MEMORANDUM

March 17, 2016

TO: MEMBERS, PORT COMMISSION
Hon. Willie Adams, President
Hon. Kimberly Brandon, Vice President
Hon. Leslie Katz
Hon. Eleni Kounalakis
Hon. Doreen Woo Ho

FROM: Elaine Forbes
Interim Executive Director

SUBJECT: San Francisco Sea Level Rise Action Plan

DIRECTOR'S RECOMMENDATION: Informational Item – No Action Requested

EXECUTIVE SUMMARY

In early 2015, Mayor Lee established the Sea Level Rise Coordinating Committee ("SLR Coordinating Committee"), an interagency task force consisting of representatives from City departments whose assets would likely be impacted by sea level rise. This committee includes twelve City departments, including the Port, charged with collaborating to develop a coordinated response to addressing sea level rise. The Mayor's SLR Coordinating Committee developed the Sea Level Rise Action Plan ("Action Plan"), a call to action for City departments and stakeholders to work together to make San Francisco a more resilient city in the face of rising sea levels. The Sea Level Action Plan can be found on San Francisco Planning's website[1] and Public Works website[2]. The Executive Summary of the report is attached in Exhibit A.

This staff report summarizes the Sea Level Rise Action Plan and prior Port work to address sea level rise. Representatives of the San Francisco Planning Department and San Francisco Public Works will present the Sea Level Rise Action Plan at the March 22 Port Commission meeting and Planning Department staff will present the Action Plan at the March 23 Waterfront Plan Working Group.

This Print Covers Calendar Item No. 12A

[1] http://www.sf-planning.org/index.aspx?page=4439
[2] http://sfdpw.org/

STRATEGIC OBJECTIVE

City and Port participation in the Sea Level Rise Action Plan supports the Port Strategic Plan Renewal objective:

> "Work with City leadership to develop a resilience and adaptation strategy that… protects the Port and City from flood risk due to climate change and sea level rise."

MAYOR'S SEA LEVEL RISE ACTION PLAN

The Action Plan was developed under the direction of Mayor Edwin Lee and led by the San Francisco Planning Department and San Francisco Public Works. It defines an overarching vision and set of objectives for future sea level rise and coastal floodplain management in San Francisco. The Port's Chief Harbor Engineer Eunejune Kim represents the Port on the SLR Coordinating Committee. Exhibit A includes the Executive Summary of the Sea Level Rise Action Plan.

The Plan provides direction for City departments to understand and adapt to the impacts of sea level rise, and identifies what long-term sea level rise means for San Francisco's residents, visitors, economy and waterfront. The SLR Action Plan:

- Establishes an overarching vision, goals, and a set of guiding principles for sea level rise planning;
- Summarizes current climate science, relevant policies and regulations, and vulnerability and risk assessments conducted to date;
- Identifies data gaps and establishes a framework for further assessment, adaptation planning, and implementation; and
- Provides the foundation and guidance to develop a **Citywide Sea Level Rise Adaptation Plan**.

Definitions

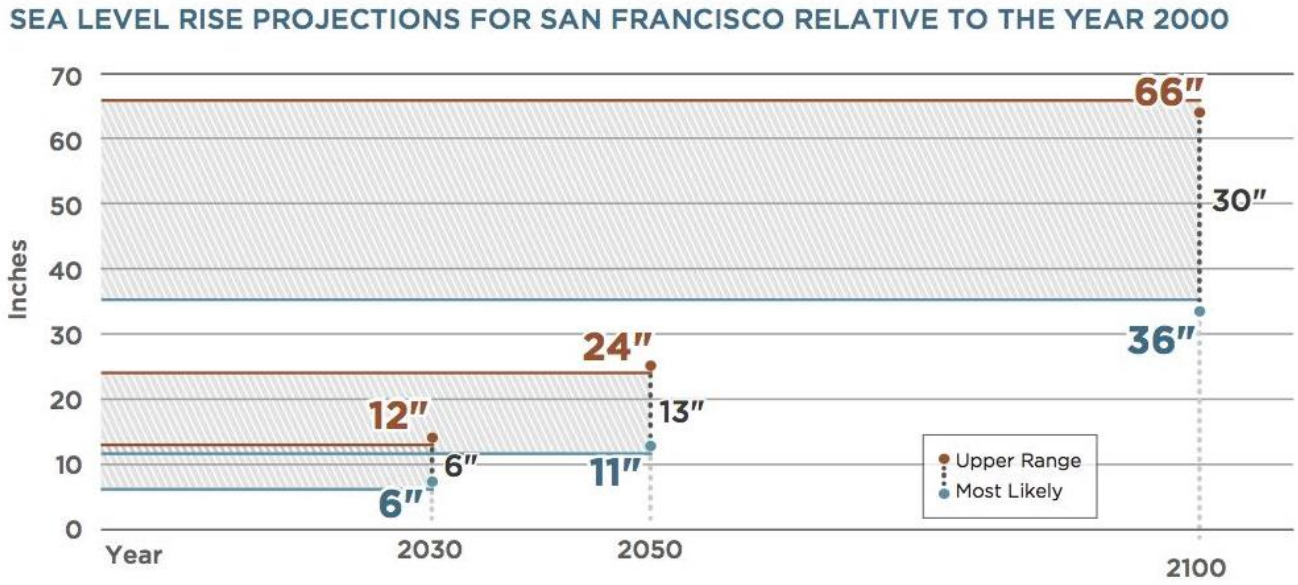
The discussion of sea level rise is complex. To help provide a foundation for this staff report and public discussions, the following terms and definitions are provided in Table 1 below.

Table 1: Definition of Terms	
Average High Tide or Mean Higher High Water (MHHW)	There are two high tides each day in San Francisco Bay. MHHW is the average of the higher high water over a 19 year period.
Average Low Tide or Mean Lower Low Water (MLLW)	There are two low tides each day in San Francisco Bay. MLLW is the average of the lower low water over a 19 year period.
North American Vertical Datum (NAVD 88)	NAVD 88 is the official vertical datum for the Conterminous United States and Alaska and is used as a reference point to measure elevations. Base Flood Elevation and projections of sea level rise are based on NAVD 88.
Base Flood Elevation (BFE)	Base Flood Elevation is the national standard used by the National Flood Insurance Program (NFIP) and all Federal agencies for the purposes of requiring the purchase of flood insurance and regulating new development. The flood having a one percent chance of being equaled or exceeded in any given year, also referred to as the "100-year flood", is a regulatory standard included in the computation of BFE. BFEs statistically account for tide (including King Tides), storm surge, wind waves and precipitation.
King Tide	This is a colloquial term that is used to describe a very high tide that occurs several times per year when the Earth, Moon and Sun are aligned, and the Moon is closest to Earth. In the Bay, this is generally a 7 ft tide, approximately 1 ft above MHHW.

