Climate Change, Water, and Cities: How Communities Can Adapt to Sea-Level Rise and Increased Flood Risk

Association of Environmental Professionals
California State Conference Session, May 19, 2017

Moderator:

Alan Murphy
Perkins Coie LLP

Panelists:

Diane Oshima
Port of San Francisco

Brian Strong
City and County of San Francisco

Geoff Smick
WRA, Inc.
Resilience Planning in San Francisco

- Definition of resilience on the 100 RC model:
  - Consider disaster preparedness and recovery for both infrastructure and communities
  - Address systemic crises like economic downturns, poverty, and housing shortages
  - Incorporate slow-moving disasters such as climate change and sea level rise
Critical Challenges to Resilience Planning

- Creating a sense of urgency
- Long-term planning and implementation in a political environment
- Focus on engineering and top-down isn’t effective
  - Emphasis has been to engineer solutions with little thought about recovery
  - Need for greater community engagement
- Issues of equity, displacement, housing, demographics, and population growth
- Multiple challenges associated with water
  - Water and sewer systems are facing massive capital improvement needs
  - SLR is not your typical capital improvement projects
  - Sever storm frequency is also rising
- Lack of incentives to encourage the private sector to address resiliency
- Funding for mitigation and planning is non-existent
Natural Topography
Changing Land Use and Growth

- Adopted and proposed Area Plans
- Growth

### UNITS

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<th>EXISTING</th>
<th>GROWTH</th>
<th>TOTAL 2040</th>
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### POPULATION

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Community Resilience

- Community Resilience – 2012
- 38 different indicators
Addressing the Resilience Deficit

- Capital Plan
- Flooding
- Sea Level Rise Efforts
- Resilience By Design Competition
- Community Resilience
10-Year Capital Plan

- Constrained 10-year plan of finance
  - Created in 2006 to coordinate and prioritize infrastructure investments
  - Objective funding principles
  - Current plan proposes to spend $35 billion through 2027

- Accomplishments
  - Over $10 billion approved since 2006
  - $3.5 billion GO bonds since 2008

- Ongoing Projects
  - Sea Wall / Sea Wall Fin. Wkg. Group
  - Sewer System Improvement Program
  - SFO Sea Wall and Improvements
  - Emergency Firefighting Water System
  - Transportation
SSIP Flood Resilience Study

Drainage Map
- Division St Outfall
- Contributing Area Downstream
- Immediately Upstream of 17th & Folsom neighborhood

Panhandle
Twin Peaks
16th St
17th and Folsom
Potrero Hill
Cesar Chavez Blvd
SSIP Flood Resilience Study
Sea Level Rise Guidelines for Capital Planning

- Findings on best available science
- Incorporates exposure, sensitivity and adaptive capacity
- Trained over 100 project managers, easy-to-use checklist
- Paves way for private property

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<th>Year</th>
<th>Projections Likely levels of SLR</th>
<th>Ranges Unlikely but possible SLR</th>
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# Sea Level Rise Guidelines for Capital Planning

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## SLR Action & Adaptation Plan

### Cost of Inaction

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<td>66” (SLR)</td>
<td>$19 Billion</td>
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<td>108” (SLR + storm surge)</td>
<td>$38 Billion</td>
<td>$37 Billion</td>
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Note: Dollar amounts indicate asset replacement cost only. Numbers are in today’s dollars and reflect upper range, end-of-century projections without adaptation or action.
SLR Action & Adaptation Plan

SAN FRANCISCO SEA LEVEL RISE ACTION PLAN

SAN FRANCISCO SEA LEVEL RISE VULNERABILITY ZONE THROUGH END-OF-CENTURY WITHOUT ANY ADAPTATION MEASURES OR ACTIONS

MAJOR WATERFRONT PROJECTS INCORPORATING INNOVATIVE ADAPTIVE MANAGEMENT

Legend

- Sea Level Rise Vulnerability Zone

CITY AND COUNTY OF SAN FRANCISCO

WORKING TOGETHER TO BUILD SAN FRANCISCO’S RESILIENCE TO SEA LEVEL RISE | MAY 2015

0 3,400 6,800 Feet

Not to Scale
SLR Action & Adaptation Plan

- Asset Inventory and Exposure Analysis (2017)
- Vulnerability and Risk Assessment (2017-18)

Adaptation Plan (2019)
- Prioritized Projects
- Policies and Code
- Design Guidelines
- Funding Strategies
Resilience by Design

- Regional
- Open competition
- 10 Multi-disciplinary teams
- Replicable and implementable
- Science-based
- Include community engagement and issues of equity
Neighborhood Empowerment Network (NEN)

- Disaster response cannot be driven by government alone
- Community-based partners expand government’s reach
- NEN organizes local institutions to activate once disaster strikes
- Community leadership academy in development
- Nine hubs in southern portion of San Francisco
Questions & Comments

www.onesanfrancisco.org

Brian Strong, Director 554-5165
Projected sea level rise: mid-century

+18 inches | 2040 High Scenario | 2068 Likely Scenario

Impacts:
- Flood risk for downtown is considerable
- High tides start affecting Embarcadero and MUNI & BART infrastructure
- Original shoreline re-emerges

