MEMORANDUM

October 23, 2020

TO: MEMBERS, PORT COMMISSION
Hon. Kimberly Brandon, President
Hon. Willie Adams, Vice President
Hon. John Burton
Hon. Gail Gilman
Hon. Doreen Woo Ho

FROM: Elaine Forbes
Executive Director

SUBJECT: Informational presentation regarding the U.S. Army Corps of Engineers Flood Resiliency Study – Focused Array of Alternatives

DIRECTOR'S RECOMMENDATION: Information Only – No Action Required

Introduction and Background

The San Francisco Waterfront Flood Resiliency Study is a joint undertaking being conducted in partnership by the Port and the US Army Corps of Engineers (USACE) under the Port's Waterfront Resilience Program. The Waterfront Resilience Program is focused on reducing seismic and flood risks to ensure a resilient and thriving Port and City. The Waterfront Resilience Program consists of several efforts including the Embarcadero Seawall Program, Southern Waterfront Seismic Vulnerability Assessment, Islais Creek Adaptation Strategy, and the subject of this Staff Report, the USACE/Port Waterfront Flood Resiliency Study.

The Port and USACE are leading the San Francisco Waterfront Flood Resiliency Study (Flood Resiliency Study or Study) to assess and develop plans to mitigate flood risk along San Francisco's bayside shoreline. The purpose of the Study is to identify, evaluate and recommend appropriate, coordinated, implementable *Flood Risk Mitigation* alternatives for the area from Aquatic Park to Heron's Head Park, comprising approximately 7½ miles of a dense urban areas along the San Francisco Bay. The Project Delivery Team (PDT) includes USACE San Francisco District staff, USACE staff from other Districts and Port staff, and includes participation from City departments as relevant.

On May 12, 2020, staff made an informational presentation to the Port Commission regarding the Flood Resiliency Study an upcoming request for authorization to amend the Feasibility Cost Sharing Agreement (FCSA) with the USACE San Francisco District dated September 5, 2018 for the Flood Resiliency Study. On May 26, 2020, the Port Commission authorized amendments to the FCSA.

The Flood Resiliency Study will inform a federal investment decision based on a benefit cost ratio, and other non-cost factors such as regional benefits, environmental quality, and other social effects. If the study identifies a *Federal Interest* in a project – measured a benefit cost ratio of at least 1:1, the PDT will produce a General Investigation Integrated Feasibility and National Environmental Policy Act (NEPA) report to the Chief of Engineers. The Chief of Engineers will deliver a Final Integrated Feasibility Report to Congress. If approved by Congress, the federal government will pay for and construct a project, subject to a 35% local matching fund requirement.

The purpose of this report and the October 27, 2020 meeting is to update the Port Commission on the Flood Resiliency Study and to identify key considerations for Port Commission input into the alternatives development process and the *Focused Array*. As this is an iterative process, the *Final Array* of Flood Risk Mitigation alternatives will be subject to public review and input and policy direction from the Port Commission, before identifying the Flood Resiliency Study's *National Economic Development Plan (NED)*, *Locally Preferred Plan (LPP),* one of which will become the *Tentatively Selected Plan*. The *Tentatively Selected Plan* is the subject of the USACE Feasibility Report and the NEPA evaluation. These steps and plans are further described in this report.

Flood Resiliency Study Process

The process to prepare a General Investigation Integrated Feasibility and NEPA report includes several steps to identify a potential Federal Interest, develop an array of alternatives, identify a Tentatively Selected Plan and conduct an analysis under NEPA.

