*Preparing for Sea Level Rise on the Hayward Shoreline*

## Introduction

When the Bay Conservation and Development Commission (BCDC) released a set of maps depicting areas of the San Francisco Bay shoreline vulnerable to sea level rise, the Hayward Area Shoreline Planning Agency (HASPA) took notice. HASPA, which consists of the City of Hayward, the Hayward Area Park and Recreation District, and the East Bay Regional Park District, commissioned a preliminary study by ESA PWA to identify vulnerable infrastructure, and assess the feasibility of protecting shoreline infrastructure and wetlands along the shoreline[1].This is the beginning of HASPA's adaptation efforts. Recommendations from the study will be fed into future versions of the City's Climate Action Plan.

## Study Summary

The study addressed the 4.3 miles of shoreline between State Highway 92 and San Lorenzo Creek which primarily consists of tidal marshland mixed with various manmade infrastructure. In addition to residential and commercial properties, the study area is home to the Bay Trail, wastewater treatment facilities, the East Bay Dischargers Authority (EBDA) pipeline, railroads, landfills, high pressure gas lines and other services that could be disrupted by sea level rise (Figure 1). Most of the infrastructure is built on reclaimed marshland which has subsequently subsided and is already vulnerable to flooding erosion and rising groundwater. This vulnerability will increase if sea level rises as it is projected to do over the next century.

Unlike traditional forms of planning that are based on a static landscape, planning for sea level rise requires a flexible approach that can adapt to dynamic shifts in the shoreline. Mudflats, marshes and beaches will all tend to move landward as sea level rises; flood hazard zones will enlarge as bay levels rise and wave run-up increases; erosion hazard zones will enlarge as wave energy on the shoreline increases. Development along the shoreline has reduced the shoreline's natural ability to accommodate sea level rise and has reduced the flexibility for potential setbacks. In addition, while all the projections show sea level will rise, the projections of the rate at which it will rise vary widely; the advice being proffered by State and Federal agencies is to 'plan for uncertainty'.

A number of options have been explored in the study, ranging from raising the existing levees to re-establishing natural systems to allow the marshland to adapt on its own. Each option has advantages and disadvantages. Maintaining and raising the existing levees is attractive because the engineering standards for their design and implementation are well developed and widely used. However this option is expected to have high construction and ecologic costs. The levees would have to be continually maintained and improved by both raising and strengthening the structures. These costs are in addition to the loss of the mudflat and salt marsh, which have both ecological and flood protection benefits, as they are "squeezed" against the levees.

[1] The report is available at http://user.govoutreach.com/hayward/faq.php?cid=11038

Another option is to move the levees to a new location further inland. This allows marshes and mudflats to move landward naturally. Realignment takes advantage of the natural protection provided by marshes and mudflats to reduce the risk of flooding and erosion allowing smaller levees to be built. However realignment over relatively flat slopes uses large amounts of land but may provide flood protection benefits for only a relatively short period, particularly if the marshes cannot keep up with sea level rise.

But there are other options for the Hayward shoreline. There is some space to realign, but there are two other opportunities for HASPA to exploit. Firstly, large amounts of treated fresh water pass through the Hayward shoreline in the EBDA pipeline, from treatment plants in the south and east. Redirecting the output to local treatment marshes and disconnecting the EBDA pipeline would remove a major constraint on the Hayward shoreline and improve the resiliency of the EBDA system. The input of fresh water could create more productive brackish marshes, with higher accretion rates, thereby better able to keep up with rising sea levels compared to saline tidal marshes.

A second opportunity is the local availability of sediment trapped at San Leandro Marina and along the flood channels leading to the Bay. In the past this sediment would have entered the Bay and built up mudflats and marshes; this connection has now been broken. The sediment presently trapped could be recovered and hydraulically placed on the bayland edges. Artificial high marsh berms on the marsh edges could be actively managed to keep pace with sea level rise and erosion by periodically raising their crests with thin deposits of sediment.

Combining these opportunities into a high marsh berm with a brackish marsh behind the existing tidal marsh will provide a shoreline that will gradually rise at similar rates to sea level - a truly adaptive and resilient shoreline (Figure 2). This will slow down the landward movement and loss habitat by "squeeze" yet maintain the wave attenuation functions of the marshes. The opening up of diked baylands could provide flood storage that would reduce creek elevations during floods and reduce the need to raise creek levees in the future. Increased tidal action in the creeks will also help maintain conveyance in the lower sections of the channels. Going one step further, storm water could be rerouted to discharge through the brackish marsh rather than the existing flood channels. Other benefits include greater nitrogen and carbon sequestration than a saline tidal marsh. The use of a freshwater swale also diffuses the flows of water and sediment; avoiding point-source concentrations of wastewater outflows and contaminants.

This option mimics many of the historic bay processes and restores brackish marsh and other habitat's which has been lost due to reclamation. The risk associated with such an option is relatively low. The individual elements are well understood; the combination of elements is new and a demonstration project is proposed on the Hayward shoreline to explore the concept.