Fisherman’s Wharf to Bay Bridge
Downtown Main & Davis
BART/Muni Tunnel Embarcadero Station
Projected sea level rise: end of century

+66 inches | 2100 High Scenario | 2160 Likely Scenario

Impacts:

- Daily flooding on Embarcadero and Finger Piers
- Downtown severely impacted
- BART and MUNI and other vital City infrastructure subject to untenable flood risk exposure
- Original shoreline re-established in most areas

- Fisherman’s Wharf and all piers
- Daily flooding on Embarcadero and into downtown
- BART/Muni Tunnel Embarcadero Station
SFWG Work Process

- 8 meetings between November 2016 and April 2017

Work to date:
- Research on 48 possible funding strategies
- Establishment of 11 evaluation criteria
- Analysis of 48 funding strategies based on the criteria
- Drafting recommendations and report (in progress)

- $350 million G.O. Bond Measure in the proposed Capital Plan
## SFWG Evaluation Process

### 5 Considerations
- Revenue Generating Potential
- Timing
- Administrative Complexity
- Political Feasibility
- Equity/Cost Burden

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<th>Funding Strategy</th>
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<th>Revenue Generating Potential ***</th>
<th>Cost of Funds</th>
<th>Long Term Sustainability</th>
<th>Flexibility of Funds</th>
<th>Timing</th>
<th>Tradeoffs for Other City Needs</th>
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- Red, yellow, or green scale for strengths and weaknesses
- Weighted average calculated for each option based on the evaluation criteria.
SFWG List of Funding Strategies

The SFWG analyzed 48 local, regional, state, and federal possible funding strategies:

- State Resilience G.O. Bond
- State Share of Property Tax Increment
- Incorporate into Pier Rehab Projects
- Geologic Hazard Abatement Districts (GHADs)
- Surcharge on Event Tickets
- Transit Pass Transfer Fee
- Increase Ferry Charges
- Cruise Ticket Surcharge
- Hazard Mitigation Grants
- National Foundation Grants
- Historic Tax Credits
- Federal Transportation Funding
- Army Corps of Engineers (USACE) – General Investigation
- USACE – CAP 103 Program
- DHS Office of Infrastructure Protection
- Commuter Transportation Tax
- Vehicle License Fee Increase
- Tax/Fee on Auto Sales
- Tax/Fee on Marina Uses
- Transit Impact Development Fee
- Increased Parking Revenues
- G.O. Bonds
- Assessment District
- CFD/Mello-Roos
- Port IFD
- IRFDs
- Sale/Lease Increment of Port Assets
- Insurance Value Capture/Resilience Bonds
- Sales Tax Increase
- Parcel Tax
- Real Estate Transfer Tax Increase
- Utility User Tax Surcharge
- Business License Tax Surcharge
- RM3- Bridge Tolls
- Cap & Trade Program Funding
- Regional Gas Tax
- Congestion Pricing
- Tax/Fee on Rental Cars
- Business Gross Receipts Tax Surcharge
- Hotel Assessment
- Infrastructure Trust Bank
- Green/Climate Bonds
- Environmental Impact Bonds
- Advertising
- Naming Rights
- Public Private Partnerships
- Philanthropy
- Pension Plan Investment
Port of San Francisco

RESILIENCY

CHALLENGES

OPPORTUNITIES

AEP Conference • May 19, 2017
Sea Level Rise & Flood Vulnerability

Sea Level in San Francisco
Increased 8 inches over last 100 yrs
Is predicted to increase
12-24 inches by 2050
36-66 inches by 2100
Sea Level Rise

100 Year Flood Vulnerability

+12 inches | 2030 High Scenario | 2050 Likely Scenario

Finger Piers
Flood Risk
Moderate (25 Yr)
Sea Level Rise

100 Year Flood Vulnerability
+36 inches | 2067 High Scenario | 2100 Likely Scenario

Regular Flooding on Embarcadero

Finger Piers
Regular Flooding
Sea Level Rise & Flood Vulnerability

Pier 14 in King Tides Today
Downtown Ferry Terminal Expansion Project
Raising the Deck: Downtown Ferry Terminal Expansion Project

+ 15.5’ Proposed Deck
+ 11.4’ BFE
+ 5.5’ High Tide
Pier 22½ Fireboat Station Expansion Project
Concrete Barge

Concrete Barge with Guide Piles and Ramp

Concrete Barge Deck Slab w/Buoyancy Tanks
Soft Shore Edge to the South
Crane Cove Park: Managed Retreat
Earthquake Vulnerability

72% Probability of Major Earthquake by 2044
Embarcadero Seawall Resiliency Project

3 Miles long ● 500+ acres ● Built over 40 years

Mission Creek

1850’s Shoreline

1878 - 1906

1906 - 1916

Fisherman’s Wharf
The Embarcadero Historic District
City Form & Identity
Bulkhead Buildings
City Form & Identity