During early steps in the process, the PDT worked with stakeholders to identify the overall study area and sub-areas, develop draft Problems, Opportunities, Objectives, Constraints, and Considerations (POOCCs) and work on a *Future Without Project* (FWOP) scenario. The FWOP examines flood damages over the study period, which is from 2040 through 2090. USACE regulations require an economic analysis of a future without any flood risk mitigation being implemented as part of the study. The PDT conducts the economic analysis on this future with no action to determine the cost of potential damages under different flooding conditions using five selected Sea Level Rise curves. For the Flood Resiliency Study, the PDT selected five sea level rise curves to use in the analysis of the future without project–the USACE standard three curves (low, intermediate and high) and two State of California sea level rise guidance curves representing the most likely scenario and the medium to high risk scenario. The State of California recommends the medium to high risk sea level rise scenario be used in heavily urbanized areas containing a critical and high consequence assets and services. During this analysis, the PDT identifies flood damages in four different categories referred to as accounts meant to consider economic, regional, social and environmental issues, described below.

The PDT uses an iterative, multi-step approach to alternatives formulation, informed by technical studies, the POOCS, agency and public input, and alternative evaluation and comparison. At each successive milestone, alternatives become more detailed and more complete.

The process progresses from the *Initial Array* to the *Focused Array* to the *Final Array*. From the *Final Array* two program alternatives are identified, referred to as the *National Economic Development Plan* and the *Locally Preferred Plan*. At each iteration of planning, the PDT works to ensure input from a broad range of stakeholders including City departments, regional agencies, resource and regulatory agencies, the public, advisory groups and other interested parties. This engagement and participation refines and revises the alternatives for the next

iteration. In addition to this engagement, Port staff is working closely across divisions to ensure that alternatives take Port strategic goals and mission into account. Port staff and the PDT will receive policy direction from the Port Commission on the *Focused Array* at this meeting and the *Final Array* in several months. This work will contribute to the *National Economic Development Plan* and the *Locally Preferred Plan,* both of which will received robust input, including another round of policy input from the Port Commission, resulting in the selection of *Tentatively Selected Plan*, which will be further developed in the feasibility study and be reviewed under NEPA.

Portions of the Study are currently undergoing Agency Technical Review to work though technical issues related to the economic, hydrology, hydraulics, and coastal analyses.

Flood Resiliency Study Milestones

The USACE planning process includes several key planning milestones, designed to develop, evaluate, refine, and narrow the alternatives under consideration. The Study milestones established in early 2020 are described in Table 1. The PDT is currently working on the WOP and *Focused Array* milestones. The Agency Technical Review, which will resolve technical issues that have been raised in the study, will result in modified scope and schedule. The PDT will develop a modified scope and schedule, which Port staff will present to the Port Commission in 2021

Table 1
Flood Resiliency Study Milestones

Flood Study Milestone	Explanation	Timing
Future without Project (No Action)	Analysis of flood risks and consequences to the Port and City without a Federal project during the period from 2040 to 2090	Winter 2020, input from targeted Agency Technical Review needed
NEPA early scoping	Early public input for alternatives development and NEPA analysis	October 2020
Agency Technical Review	Targeted Agency Technical Review for technical input	October 2020
Focused Array	The first detailed set of flood mitigation options for public and policymaker review	To be determined, based on outcomes of targeted Agency Technical Review
Final Array	The final detailed set of flood mitigation options for the public and policymakers to review	To be determined, based on outcomes of targeted Agency Technical Review
Notice of Intent – NEPA	Start of Federal environmental review	April 2021
Establishment of: National Economic Development (NED) Plan and Locally Preferred Plan (LPP)	The NED is the plan that maximizes the net economic benefits within the Federal interest that meets study objectives. The LPP is the Non-Federal Sponsor's plan that meets study objectives. The NED and LPP are identified concurrently	July 2021

Table 1 Flood Resiliency Study Milestones		
Flood Study Milestone	**Explanation**	**Timing**
Tentatively Selected Plan	The Tentatively Selected Plan is either the NED or the LPP, as agreed by USACE and the Non-Federal Sponsor	January 2022
Draft NEPA document	Publication of NEPA document for public review	March 2022
Agency Decision Milestone	USACE endorsement of TSP following public, technical, legal, and policy review of the integrated draft report and NEPA document	July 2022
Draft Feasibility Report and Environmental Impact Statement	Federal environmental review is complete	March 2023
Feasibility Report to Congress	Recommendation and Federal interest finding to Congress	January 2024

As further described in this report, Port staff will use the period between the Focused Array and the Final Array to continue to work with Port Divisions, the Port Commission, City department and regulatory partners and the public to develop flood and seismic risk reduction alternatives to inform the Final Array. The period between this presentation and the 1st quarter of 2021 presents an opportunity to obtain key policy direction from the Commission to inform this critical work.