Science of Sea Level Rise

The Action Plan includes a vulnerability analysis completed to date which includes inundation maps for the City's entire waterfront, including Port jurisdiction. Figure 1 shows the predicted ranges of sea level rise for 2050 of 12-24 inches and 2100 36-66 inches.

Figure 1: Range of Predicted Sea Level Rise through 2100



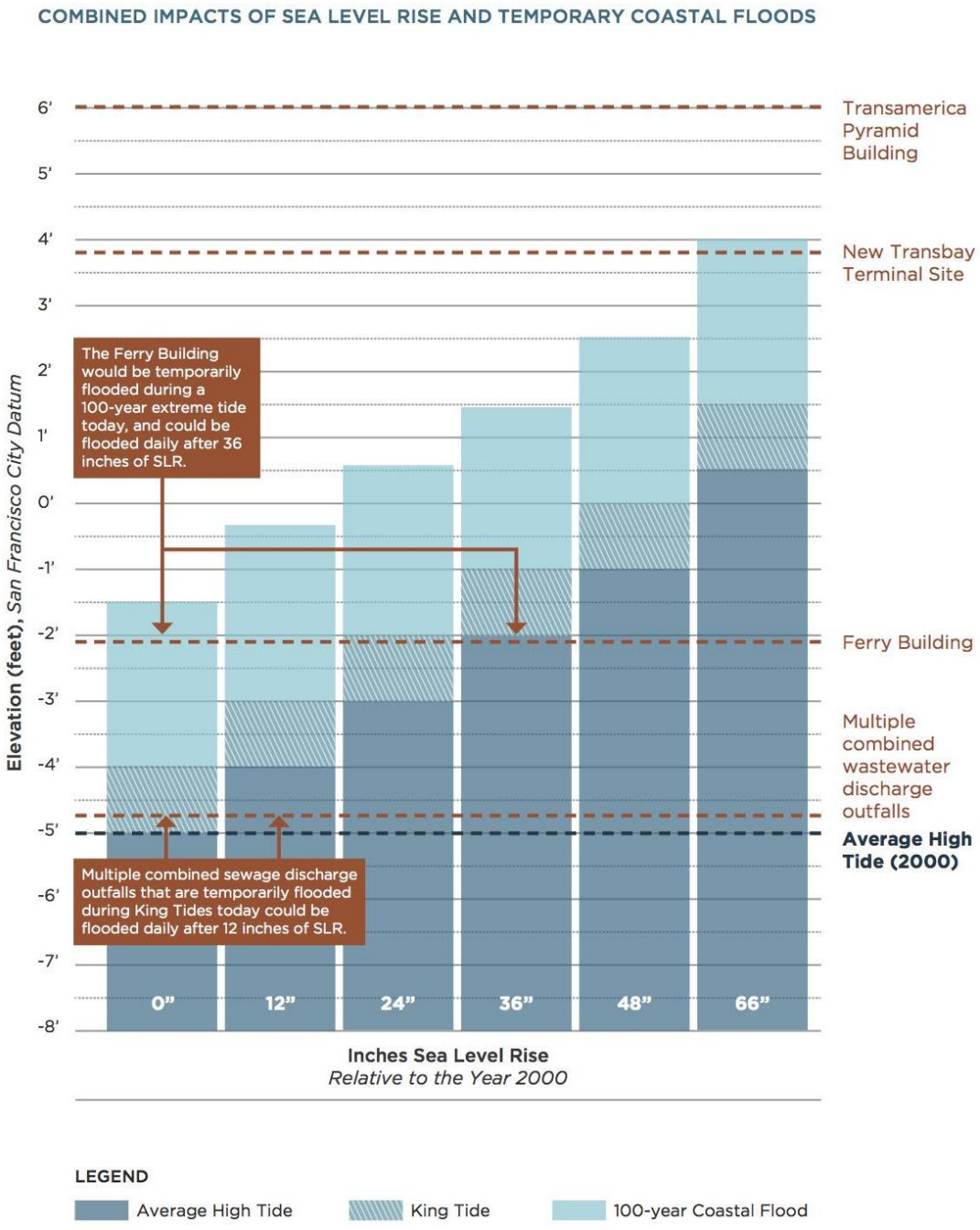
Source: NRC (2012). Lower range projections are excluded as they are not recommended for planning purposes.

NOTE: These SLR projections do not include extreme tides or coastal storms, which could add up to 42 inches of temporary flooding on top of rising sea levels, for a total of up to 108 inches above today's average high tide (*unlikely, but possible upper-range scenario*).

Some areas of Port property, such as Mission Creek, Islais Creek, Heron's Head Park and the Ferry Building area are at lower elevations than other areas[3], and are subject to potential flood risk in a base flood condition from a 100 Year Storm event today.

[3] The lower elevations of these areas are also reflected on the Federal Emergency Management Agency's preliminary *San Francisco Flood Insurance Rate Map*. See March 8 Port Commission Staff Report for Item 10A, which is available at the following link: http://www.sfport.com/meeting/san-francisco-port-commission-march-8-2016-supporting-documents-0

Figure 2: Combined Impacts of Sea Level Rise through 2100



All of Port property resides in the sea level rise vulnerability zone for the year 2100, shown in Figure 3. This map is a planning tool to illustrate the potential for inundation and flooding under future sea level rise and storm surge scenarios, if nothing is done to adapt or prepare for sea level rise over the next century.

Figure 3: Sea Level Rise Vulnerability Zone

NOTE: Zone represents upper range (unlikely, but possible), end-of-century projections for permanent SLR inundation (up to 66 inches) plus temporary flooding due to a 100-year extreme storm (up to 42 inches) for a total of 108 inches above today's average high tide.

Map Disclaimer: The inundation maps and the associated analyses are intended as planning level tools to illustrate the potential for inundation and coastal flooding under a variety of future sea level rise and storm surge scenarios. The maps depict possible future inundation that could occur if nothing is done to adapt or prepare for sea level rise over the next century. The maps do not represent the exact location of flooding. The maps relied on a 1-m digital elevation model created from LiDAR data collected in 2010 and 2011. Although care was taken to capture all relevant topographic features and coastal structures that may impact coastal inundation, it is possible that structures narrower than the 1-m horizontal map scale may not be fully represented. The maps are based on model outputs and do not account for all of the complex and dynamic San Francisco Bay processes or future conditions such as erosion, subsidence, future construction or shoreline protection upgrades, or other changes to San Francisco Bay or Open Coast. For more context about the maps and analyses, including a description of the data and methods used, please see the Climate Stressors and Impacts Report: Bayside Sea Level Rise Inundation Mapping Technical Memorandum, March 2014 and FEMA Open California Coast Sea Level Rise Pilot Study, San Francisco County, 2015.

