,~~ Scientists studying the Bay estimate that ~~sedimentation will not be able to keep pace with accelerating sea level rise, due largely to decline in~~ the amount of sediment entering the Bay from the Sacramento and San Joaquin Delta is declining. As a result, the importance of sediment from local watersheds as a source of sedimentation in tidal marshes is increasing. As sea level rise accelerates, the erosion of tidal flats will also accelerate, thus potentially exacerbating shoreline erosion and adversely affecting the ecosystem and the sustainability of ~~future wetland~~ ecosystem restoration projects. An adequate supply of sediment is necessary to ensure resilience of the Bay ecosystem as sea level rise accelerates.	The finding has been updated to reflect the most current information on sediment supply and how the supply is expected to be altered with climate change.
Add underlined language as follows: m. Human actions, such as dredging, disposal, ecosystem restoration, and watershed management, can affect the amount of sediment available to sustain and restore wetlands. Research on Bay sediment transport processes is needed to understand the volume of sediment available to wetlands, including sediment imported to and exported from the Bay. Monitoring of these processes can inform management efforts to maintain an adequate supply of sediment.	The new finding describes information that is needed to understand sediment transport and volumes in the Bay so that efforts can be made to effectively manage sediment supply.
Add underlined language and delete struck-through language as follows: ~~l~~ n. Buffers are areas established adjacent to a habitat to reduce the adverse impacts of surrounding land use and activities. Buffers also minimize additional loss of habitat from shoreline erosion resulting from accelerated sea level rise and allow them to move landward. Buffer areas may be critical for achieving the regional goals for the types, amounts, and distribution of habitats in the Baylands Ecosystem Habitat Goals report or future updates to these goals.	The new finding defines buffer areas, describes their current benefits, and highlights the need for them as space where marshes can migrate as sea level rises.

Tidal Marshes and Tidal Flats	
Policies	Staff Analysis
Add underlined language and delete struck-through language as follows: 4. Where and whenever possible, former tidal marshes and tidal flats that have been diked from the Bay should be restored to tidal action in order to replace lost historic wetlands or should be managed to provide important Bay habitat functions, such as resting, foraging and breeding habitat for fish, other aquatic organisms and wildlife. As recommended in the Baylands Ecosystem Habitat Goals report~~,~~ around 65,000 acres of areas diked from the Bay should be restored to tidal action to maintain a healthy Bay ecosystem on a regional scale. The Baylands Ecosystem Habitat Goals report should be updated periodically to establish conservation, restoration, and management targets that result in a Bay ecosystem resilient to climate change and sea level rise. Further, local government land use and tax policies should not lead to the conversion of these restorable lands to uses that would preclude or deter potential restoration. The public should make every effort to acquire these lands from willing sellers for the purpose of restoration.	The policy has been modified to recommend periodic updates to the Habitat Goals report so that it reflects the effects of climate change on wetlands.
Add underlined language and delete struck-through language as follows: 5. The Commission should support comprehensive Bay sediment research and monitoring to understand sediment volume necessary to sustain and restore wetlands. Monitoring methods should be updated periodically based on current scientific information.	The new policy recommends supporting sediment research and monitoring that can inform future management decisions on projects in the Bay, particularly wetland restoration projects.
Add underlined language and delete struck-through language as follows: ~~5~~ 6. Any ecosystem ~~tidal~~ restoration project should include clear and specific long-term and short-term biological and physical goals, ~~and~~ success criteria, and a monitoring program to assess the sustainability of the project. Design and evaluation of the project should include an analysis of: (a) ~~the effects of relative~~ how the system's adaptive capacity can be enhanced so that it is resilient to sea level rise and climate change; (b) the impact of the project on the Bay's sediment budget; (c) localized sediment erosion and accretion; (d) the role of tidal flows; (e) potential invasive species introduction, spread, and their	The policy has been updated to expand on an existing requirement for analysis of restoration projects—incorporating current information on restoring resilient ecosystems—and to include new analysis of the potential for buffer areas for marsh migration where feasible.

Tidal Marshes and Tidal Flats	
Policies	Staff Analysis
control; (f) rates of colonization by vegetation; (g) the expected use of the site by fish, other aquatic organisms and wildlife; (h) an appropriate buffer, where feasible, between shoreline development and habitats to protect wildlife and provide space for marsh migration as sea level rises; and (j) site characterization. If success criteria are not met, appropriate ~~corrective~~ adaptive measures should be taken.	

Public Access. The staff preliminarily recommends the Commission revise the findings and policies in the "Public Access" policy section as shown below.