Future Without Project

As sea level rises, so does the likelihood that flood events will cause damages to the San Francisco waterfront, which will have localized and systematic impacts felt throughout the City, Region and Nation. A major portion of the USACE flood study is dedicated to determining how significant these damages are on a Federal level to determine if there is "Federal Interest" in preventing these damages before they are realized.

This quantification process is referred to as establishing the "future without project condition", commonly abbreviated FWOP. As the study progresses, different flood risk reduction plans will be evaluated to determine the "future with project" damages, such that the difference between the two is the benefit of actions taken. The benefits must exceed the cost of the flood risk reduction plan to receive Federal funding; therefore, it is critical to establish an expected baseline for the FWOP since this will be the primary metric by which plans will be compared, screened and ultimately selected.

Damages will be classified in one of four accounts, or metrics, as part of this process to fit into the procedure that USACE uses to track the impacts of flooding. As described in the USACE Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies[1] that guides USACE studies such as the Flood Resiliency Study:

(a) The **National Economic Development (NED)** account displays changes in the economic value of the national output of goods and services.

[1] https://planning.erdc.dren.mil/toolbox/library/Guidance/Principles_Guidelines.pdf

(b) The **Environmental Quality (EQ)** account displays non-monetary effects on significant natural and cultural resources.

(c) The **Regional Economic Development (RED)** account registers changes in the distribution of regional economic activity that result from each alternative plan. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output, and population.

(d) The **Other Social Effects (OSE)** account registers plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

The primary driver for determining Federal Interest is the NED, which is the only account used for determination of the benefit-to-cost ratio, such that it is desirable from a local perspective to accurately estimate damages in the NED account and maximize benefits of plans to secure Federal funding.

While not all damages will be recognized in the NED account, the City will leverage the other accounts (RED and OSE) to inform the locally preferred plan. This approach is expected to be supported in forthcoming guidance from USACE Headquarters, which updates the approach to recommending plans to ensure a holistic plan is recommended for flood risk reduction.

Within existing USACE rules, seismic benefits associated with an implemented flood protection plan, are quantifiable and eligible “incidental” additions to the NED benefits once a minimum benefit-cost ratio of 0.5 is met by a proposed plan. The Port is currently pursuing legislation which would allow seismic benefits to be counted to meet the 0.5 benefit cost ratio threshold through WRDA 2020. In USACE policy, “incidental” benefits are those that are not a core USACE mission but recognized as valuable additions to a project and quantifiable using USACE approved methodology. The 0.5 threshold is put in place to ensure projects are selected based on USACE mission priorities versus “incidental” benefit categories.

As a critical element of the study and potentially huge financial implications to the City, the Port took a robust, collaborative approach to collecting information in support of the FWOP condition. The first step from a technical perspective is to compile an inventory of current and known future assets, their physical and indirect value and identification of the flood levels to which they are vulnerable.

Future plans and developments within the study area, such as Mission Rock, Potrero Power Station and Pier 70 were incorporated into the asset inventory and will be used to guide the formulation of flood risk reduction plans. Staff conducted an extensive workshop series with BART and SFMTA to evaluate and document potential flood damages to the above and underground transit systems, quantifying both physical damages that will need replacement as well as lost revenue resulting from system downtime. Staff continues to identify long range plans and rough magnitude of costs that SFPUC wastewater enterprise will need to invest without the USACE flood risk reduction project. Any costs avoided as a result of the flood risk reduction plan may be captured as benefits. The inventory includes bridges, buildings, transit systems and other specialized assets within the flood plain, such as the Recology recycling plant, industrial maritime facilities and concrete batch plants. Working with the operators of these facilities, the value of their physical infrastructure and operational damages resulting from flooding were computed to complete the asset inventory.