Data Source: Bayside—SFPUC SSIP Inundation Mapping, 2015. Westside—FEMA Sea Level Rise Pilot Study, 2015.

Cost of Inaction

Over the coming decades, the impacts of sea level rise and the increasing frequency and intensity of storms mean that areas currently not subject to flood risk could begin to experience periodic coastal and/or urban flooding. The Action Plan provides a preliminary estimate that approximately $75 billion in assets will be vulnerable to inundation due to sea level rise and extreme storms by 2100 if the City does not prepare and implement adaptation plans. Figure 4 below shows the value of public assets in the 2100 vulnerability zone.

Figure 4: Value of City Assets at Risk

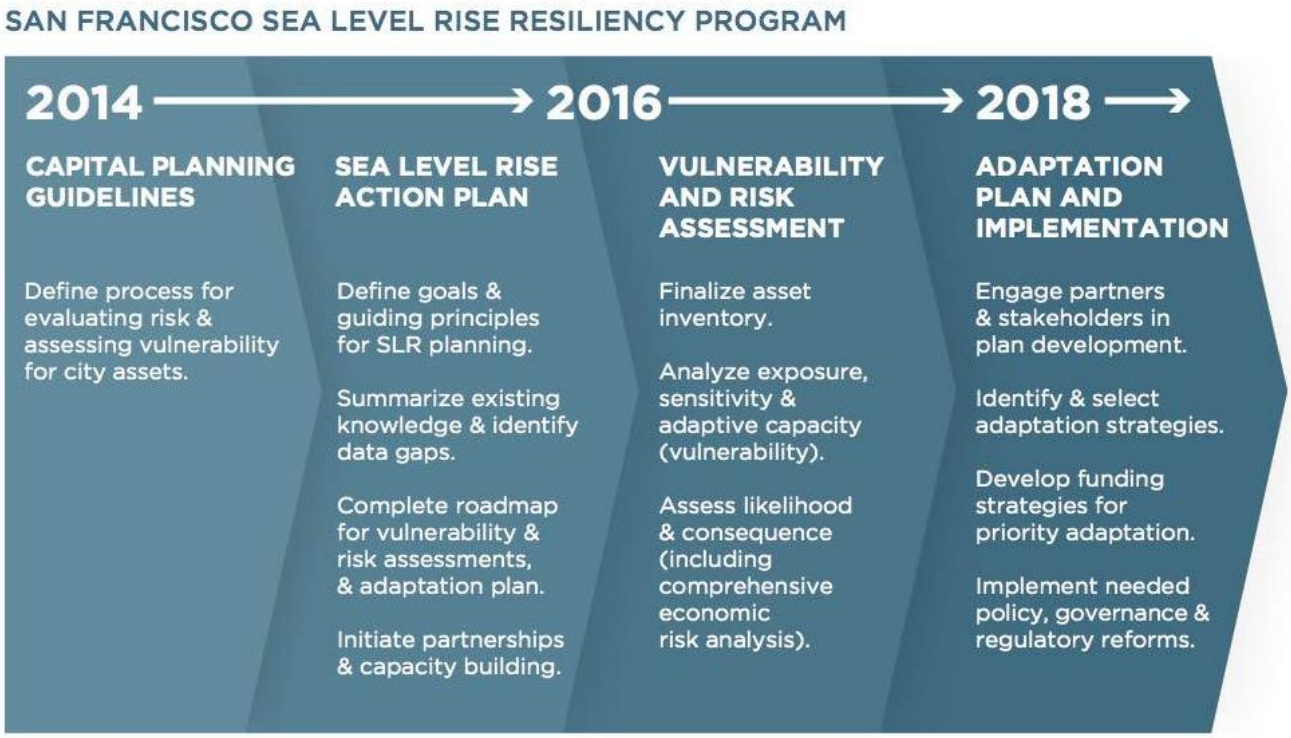
Public Sector Asset Value at Risk in San Francisco

	66" (SLR)	108" (66" SLR + 100-yr extreme tide)
Public Buildings	$1.5B	$2.3B
Port Building Facilities	$4.5B	$4.9B
San Francisco Airport	$25B	$25B
Northern Sea Wall	$2.5B	$2.5B
MUNI and Streets	$1.8B	$2.8B
TOTAL	**$35B**	**$37B**

Next Steps

The Action Plan sets forth guiding principles for adaptation planning and implementation, presented in the Executive Summary attached as Exhibit A. This is the first step towards the development of a Citywide Sea Level Rise Adaptation Plan, expected to be completed by summer 2018, which will incorporate the strategies identified in the Action Plan and set a planning framework to prioritize investments that can provide climate resilience, while protecting economic and environmental value.

Figure 5: City SLR Planning Steps



The SLR Coordinating Committee will work across the Bay Area to form strategic partnerships with local and regional stakeholders as collaborators to participate in the adaptation planning and implementation process. Part of the resiliency efforts are to promote an increased understanding of the shared responsibilities between public, private, and community interests throughout the region in adapting to sea level rise, and how a collaboration with a variety of stakeholders can provide the combined resources required to make necessary investments for the protection and adaptation of our coastlines. Strategic adaptation planning through partnerships with local and regional stakeholders will protect San Francisco's most vulnerable residents as climate conditions change.