More context on how other findings and policies in this section of the Bay Plan, especially those that the staff is not proposing to change, relate to the proposed changes is available at http://www.bcdc.ca.gov/laws_plans/plans/sfbay_plan.shtml

Public Access	
Findings	**Staff Analysis**
Add underlined language as follows: f. Accelerated flooding from sea level rise and storm activity will severely impact existing shoreline public access, resulting in temporary or permanent closures. Periodic and consistent flooding would increase damage to public access areas, which can then require additional fill to repair, raise maintenance costs, and cause greater disturbance and displacement of the site's natural resources. Risks to public health and safety from sea level rise and shoreline flooding may require new shoreline protection to be installed or existing shoreline protection to be modified, which may impede physical and visual access to the Bay.	The new finding describes the range of impacts on public access from flooding from sea level rise and storm activity and identifies related issues, such as higher maintenance costs.
Add underlined language and delete struck-through language as follows: ~~h~~ i. Public access areas obtained through the permit process are most utilized if they provide physical access, provide connections to public rights-of-way, are related to adjacent uses, are designed, improved and maintained clearly to indicate their public character, and provide visual access to the Bay. Flooding from sea level rise and storm activity increase the difficulty of designing public access areas (e.g., connecting new public access that is set at a higher elevation or located farther inland than existing public access areas).	The finding has been updated to reflect the difficulties of designing public access in the face of sea level rise and related flooding.

Public Access	
Findings	**Staff Analysis**
Add underlined language and delete struck-through language as follows: ~~k~~ l. Studies indicate that public access may have immediate effects on wildlife (including flushing, increased stress, interrupted foraging, or nest abandonment) and may result in adverse long-term population and species effects. Although some wildlife may adapt to human presence, not all species or individuals may adapt equally, and adaptation may leave some wildlife more vulnerable to harmful human interactions such as harassment or poaching. The type and severity of effects, if any, on wildlife depend on many factors, including physical site configuration, species present, and the nature of the human activity. Accurate characterization of current and future site, habitat and wildlife conditions, and of likely human activities, would provide information critical to understanding potential effects on wildlife.	The finding has been updated to recommend characterization of current and future wildlife habitats as they may be significantly altered by sea level rise and, thus, any impacts from public access on wildlife may be more serious than otherwise anticipated.
Add underlined language and delete struck-through language as follows: ~~l~~ m. Potential adverse effects on wildlife from public access may be avoided or minimized by siting, designing and managing public access to reduce or prevent adverse human and wildlife interactions. Managing human use of the area may include adequately maintaining improvements, periodic closure of access areas, pet restrictions such as leash requirements, and prohibition of public access in areas where other strategies are insufficient to avoid adverse effects. Properly sited and/or designed public access can avoid habitat fragmentation and limit predator access routes to wildlife areas. In some cases, public access adjacent to sensitive wildlife areas may be set back from the shoreline a greater distance because buffers may be needed to avoid or minimize human disturbance of wildlife. Appropriate siting, design and management strategies depend on the environmental characteristics of the site, ~~and~~ the likely human uses of the site, and the potential impacts of future sea level rise.	The finding has been updated to reflect the need to site and design public access that is compatible with wildlife even as sea level rises and sites change.

Public Access	
Findings	**Staff Analysis**
Add underlined language as follows: 5. <u>Public access should be sited, designed, managed and maintained to avoid significant adverse impacts from sea level rise and shoreline flooding.</u>	The new policy requires the creation of public access that will be resilient to sea level rise.
Add underlined language and delete struck-through language as follows: ~~5~~ <u>6</u>. Whenever public access to the Bay is provided as a condition of development, on fill or on the shoreline, the access should be permanently guaranteed. This should be done wherever appropriate by requiring dedication of fee title or easements at no cost to the public, in the same manner that streets, park sites, and school sites are dedicated to the public as part of the subdivision process in cities and counties. <u>Any public access provided as a condition of development should be required to remain viable in the event of future sea level rise or flooding.</u>	The policy has been updated to require that permit conditions for public access account for sea level rise. Since a permit requiring public access is recorded with the property document the public access is guaranteed for the life of the project even if sea level rises.

Amendment Consistency with the McAteer-Petris Act

Section 66652 of the McAteer-Petris Act requires that amendments of the Bay Plan be consistent with the Findings and Declarations of Policy in the McAteer-Petris Act. The relevant Findings and Declarations of Policy sections of the McAteer-Petris Act are Section 66605 regarding fill in the Bay, Section 66602 regarding public access and Section 66632.4 regarding the Commission's authority to issue permits in the shoreline band.

Section 66605 of the McAteer-Petris Act states, in part: (a) the public benefits from fill must clearly exceed the public detriment from the loss of water areas, and fill should be limited to water-oriented uses, such as bridges; (b) no alternative upland location exists for the fill; (c) the fill should be the minimum amount necessary; (d) the fill should minimize harmful effects to the Bay including the water volume, circulation, and quality, fish and wildlife resources, and marsh fertility; (e) the fill should be constructed in accordance with sound safety standards. The McAteer-Petris Act broadly defines the term "fill" to include "earth or any other substance or material, including pilings or structures placed on pilings, and structures floating at some or all times and moored for extended periods…." The updated findings and policies pertain to several types of fill.