Finger Piers
Earthquake Vulnerability

Liquefaction, Lateral Spreading & Settlement

Utility Breaks, Roadway/Rail Damage

Bulkhead Wall Failure

Liquefiable Fill

Rock Dike Slides Bayward

Ground Failure in Young Bay Mud

Building Collapse

Pile Failure

Firm Sand and Old Bay Clay

San Francisco Bay
Initial Concepts

**Option: Ground Improvement Under Seawall**

- Ground Improvement Under Rock Dike
- Repair and Retrofit Existing Bulkhead Wharf & Wall
- Flood Proofing & Barriers
- Future Replacement
Initial Concepts

**Option: Bulkhead Wharf Replacement**

- Temporarily Relocate Bulkhead Buildings
- Demolish existing Bulkhead Wharf & Wall
- Construct new Bulkhead Wharf & Wall, Stabilize Rock Dike
  - Set New Elevation & Build in Capacity for Raising in Future
Initial Concepts

Option: New Bayward Seawall

- New Bayward Seawall, Construct from Waterside, New Elevation
- Pumpable Lightweight Fill Under Bulkhead Wharf
- Remove and Replace Shed

Dewater and pump cellular concrete

Hydraulic fill

Strengthen fill and mud Deep Soil Mixing (DSM)

60 to 80 ft Minimum width no maximum

Anchor pile
Waterfront Planning Public Process
Climate Change, Water, and Cities: How Communities Can Adapt to Sea-Level Rise and Increased Flood Risk

Geoff Smick – WRA, Inc.
Regulatory Primer

- FEDERAL
  - Corps of Engineers

- STATE
  - Bay Conservation and Development Commission (BCDC)
  - Regional Water Quality Control Board

- LOCAL
  - City/County Regulations
Climate Change, Water, and Cities: How Communities Can Adapt to Sea-Level Rise and Increased Flood Risk
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Tidal Marsh Ecology 101

Tidal Inundation & Correlation with Habitat

Marsh zones are correlated to the frequency of tidal inundation.

tide over 48 hour period

elevation

mean low low
mean high
mean low
mean high high

upland
transition zone
high marsh
low marsh
mudflat

diurnal tide
Tidal Marsh Ecology 101

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### Tidal Marsh Ecology 101

<table>
<thead>
<tr>
<th>Zone</th>
<th>Indicator Plant Species</th>
<th>Average Low (Ft.)</th>
<th>Average High (Ft.)</th>
<th>Elevation Range (Ft.)</th>
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</thead>
<tbody>
<tr>
<td>Low Marsh</td>
<td>Cordgrass</td>
<td>2.37</td>
<td>4.78</td>
<td>2.41</td>
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<tr>
<td>High Marsh</td>
<td>Pickleweed</td>
<td>4.78</td>
<td>6.83</td>
<td>2.05</td>
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<tr>
<td>Transition</td>
<td>Grindelia</td>
<td>6.55</td>
<td>8.16</td>
<td>1.61</td>
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<tr>
<td>Upland</td>
<td>Coyote Brush</td>
<td>7.62</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
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Climate Change, Water, and Cities: How Communities Can Adapt to Sea-Level Rise and Increased Flood Risk

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Resiliency Strategies – Natural or Engineered?

Living Shorelines

Waves decreased with healthy coastal habitats.

Waves with degraded coastal habitats.
Case Study: Dotson Family (Breuner) Marsh
Dotson Marsh – Historic Marsh Filling

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Grading Plan 3D Hillshade
Grading Plan Cross Section w Sea Level Rise

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Restoration Construction - 2014

Photo Credits: Questa Engineering

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Case Study: India Basin
Existing Conditions
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India Basin: Beach 2050
India Basin: Tidal Marsh 2017
India Basin: Tidal Marsh 2050
India Basin: Tidal Marsh 2100
India Basin: Cove 2017

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India Basin: Cove 2100
Long Term Solutions

- Change in state and federal regulatory policy
- Regional framework for harmonizing local jurisdictions
- Some real out-of-the-box thinking
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Modernized Seawalls

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San Francisco Bay Conservation and Development Commission (BCDC)

- BCDC has planning and regulatory authority over tidal areas of the Bay and over the 100-foot shoreline band.
  - Maximum feasible public access
  - Minimum necessary placement of fill

- In 2011, BCDC amended the San Francisco Bay Plan to account for expected impacts of climate change on Bay
Policies for a Rising Bay Project

• *Stated goal:* “Collaboratively evaluate BCDC’s fill policies in light of sea level rise and develop guidance for the Commission, staff and project proponents to promote shoreline resilience”
• Concerns were raised that BCDC laws and policies might impede resilience and adaptation efforts, especially natural shoreline protection approaches
• Final report issued in November 2016
• Ongoing implementation process
Climate Change, Water, and Cities: How Communities Can Adapt to Sea-Level Rise and Increased Flood Risk

Association of Environmental Professionals
California State Conference Session, May 19, 2017

Moderator:

Alan Murphy
Perkins Coie LLP

Panelists:

Diane Oshima
Port of San Francisco

Brian Strong
City and County of San Francisco

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