The likely course will probably be a mix of approaches that will allow portions of the shoreline to adapt naturally. In addition, while the Hayward study provides insight on how various approaches will work to address future sea level rise, these approaches are relatively new and may conflict with commonly accepted best practices and regulations. Moving forward will require extensive discussion and cooperation among the many stakeholders.

In 2010, the study was presented to the Hayward City Council, staff at the Hayward Shoreline Interpretive Center, the East Bay Dischargers Authority (EBDA), the San Francisco Bay Conservation and Development Commission (BCDC), the Bay Planning Coalition, the North Bay Watershed Association (NBWA) and the Alameda Creek Watershed Council.

**Multi-Jurisdictional Approach**

The PWA study recommends vulnerability analysis as the most appropriate next step. In an effort to initiate this next phase, staff of the HASPA member agencies, met with staff and boards of other agencies that have an interest in protecting the Hayward/San Leandro Shoreline. A resolution was developed for agencies to express an interest in working cooperatively on a vulnerability analysis. The resolution seeks to expand the study area from San Lorenzo Creek north to Davis Street in San Leandro.

The resolution was adopted by the Hayward City Council and the Boards of EBRPD, EBDA and the Bay Trail. The HARD Board is scheduled to adopt the resolution on January 24, 2011. Staff has also had discussions with the Oro Loma Sanitary District, the City of San Leandro, and Alameda County. HASPA and County staff are scheduled to discuss sea level rise planning efforts on January 20, 2011.

**ART Project**

In October, 2010, BCDC and NOAA announced the Adapting to Rising Tides[2] (or ART) project and solicited applications from jurisdictions interested in being part of the subregion to be studied. Building on the relationships established throughout 2010, HASPA staff coordinated and submitted to BCDC interest forms from several East Bay jurisdictions. The East Bay, from Union City to Emeryville, was selected as the shoreline that will be the subject of the ART Project.

**Next Steps**

Depending upon the outcome of the ART Project, HASPA and other East Bay jurisdictions may seek funding for additional planning and environmental review. In November 2009, HASPA staff submitted an application through Congressman Pete Stark's office for funding through the Water Resources Development Act of 2010. The application requested funds for levee and infrastructure repair, a demonstration project, and a Shoreline Realignment Master Plan. Following the initial application, additional information was submitted to Representative Pete Stark, Senator Barbara Boxer and the Army Corps of Engineers. Congress is not expected to approve WRDA funding requests until sometime in 2011.

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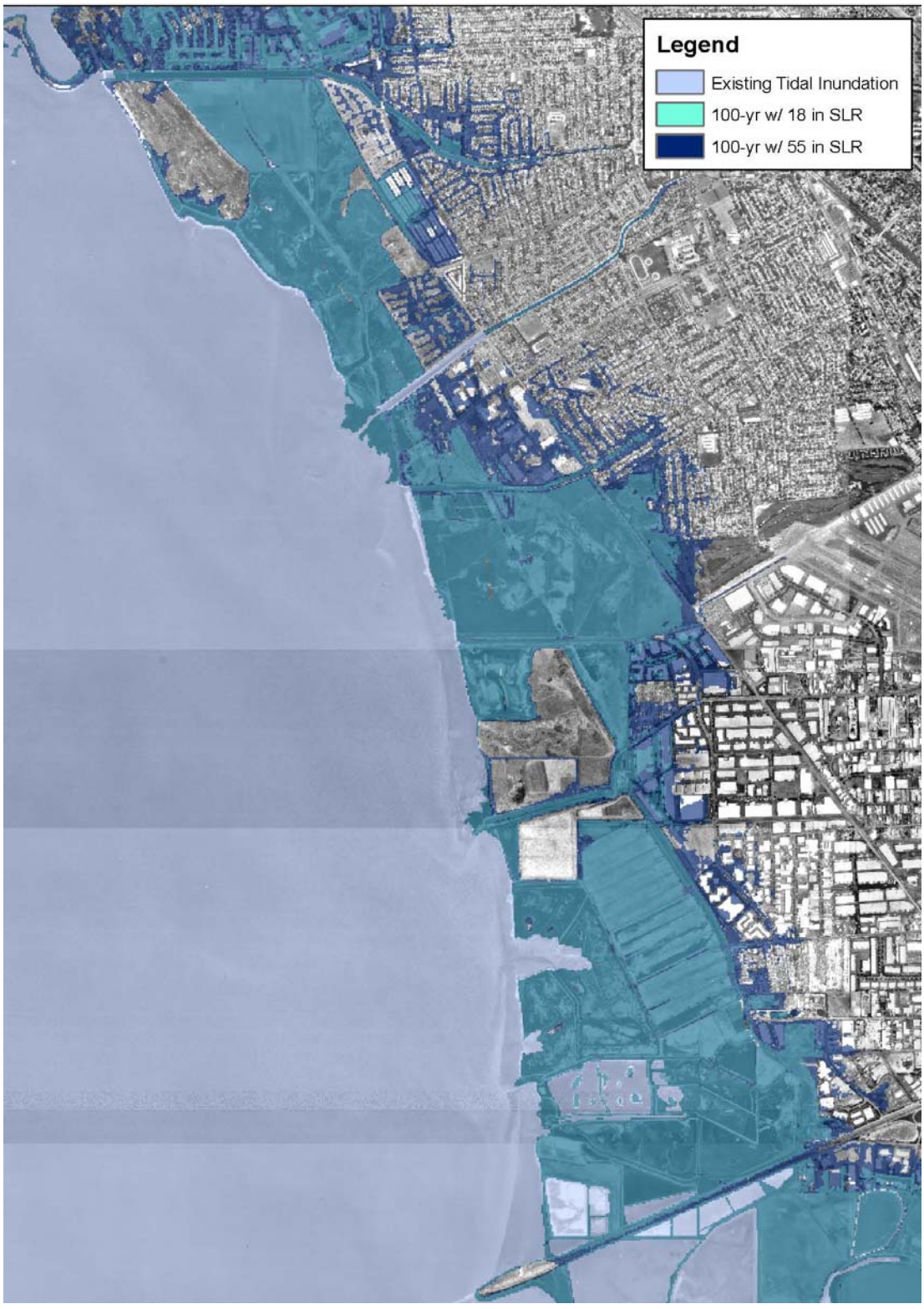
[2] More information about the ART Project is available at http://risingtides.csc.noaa.gov/