The amendment will add a new climate change policy section to the Bay Plan that includes policies that require evaluation of sea level rise and storm activity for permit decisions regarding fill. The proposed policies anticipate future desire to place fill for shoreline protection and in areas that are vulnerable to flooding from sea level rise and provides guidance on the circumstances under which such fill is allowable, so that such fill is consistent with the provisions of Section 66605. Therefore, the portion of the amendment that proposes to add a new climate change section to the Bay Plan is consistent with Section 66605 of the McAteer-Petris Act.

The amendment will revise existing policies regarding protection of the shoreline, which currently addresses shoreline protection to minimize erosion. The proposed revisions to the findings and policies would expand the scope of the policy section to address flooding in addition to erosion, thereby anticipating again the future desire to construct additional shoreline protection or modify existing shoreline protection as sea level rises. The revisions encourage the use of natural shoreline protection, when feasible, and the minimization of harmful effects to the Bay so that fill for shoreline protection is consistent with Section 66605 of the McAteer-Petris Act.

The amendment further will revise existing policies in the Tidal Marsh and Tidal Flats policy section of the Bay Plan to improve the analysis of climate change impacts required for marsh restoration (which usually involves fill) so that marshes are more likely to sustain the impacts of climate change and adapt over time.

For all of the reasons above, the proposed amendment is consistent with Section 66605 of the McAteer-Petris Act.

Section 66632.4 of the McAteer-Petris Act applies within the Commission's shoreline band jurisdiction and allows that the Commission may only deny a permit for a project that: (1) fails to provide maximum feasible public access consistent with the project; or (2) conflicts with the use designated in a priority use area. The Commission can only condition a permit—require changes to the project—to bring the project into compliance with the requirement to provide maximum feasible public access and to be consistent with a priority use. Section 66602 of the McAteer-Petris Act states that existing public access to the shoreline and waters of San Francisco Bay is inadequate and that maximum feasible public access, consistent with a proposed project, should be provided. A portion of this proposed amendment would revise the public access findings and policies. The policies would be updated to reflect the significant vulnerabilities of shoreline public access to flooding from sea level rise and the need to maintain and guarantee public access for the life of the project. The proposed amendment is therefore consistent with Sections 66602 and 66632.4 of the McAteer-Petris Act.

Environmental Assessment

The proposed amendment must meet the requirements of the McAteer-Petris Act and the Commission's standards for environmental review through an Environmental Assessment. Environmental Assessments are prepared in conformance with the Commission's regulations (CCR, Title 14, Section 11511-11512), which have been certified by the Secretary of Resources as functionally equivalent to the California Environmental Quality Act (CEQA). Because the proposed amendment is a programmatic policy change rather than a specific project with more precise quantifiable impacts, the discussion is more general in the background report entitled, *Living with a Rising Bay: Vulnerability and Adaptation in the San Francisco Bay and on its Shoreline,* than an environmental assessment for a specific project.

The proposed amendment addresses the need to update the sea level rise findings and policies that were created twenty years ago and to address other impacts caused by climate change. In the last twenty years, international scientific consensus has concluded that climate change is already occurring, that human activities that release greenhouse gases have caused climate change, and that some warming is inevitable no matter no matter how much the world reduces greenhouse gas emissions. Scientists have already observed higher surface and ocean temperature, rising sea levels, and increased rates of ice melt. Most notably, scientist project that sea levels will continue to rise, long after greenhouse gas emissions are reduced. The background report incorporates the Environmental Assessment and is the fundamental basis of the staff report analysis and staff's recommended changes to the Bay Plan. Specifically, the staff background report provides an environmental assessment of the proposed amendment through: (1) analysis of the causes and effects of sea level rise and the use of scenarios for determining vulnerability; (2) analysis of shoreline vulnerability to flooding from sea level rise and storm activity; (3) analysis that identifies vulnerabilities in the Bay ecosystem to the effects of climate change; (4) analysis of vulnerabilities in Bay and shoreline governance; and (5) analysis of adaptation strategies that reduce vulnerabilities and increase resilience.

The resulting proposed revisions to the Bay Plan, as discussed in the background report and outlined in the proposed amendment to address climate change serve to update the Bay Plan to better reflect scientific understanding of climate change and sea level rise and to provide further guidance to minimize adverse impacts from climate change. Therefore, as described in the accompanying staff report, the proposed amendment will have no significant adverse environmental impacts.

Furthermore, the proposed amendment of the Bay Plan would not affect the Commission's ability to require specific environmental review of projects proposed in its jurisdiction under the provisions of the McAteer-Petris Act, the Bay Plan, the California Environmental Quality Act of 1970, and the Commission's federally-approved Management Program for the San Francisco Bay. Specific project review would require a more detailed level of environmental analysis than that required for a policy change to the Bay Plan, which is a general policy plan.

Summary of Written Comments Received

One written comment was received following the distribution of the descriptive notice on November 6, 2008. David Lewis from Save the Bay requested that the amendment be expanded to include other policy sections of the Bay Plan, particularly the sections on salt ponds and managed wetlands.