After staff compiled this robust inventory, the PDT employed a computerized planning model called G2CRM to determine potential economic damages from various levels of coastal floods. The model simulates a 50 year cycle, starting in 2040 and ending in 2090. The 2040 start date is the earliest expected timeframe for a completed USACE flood risk reduction plan that would start producing benefits to the City. However, portions of the plan could be completed earlier, for example through Proposition A funding. Within the planning model, different flood events are simulated based on their likelihood of occurrence, accounting sea level rise and the average value of all damages in the 50 year period is said to be the quantified FWOP condition. The modeling is repeated for 5 different sea level rise curves, such that the quantified FWOP condition, thus potential benefits, change based on the sea level curve. It is important to note that due to the time value of money, damages occurring near the end of the 50 year period are worth significantly less when discounted back to 2020 values. The planning model can be used to quantify benefits in all accounts (NED, RED and OSE) if the asset inventory is properly set up for this purpose.

As part of plan formulation, the PDT will evaluate the shortlist of flood risk reduction plans through the planning model, using the same robust asset inventory to measure how effectively the plan reduces damages across the 50 year period of analysis. The plan that maximizes benefits in the NED account is identified as the NED plan, which effectively establishes the maximum amount of Federal investment. The Port will evaluate the benefits to the RED and OSE accounts to inform a Locally Preferred Plan, which may differ from the identified NED plan.

The results of the FWOP are still undergoing a quality assurance review through a standard USACE technical review process.

Community and Stakeholder Engagement

Continued community and stakeholder engagement is ongoing with City departments, local and regional agencies, resource agencies, CACs, neighborhood and community organizations, youth groups, and San Francisco and regional residents.

Interagency Coordinating Team (ICT)

The Interagency Coordinating Team, which is a convened jointly by USACE and the Port staff, includes staff participation from the City Administrator's Office of Resilience and Capital Planning, City departments and regional agencies shown in Table 2.

Table 2:
Interagency Coordinating Team

San Francisco City Planning Department	Federal Emergency Management Agency
San Francisco Environmental Planning Department	US National Parks Service
San Francisco Public Utilities	US Department of Transportation
San Francisco Department of Public Works	Bay Area Rapid Transit
San Francisco Emergency Management	SF Bay Area Water Emergency Transportation Authority
San Francisco Fire Department	San Francisco Bay Conservation and Development
San Francisco Municipal Transportation Agency	Caltrans

The purpose of the ICT is to ensure that input and guidance is providing at each key step in the Study process. This provides the PDT with timely input to ensure that alternatives reflect the priorities and objectives of a broad range of stakeholders and that trade-offs and difficult issues

are discussed at an early stage in the study process. On September 23, 2020, the PDT met with the ICT and presented the status of the FWOP, more detail on the USACE planning process and a high level overview of the Focused Array.

Resource Agency Working Group (RAWG)

A Cooperation and Participating Resource Agency Working Group (RAWG) was established consisting of representatives from the Corps, the Port, and the various State and Federal agencies concerned with the study area in Table 3. The purpose of the RAWG is similar to that of the ICT with more focus on permitting and NEPA/CEQA issues.

Table 3: Resource Agency Working Group	
San Francisco Environmental Planning Department	California Department of Parks and Recreation
SF Bay Conservation and Development	Bay Area Air Quality Management District
San Francisco Bay Regional Water Quality Control Board	Department of Interior, US Fish and Wildlife Service
California State Lands Commission	NOAA, National Marine Fisheries Service
California State Historic Preservation Office	US Environmental Protection Agency
California Department of Fish and Wildlife	

Community and Stakeholder Engagement

The Port staff began education and outreach to the public on risks to the waterfront in early 2017. Some examples of the early education conducted by the Port included written, TV and radio press in order to inform and educate the public and interested parties on the risks and consequences to the San Francisco Waterfront from earthquakes and current and future flooding. Additionally, the Port participated in neighborhood outreach at events during this time period across the entire City, as well as giving presentations to advisory groups, issue groups and advisory committees, also across the entire City.