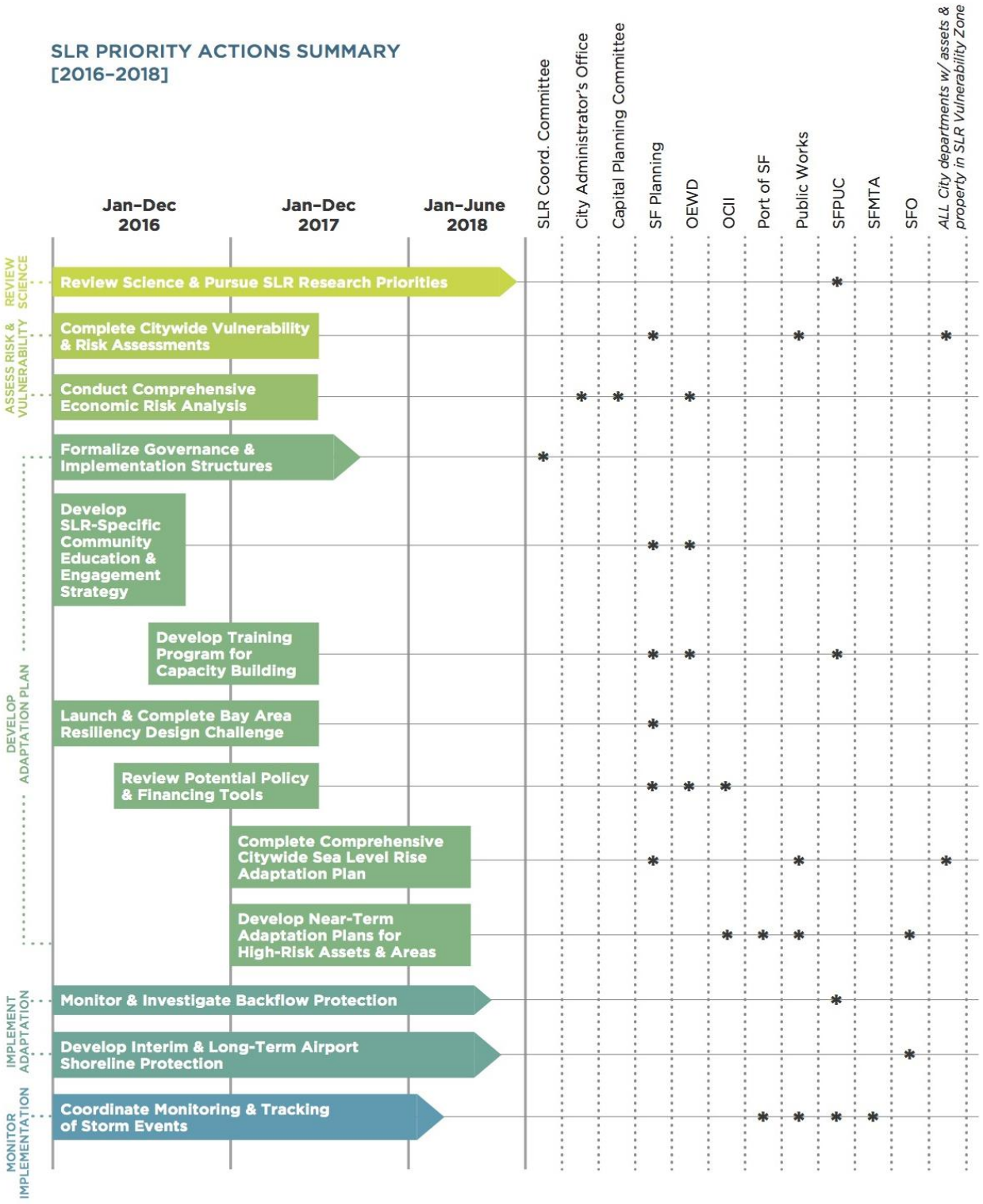
Given the complexity and significance of sea level rise and waterfront planning to the residents and businesses in San Francisco, the Action Plan places a high priority on a robust community engagement effort. San Francisco will coordinate and leverage existing citywide and local community engagement opportunities to increase the public's understanding of the potential effects of sea level rise on their homes and local businesses.

Table 2 below shows the roles and responsibilities of various City departments in the City's planned sea level rise response. The Port's primary roles will be developing near-term adaptation strategies for high risk assets and low-lying areas of the waterfront, including the Seawall and the finger piers and monitoring and tracking storm events. Port staff will engage these issues with Port tenants and the Waterfront Plan Working Group.

As it has in the past, the Port will utilize its capital planning process and, in consultation with other City departments, design projects such as the Northern Waterfront Seawall seismic project to address low-lying areas that are projected to provide points of entry for flooding. Port staff is consulting with the U.S. Army Corps of Engineers to examine federal funding options for a flood protection feasibility study which considers SLR.

The Planning Department and San Francisco Public Works will lead development of the Citywide Sea Level Rise Adaptation Plan. Through its participation in the SLR Coordinating Committee, the Port will participate with other City departments in the development of this plan.

Table 2: City Department Sea Level Rise Roles



PRIOR PORT SEA LEVEL RISE PLANNING EFFORTS

Port staff has been analyzing and incorporating projected sea level rise ("SLR") into Port project planning since 2009. This section of this staff report briefly summarizes those efforts for the benefit of the Port Commission and the public.

Sea Level Rise and Adaptation Study (2012)

In January, 2012, under the direction of Port Engineering, a joint venture of URS and AGS published a study which analyzed available literature and studies related to sea level rise and performed coastal engineering analysis of the Port's Northern Waterfront. The study used the following approach:

- Review scientific literature to compare and contrast different SLR projections, including methods used to project future levels.

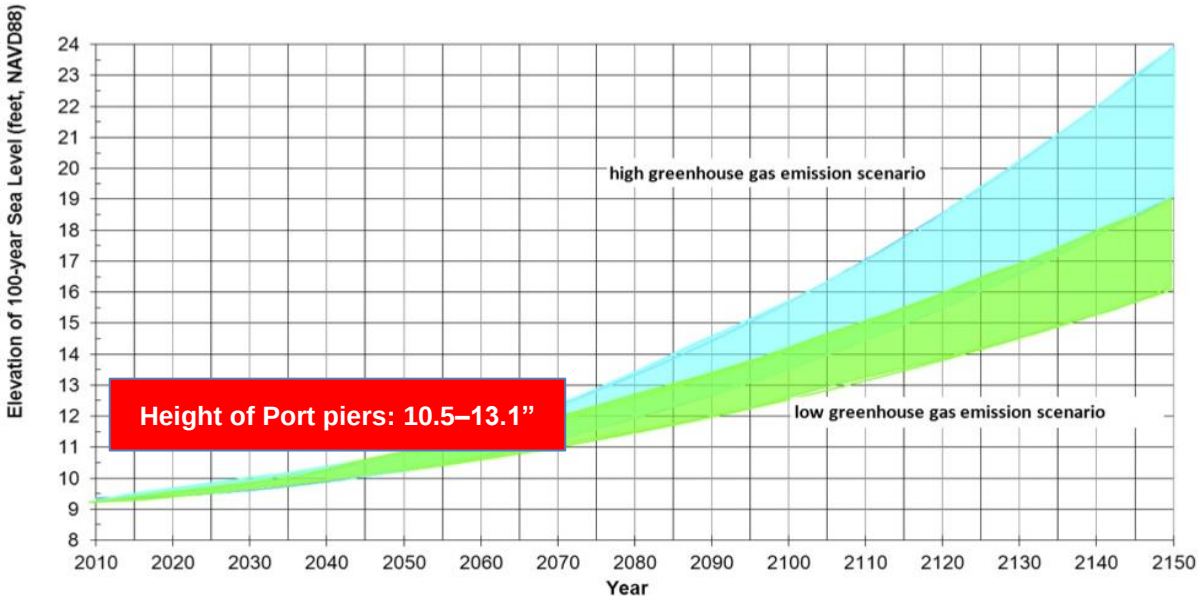
- Review SLR policy documents to identify how current policies compare and contrast different SLR projections and to understand the scientific basis underlying each policy.