Source: Knowles 2008

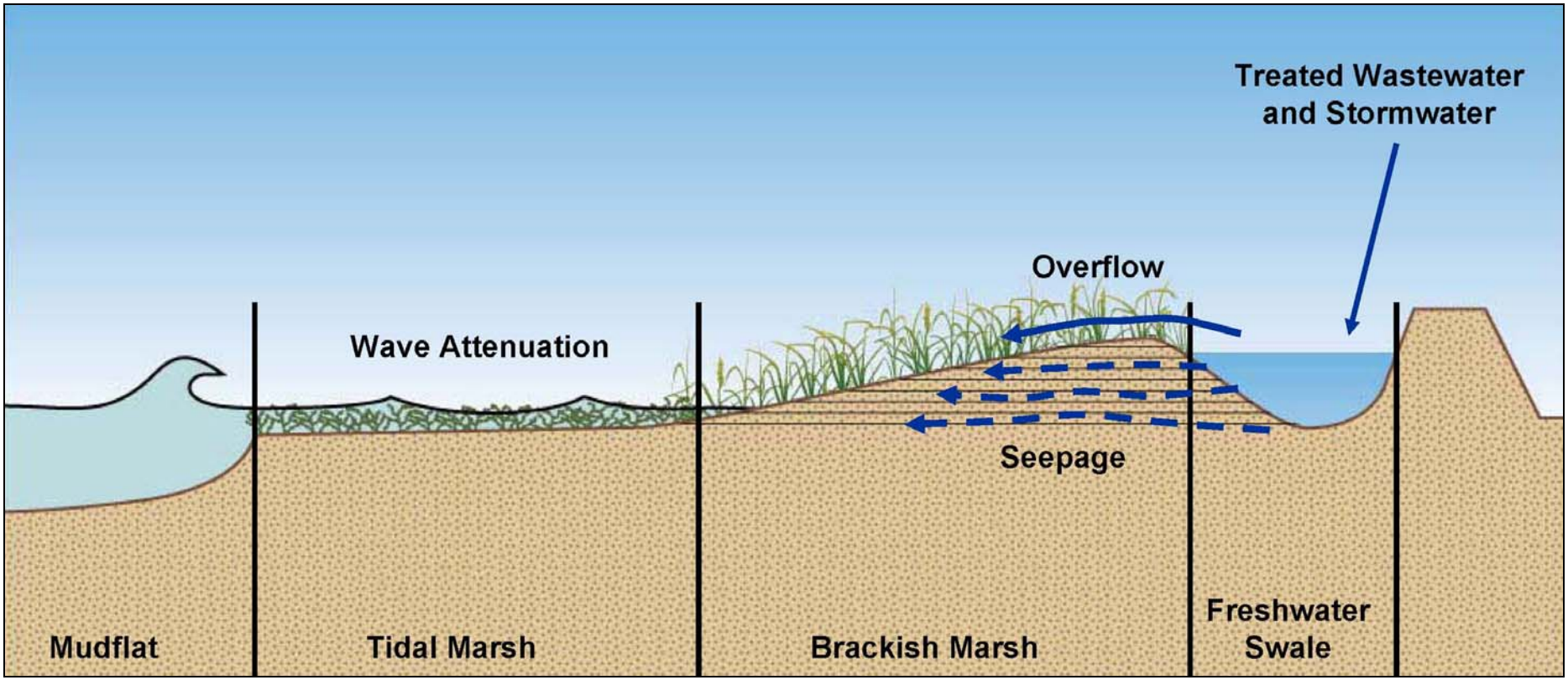
Shows 100-year flood level in addition to sea level rise.

*figure* ***1***
*HASPA Sea Level Rise Study*

100-Year Water Level Inundation Map

PWA Ref# 1955.00

PWA




Source:

*figure 2*
*HASPA Sea Level Rise Study*

Seepage Through Vegetated Berm

PWA Ref# 1955.00

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