The Resilience team began more focused community and stakeholder engagement in late 2018, during the early scoping stage of the Program. The Resilience team developed a community meeting series to ensure that community and stakeholder input was sought at each step in Program development and implementation. Initially, this community meeting series was held in the Embarcadero segment of the waterfront, but in 2019 the team began to hold a community meeting series in Mission Creek and Islais/Creek Bayview which followed a similar model as those held in the Embarcadero segment of the waterfront. As an example, the meeting series included opportunities for engagement and input on priorities, vision, goals and principles, evaluation criteria, deeper engagement on the MHRA approach and early findings and an early opportunity to provide input on the alternatives development process. The meetings follow a format of presentations first with engagement exercises followed by engagement exercises in small groups after, allowing for deeper engagement and discussion of the issues.

Here is a list of the methods the Resilience team used to garner input:

- Community meetings
- Digital engagement
- Roadshows to CACs, neighborhood organizations
- Neighborhood outreach at events such as Bayview Sunday Streets and others

- Community “mixers”
- Boat, bike, and walking tours
- Others

Due to COVID-19 and public health guidance, all engagement has currently moved to a digital realm.

Input on Seismic and Flood Risk Reduction Measures

The Resilience team has been developing flood and seismic measures to reduce the risks that were identified in the Multi-Hazard Risk Assessment (MHRA). The team used the content developed to engage the public , including at two digital community meetings, online via https://www.sfportresilience.com, the Waterfront Resilience Program’s website, the creation of a Waterfront Resilience Program Storymap and through an event to engage youth.

Community Meetings

RDJ Enterprises (RDJ) has been a critical partner in the engagement that we have been doing in Islais Creek/Bayview, including past community meetings, organizing presentations and discussions to advisory groups and in past community mixers and events. RDJ will continue to work closely as part of the Resilience team on future engagement in Islais Creek/Bayview including the next community meeting in the series in November/December.

The Resilience Team will work with Civic Edge Consulitng (CEC) to develop and implement the next community meeting in the Mission Creek and Mission Bay area in November/December.

Recently, the Resilience team executed a community meeting focusing on measures were a focus of the presentation and engagement activity shared during the September 24 and 25 digital community meetings for the Embarcadero Seawall Program and the Northern Waterfront segment of the Waterfront Resilience Program. The measures engagement activity was hosted in breakout rooms, supporting small group discussions led by Port staff and attendees. Attendees were asked where they would place certain measures and which compatible measures they would consider pairing.

For the purposes of the group activity, a small sample of measures was selected, and each group of attendees was given a subarea map that showed the area’s flood and seismic risk as well as locations for key assets. Attendees understood that the goal of the activity was not to determine where measures would be placed but to become familiar with the measures under consideration and the decision-making process for evaluating the selection of different measures. Over the two community meetings, there were nine small-group discussions for this activity.

From these group discussions, some of the key themes we heard included:

- Priority for longer design life of flood risk reduction alternatives.
- Protection for historic and iconic buildings, including the Ferry Building.
- Maintaining public access to the waterfront.
- Balancing near- and long-term risk.

Additional comments spoke to some concern related to Bay fill. Other points of input were to consider total cost (societal and environmental) and not just financial cost as part of

calculations, to consider the potential impact of a measure on areas of the waterfront outside of where it might be located and intended to mitigate risk, and to consider the potential effects to the broader Bay Area.

Digital Engagement

The Measures Explorer, an online tool to share information about the different types of measures and outline their respective tradeoffs – such as potential hazards mitigated, impact to the waterfront, adaptability, design life – was publicly launched on the Waterfront Resilience Program website at https://www.sfportresilience.com/measures-explorer on September 24. A social media campaign and paid digital ad campaign promoted awareness about the new Measures Explorer. The Measures Explorer also includes a short survey for each measure for website visitors to share their feedback. Each survey includes questions on where along the waterfront people would like or not like to see a measure incorporated and how well people think the measure aligns with the Program's vision and goals.