- Summarize the results with the strongest support within the scientific and policy documents for SLR through the years 2050 and 2100.

The joint venture performed a detailed coastal engineering analysis to develop projected total water levels (assuming storm surge and wind waves in a 100 Year Storm Event at high tide) at twenty locations along the Port's Northern Waterfront, as shown in Exhibit A.

At the time, the scientific consensus pointed to +/-15" of SLR by 2050 and +/-55" of SLR by 2100 (these SLR estimates have been replaced by the ranges shown in Figure 1 of this report). Based on this assumption, the report produced estimates of total water levels under high and low carbon emissions scenarios (which also informs the range of SLR projections in the City's Action Plan), as shown in Figure 5 below:

Figure 5: URS/AGS Joint Venture 2012
Projected Water Surface Levels at the Port of San Francisco



Mission Creek Study (2014, pending publication)

In consultation with the San Francisco Bay Conservation and Development Commission ("BCDC"), the Port and other City departments including the Planning Department, San Francisco Public Works, the San Francisco Public Utilities Commission, the Office of Community Investment and Infrastructure, the Capital Planning Committee (under the City Administrator), teamed with the Dutch government to study one of the lowest lying areas on Port property: Mission Creek.

Utilizing grant funding from the Dutch government and funds from participating City departments, the Project seeks to build the capacity of San Francisco to address the risks of flooding from sea level rise and storms by developing adaptation alternatives for the Mission Creek area and continuing the exchange of knowledge and information between the Netherlands and California.

The four main Project objectives are:

1. Develop sea level rise and storm water adaptation alternatives for the Mission Creek area portion of the City's waterfront based on the findings of a high-level vulnerability assessment;

2. Apply the lessons learned from BCDC's Adapting to Rising Tides (ART) project in Alameda County to the Project area;

3. Further develop and refine adaptation methods to incorporate equity, finance and governance in the selected adaptation methodologies; and

4. Exchange knowledge and best practices on climate adaptation between the Netherlands and California.

This project is a conceptual design analysis to illustrate different forms of possible adaptation responses, issues, tradeoffs and regulatory considerations to inform city and regional SLR planning discussions. The project report is expected to be issued in Spring of 2016.

Port Capital and Development Projects

Exhibit C to this staff report includes a description of SLR adaptation strategies in past and planned Port projects. Table 3 below summarizes the adaptation approaches for these projects, which have evolved over time in response to best available estimates of sea level rise.

Table 3: Past and Planned Port Project SLR Adaptation Strategies

Bayfront Park	Raise shoreline with rip rap edge to adapt to 16" of sea level rise
Brannan Street Wharf	No wave overtopping w/16" of sea level rise; design deck supporting park for wave and current forces for 66" of sea level rise w/adaptive capacity
Downtown Ferry Terminal	Elevate to 14.5' NAVD 88 to address sea level rise through 2065 (50 year design life) with adaptive capacity through 2100
Crane Cove Park	Redesigned shoreline to accommodate 28" of sea level rise with occasional flooding through 2065
Pier 1	Pier deck elevation remains the same; tenant assumes responsibility for flood safety including interventions including raising utilities and short flood walls.
Pier 70 Waterfront Site	Raise site to accommodate 66" of sea level rise; Bay Trail will flood earlier. Includes adaptive management funding measures.
Seawall Lot 337	Raise building pads and streets to accommodate 55" of sea level rise plus 100 Year Flood, with grading down to existing elevations along 3rd Street and Terry Francois Boulevard. Examine near term improvements to Pier 48 and adaptation strategies

Northern Waterfront Seawall Project

The Northern Waterfront Seawall, or Seawall, was built over 100 years ago to transform three miles of shallow tide lands into a world class maritime waterfront. Constructed hundreds of feet Bayward of the natural shoreline, today the seawall protects and stabilizes the historic waterfront and hundreds of acres of made land stretching continuously from Fisherman's Wharf to Mission Creek. Within this area are significant Port and City assets including the Embarcadero Historic District piers and bulkhead buildings, Ferry Building, Embarcadero Promenade and roadway, ferry & cruise Terminals, BART Transbay Tube, MUNI light rail, and key sewer and utility infrastructure.

The Port has begun a project to ensure the Seawall is prepared for the next big earthquake and can do its part to support essential Port, City and regional lifelines necessary for disaster recovery. As a first step, a screening level engineering study is

being completed to assess earthquake vulnerability, predict damage and economic impacts from a range of earthquake scenarios, develop conceptual mitigation alternatives, and make recommendations for further action and/or study. This study also has identified locations of lower elevations that are vulnerable to possible flooding in the near-term. The information is vital for the Port's Strategic Plan and for informing Port and City efforts to improve our resilience to earthquake, climate change and sea level rise hazards. The study is expected to be released in draft form this April.

Waterfront Plan Update

SLR is a major topic of discussion with the Waterfront Plan Working Group (Working Group) as part of the public process underway for the Waterfront Plan Update project. The Waterfront Land Use Plan was developed before there was a broad public awareness of SLR, and currently does not include policies related to SLR. Staff also formed a Resiliency Advisory Team of experts to support the Working Group, to provide further examination of the implication of SLR and seismic risk to the Port.

Port staff is collaborating with Planning Department and BCDC staff to develop a series of presentations related to flood risk and SLR planning efforts, including the Mayor's SLR Action Plan, to the **Waterfront Plan Working Group scheduled for March 23, 2016 from 6-8 PM in the Port's Bayside Conference Room**.

SLR has potential implications for long-term use of Port finger piers and may have additional land use implications. The typical elevation of the finger piers is around 12 feet above low tide (MHHW). It is an elevation that has worked well, balancing the needs of ship berthing, under pier maintenance, and preventing top side flooding. FEMA's latest modeling of the Bay is now showing that some finger piers are vulnerable to limited overtopping under today's 100-year flood, and that most are very close. Although the Piers have never overtopped, sea level rise will certainly change that situation by increasing the flood risk, limiting the under pier maintenance windows, and eventually making overtopping a frequent occurrence. Port Engineering believes that, with minor modifications, most piers can remain useful for at least 11 inches of sea level rise. Potential adaptation measures include moving utilities topside, installing deployable flood barriers for shed and building doorways, adding solid sections to railings, and closing pier aprons and piers for short periods of time during flood events. Staff notes that The Embarcadero Promenade and roadway will also experience wave-overtopping which could limit pier access and also require interventions, while long-term adaptation plan strategies are being developed. Port staff welcomes the efforts of the Planning Department and San Francisco Public Works to lead the Citywide Sea Level Rise Adaptation Plan. A better understanding of the various options the City may employ to address long-term flood protection in the northern and central waterfront will inform the Port's decisions about uses of the waterfront and how to approach the Port's historic piers.

ONGOING REGIONAL EFFORTS

There are a multitude of ongoing efforts both regionally and locally to identify and address sea level rise.

BCDC Policies for a Rising Bay Steering Committee

Port staff participates in this BCDC planning effort to examine BCDC's San Francisco Bay policies in the context of flood protection projects that may be required to address SLR. BCDC convened this grant-funded project to address concern that BCDC policies may hinder projects that improve shoreline resilience to sea level rise. The Policies for a Rising Bay project is taking a close look at BCDC policies to understand if and how current policy interpretation can evolve to meet the new challenge of sea level rise. The intent of the McAteer-Petris Act and the Bay Plan was on preventing the Bay from getting smaller; this inquiry is examining whether the existing BCDC policy framework is appropriate for a scenario where the Bay will likely get larger.

CHAARG

Port staff also participates in CHARG, or Coastal Hazards Adaptation Resiliency Group, a forum at which local, regional, state, and federal scientists, engineers, planners, and policy makers can develop a common understanding about regional coastal hazards issues. These experts are uniquely qualified to explore solutions and advocate for changes needed to implement those solutions.

CHARG is working collectively to increase the resiliency of San Francisco Bay Area communities by adopting a regional approach to address coastal hazards, and to reduce the long-term risk to human life and property from flooding and other hazards caused by sea level rise and extreme tides.

NEXT STEPS

Port staff will continue to engage the Waterfront Plan Working Group and the Resiliency Advisory Team in a discussion about SLR as it pertains to the Port and its finger piers. As requested by the Port Commission, staff will also examine the implication of SLR for long-term projects exposed to future flood risk.

Staff will also continue to participate in the BCDC Policies for a Rising Bay Steering Committee, CHAARG, and the Mayor's SLR Coordinating Committee to develop adaptation planning and implementation as a continuous, iterative process that includes the following steps:

1. Review latest science
2. Assess vulnerability and risk
3. Develop adaptation plan(s)
4. Implement adaptation
5. Monitor implementation

Prepared by: Brad Benson, Director of Special Projects
Eunejune Kim, Chief Harbor Engineer

for: Elaine Forbes, Interim Port Director

Exhibit A: Mayor's SLR Action Plan Executive Summary

Exhibit B: URS/ARG Joint Study Coastal Engineering Analysis Locations in the Port's Northern Waterfront

Exhibit C: Past and Planned Port Projects Approach to SLR Adaptation

Exhibit A: Mayor’s SLR Action Plan Executive Summary

Exhibit B: URS/ARG Joint Study Coastal Engineering Analysis Locations in the Port's Northern Waterfront

Figure 4-4. Locations where total water level was calculated

Exhibit C: Past and Planned Port Project SLR Adaptation Strategies

Bayfront Park Shoreline Restoration (2009)

In 2009, the Port began design of the Mission Bay Bayfront Park shoreline restoration project. This project was funded form the City's 2008 Clean and Safe Neighborhoods Parks and Open Space General Obligation Bond. The Project improved and stabilized approximately 1200 linear feet of bay shore and slope from the Pier 54 to Agua Vista Park. The project included demolition and excavation of debris and shoreline structures. In addition, the existing seawall was stabilized. The revetment and seawall stabilization resulted in a long-term stable shoreline for protection of the future Bayfront Park. The crest elevation of the structure was set to accommodate BCDC's then anticipated sea level rise for 50 years (16" of SLR by 2050 then suggested by BCDC) plus 2 inches.

Brannan Street Wharf (2013)

The Brannan Street Wharf is a major new public open space located over the Bay and along The Embarcadero between Pier 30/32 and Pier 38. The Project was designed in 2011 and opened to the public in 2013 at a total cost of approximately $26 million. The Project demolished existing pier and wharf structures along 1,000 feet of shoreline, modified the bulkhead wall, and constructed 64,000 square-feet of new pile supported wharf. The design life for the wharf structure is 75 years, and the design life for the park improvements is 35 years. Consideration of SLR was a key component of the design.

At the time, the Port and City had not yet developed a unified SLR strategy, but the Port had begun considering SLR on a project by project basis using CA state guidance of as much as 16 inches of SLR by 2050 and 55 inches by 2100. The SLR strategy selected for the Brannan Street Wharf considered a balance between the functional aspects of the existing waterfront and the project specific function and adaptive capacity goals during project life. Specific SLR strategy measures include:

- Preventing overtopping by the 100-Year Flood with 16 inches of SLR by tilting the wharf up toward the Bay and providing a solid base to the edge railing (increased flood protection);

- Designing the wharf structure for wave and current forces assuming 66 inches of SLR (adaptive capacity for design life of the structure);

- Using finishes that perform well in occasional salt water flooding (living with occasional flooding); and

- Raising the salt intolerant lawn and planted areas by an additional 18 inches (living with occasional flooding).

Downtown Ferry Terminal (2016 Construction)

To meet the growing demand for ferry service in San Francisco Bay, in 2012 the Water Emergency Transportation Authority (WETA) prepared a Master Plan for expansion of the Downtown Ferry Terminal. The Master Plan provides for one additional gate in the Basin north of the Ferry Building, Gate A, and two additional gates in the Ferry Building South Basin, Gates F and G. The Master Plan when fully implemented would make significant changes to the Ferry Building area through the following:

- Removal of dilapidated pier and wharf areas not needed for ferry operations or public access;

- Construct new pile supported areas that provides passenger access to the gates, public access, and can accommodate high passenger volumes for emergency service;

- Passenger amenities and public access improvements including weather protection in the South Basin; and

- Pier improvements that accommodate sea level rise and possible rehabilitation of the Agriculture Building by the Port.

WETA is currently advancing construction of the South Basin Ferry Terminal Project, and will consider construction of Gate A at a future point in time. The South Basin Project is located between Ferry Pier and Pier 14, wraps around the north and east sides of the Agriculture Building, and meets the seawall along the Embarcadero. The South Basin Ferry Terminal Project repositions Gate E and adds two new gates, F and G.

The ferry facilities and access areas are designed for the anticipated sea level rise for the project's 50-year life. The finish floor of the Ferry Building is at an elevation of about 11.5 ft. (NAVD 88), and the current queuing area for Gate E is at an elevation of about 11.8 ft. Ferry Gates E, F and G and a new plaza which would be used for queuing large numbers of people in an emergency are all being designed at an elevation of 14.5 ft. NAVD 88 to meet the 50-year life of the facility, with consideration for how the elevation could be raised to meet SLR in 2100. The project also anticipates the Port's possible renovation of the Agriculture Building and raising it to an elevation of 15 or 15.5 by providing necessary space around the Building for ramps to the Embarcadero and direct connection to the ferry facilities.

Crane Cove Park (Construction 2016-2017)

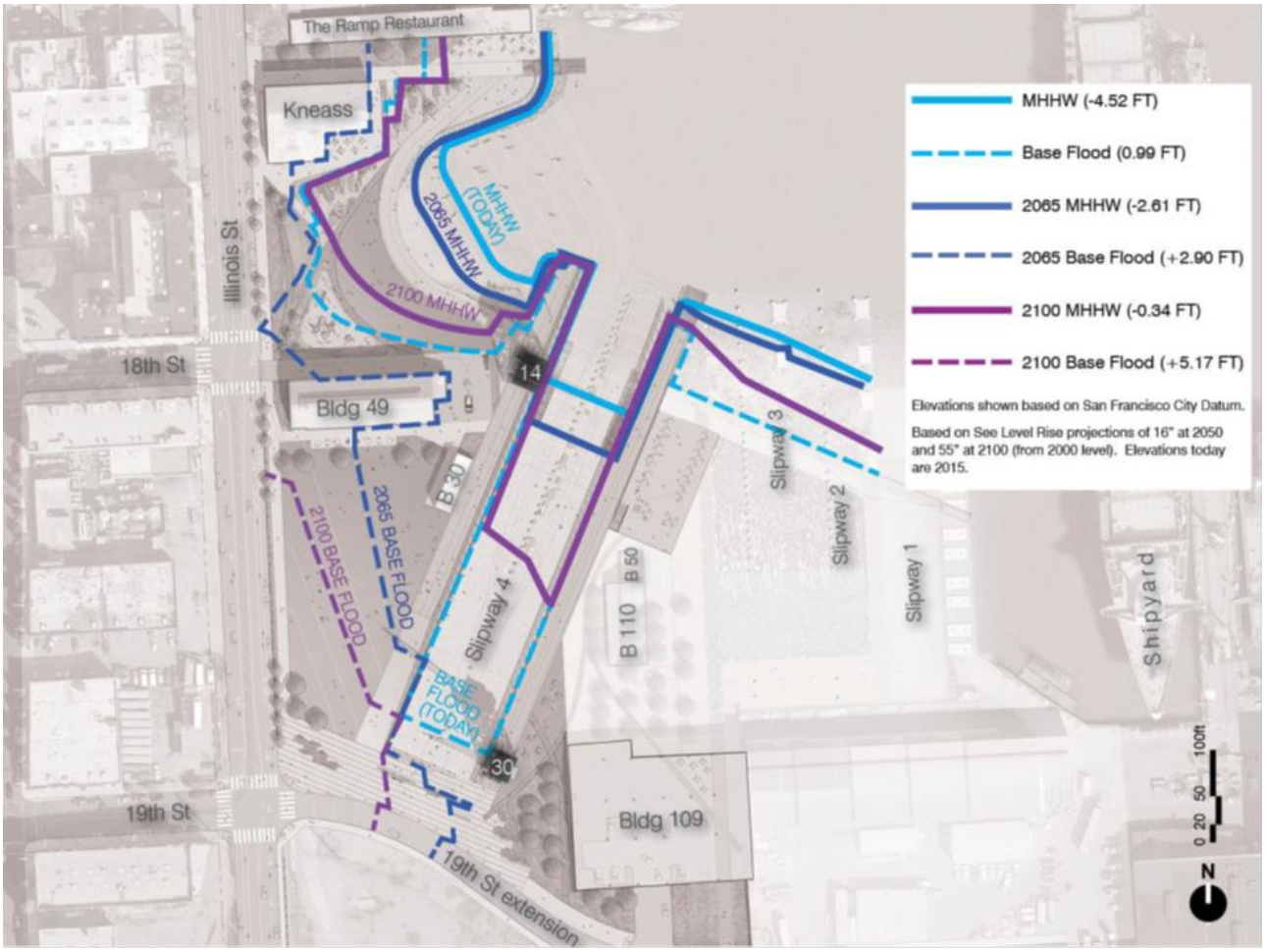
Phase 1 of Crane Cove Park at Pier 70, scheduled to start construction in 2016, is a planned 9 acre park located within the Port's Pier 70 Area. The park boundaries are generally between Mariposa Street on the north, Illinois Street on the west, a future 19th street on the south and the Bay on the east. The completed park will include a variety of landscape and plaza areas, 1,000 feet of Bay shoreline open to the public, adaptive

reuse of historic resources, including slipway 4 and the cranes, and views of the dry dock, city skyline and Bay.

Portions of the existing shoreline at the site are below the current 100-year flood. Assuming a 50 year design life, Crane Cove Park has been designed to accommodate up to 28” of sea level rise with periodic flooding in some areas as follows:

- Protect roadway, sidewalks, and buildings against 100-year flood plus 28 inches of SLR;
- Design the primary path of travel to be above King Tides plus 28 inches of SLR;
- Design the main lawn and primary landscaping to be above the level of the primary path of travel;
- Design the beach area so it can remain functional in all predicted tide events with up to 28 inches of SLR.

Figure 6: Crane Cove Park Sea Level Rise Considerations



Pier 1 Lease Extension (2016, Pending Board of Supervisors Consideration)

The Port and AMB Pier One LLC, a wholly owned subsidiary of Prologis, Inc. negotiated a 15 year lease extension option for L-12838 for Pier 1 (through 2065), which is also home to Port headquarters. The new lease terms address SLR as follows:

L-12838 Pier Flood Protection Measures

In addition to Tenant's obligations in the Lease to comply with Laws and to repair and maintain the Premises, (including, but not limited to, the Bulkhead and Substructure, pier, pier apron, the Public Access Area and all other Improvements) if, at any time during the term of the Lease, and subject to compliance with the California Environmental Quality Act ("CEQA"), the Chief Harbor Engineer (CHE) determines in his or her regulatory capacity in accordance with applicable Laws that there is a need to institute Flood Protection Measures at the Premises or proximate to the Premises to protect the Premises from a significant risk of flooding or other damage resulting from climate change or sea level rise, in order to protect public health and safety ("CHE Determination"), Tenant shall be responsible at no cost to Port, for permitting, constructing and implementing any such Pier Flood Protection Measures. Tenant may be eligible for Core and Shell Improvements during the Extension Term as deductions in the determination of net income for the purposes of calculating participation rent, but otherwise no other compensation or consideration for any Pier Flood Protection Measures will be provided including any additional lease term. Pier Flood Protection Measures may include, without limitation: (1) temporary public access closures, sandbagging or similar temporary measures to minimize the risks associated with wave overtopping of the pier apron; (2) waterproofing or relocation of utility infrastructure from underneath the pier to minimize the risk of water or wastewater discharges to San Francisco Bay; and/or (3) short perimeter flood walls.

At any time during the Term or the Extension Term, Port or Tenant may propose improvements, at Tenant's cost, that (i) are not within the scope of the potential Pier Flood Protection Measures, such as raising first floor elevations or rebuilding pier structure or Substructure elements to address sea level rise; and (ii) are not otherwise Tenant's obligation under the Master Lease, in order to preserve or enhance the value or useful life of the Premises. If Port approves such improvements and the improvements cannot be amortized over the remaining original term and subject to Port's consent in its reasonable discretion, then, Tenant may exercise its Extension Option at the time of Port's approval prior to 2045 and which shall not exceed the extension option period of 15 years (2064). Additional permitting and approvals may be required, as well as possible additional environmental review.

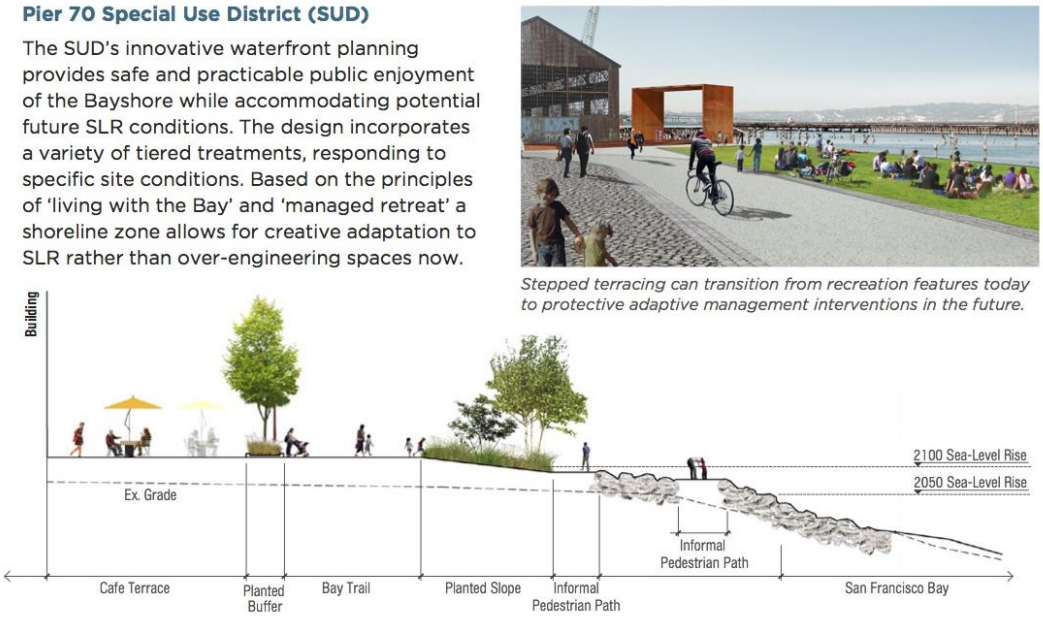
Pier 70 (2017 Project Approval)

Based on sea level rise adaptation criteria for the mixed use development project proposed by Forest City Development California, Inc. for the Pier 70 Waterfront Site, this project includes plans to use excavated soils from within the project site to regrade the site to accommodate projected SLR for 2100:[4]

- Elevate new buildings to accommodate a minimum of 5.5 feet of SLR above the present day 100-year still water level;
- Elevate historic buildings, or grade down to existing historic building elevations (a possible approach for Building 12);
- Raise the Bay Trail within the project site an elevation of +4 SF Datum, which would allow for over 2 feet of sea level rise plus future total water levels (6 feet above the 100-year still water level); and
- Design the zone between elevation +4 SF Datum and the water's edge to provide safe public access to the water in the near term (for the next 20 to 30 years) and allow for adaptive management over the longer term.

Figure 6 shows SLR design approaches for the Pier 70 Waterfront Site. The City anticipates the possible use pf infrastructure financing district proceeds and/or community facilities district special taxes (or both) to fund future adaptive management strategies at the project site or elsewhere along Port property.

Figure 6: Pier 70 Waterfront Site Adaptation Strategy



[4] Moffat and Nichol, "Pier 70 Development, Preliminary Shoreline Improvements Report, San Francisco, California," Draft, August 2015.

Mission Rock (Seawall Lot 337, 2017 project approval)

Based on SLR adaptation criteria for the Seawall Lot 337 waterfront site (bounded by 3rd Street to the West, Mission Rock Street to the South and Terry Francois Blvd. to the East/currently North), the Port's Mission Rock master developer (Seawall Lot 337 Associates, an affiliate of the San Francisco Giants) currently contemplates raising interior project streets and building pads by constructing pile-supported streets to accommodate 55" of projected SLR.

The approach includes the following strategies:

- Elevate the core of the site, and building finish floor elevations (FFE) and construct pile-supported streets to accommodate 55" of SLR plus the 100-year FEMA base flood elevation;

- Pier 48 will remain at current elevations but interior improvements are being evaluated to extend useful life and accommodate some sea level rise;

- Meet existing grade at historic building elevations at Piers 48 and 50 and at Terry Francois Boulevard, 3rd Street, and Mission Rock St, and examine future adaptive strategies;

- Raise the Bay Trail within China Basin Park to accommodate 55" of sea level rise plus king tide event water levels (with occasional flooding in base flood conditions)

- Grade China Basin Park to transition between the raised site design and the existing grade at 3rd Street, Pier 48, and the shoreline.

Figure 7 shows SLR design approaches for Mission Rock. As reflected in the endorsed Term Sheet for the project, the City anticipates the possible use of infrastructure financing district proceeds or community facilities district special taxes (or both) to fund future adaptive management strategies at the project site or elsewhere along Port property.

Figure 7: Seawall Lot 337 SLR Strategy