To date, there have been more than 100,000 page visits across all Measure Explorer and Story Maps pages. The top three measures with the most page views: Levees, Floodwalls, and Seawalls. The top three Story Maps with the most pages views: South Beach, Aquatic Park, Fisherman's Wharf. The top three themes with the most page views: Open Space, Transportation, Maritime.

Youth Engagement

Youth engagement is under development by Bonner Communications. Youth organizations will be given the opportunity to engage on three upcoming areas of content when they become available to the public.

Focused Array

In the USACE planning process, the Alternatives and Evaluation step of the study process has four iterations of planning, including the Alternatives Milestone Meeting (completed in October 2018), the Focused Array, Final Array, and the Tentatively Selected Plan. At each iteration, a series of six standard planning steps are revisited and refined, as depicted in Figure 1.

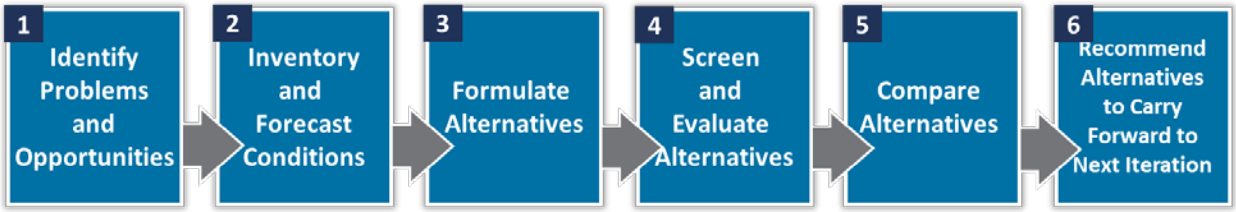

Figure 1. Six Planning Steps will Be Performed at Each Planning Iteration

Work on developing the second iteration of alternatives, known as the Focused Array, began in late 2019 and concluded in May 2020. The Focused Array took a different approach from the Initial Array that was completed in late 2018 and was based on identifying a "line of defense" at a very high level with a more limited information and not based on more refined POOCCs, subareas and measures scale that was incorporated in the development of the Focused Array. The Initial Array included high level concepts of placing flood risk reduction structures in the Bay, along the shoreline, around the piers and at various locations within the Embarcadero corridor.

In advance of the Focused Array work, the team developed a robust set of material at a subarea scale to provide the level of information and detail on conditions, assets and services, stakeholder priorities, flood and seismic hazards, risks and consequences and existing and proposed projects in the entire project area which includes both Port and City. Conducting the Focused Array work at a more refined, site specific scale allowed the PDT to apply an understanding of the area, the priorities, the possible applicable measures and approaches and the trade-offs in way that provided a better understanding of some of the key findings, constraints and opportunities when reducing flood risk along the San Francisco Waterfront.

During the Focused Array iteration, the PDT used a subarea approach to identify a range of flood measures for further consideration within each subarea. The robust list of measures was reviewed at a conceptual level within each subarea to assess how and if the measure might reduce identified flood risk to communities, assets, and services. Measures were organized into "themes" to help explore tradeoffs and consider how site-specific considerations might inform the feasibility, effectiveness, and suitability of different measures in different locations. This range of measures was then evaluated to identify key findings and illuminate policy questions that would inform further alternatives development. This range of measures, key questions, and other supporting materials is known as the "focused array." The PDT developed the following themes:

- Seismic safety and disaster response
- Historic and cultural presentation
- Transportation-mobility
- Ecological assets and services
- Community Cohesiveness
- Non-structural

Problems, Objectives, Opportunities, Constraints, and Considerations (POOCCs)

In order to ensure that alternatives are designed to address the risks and address the consequences of flooding, the scoping step of the process includes the development of Problems, Opportunities, Objectives, Constraints and Considerations (POOCCs). The POOCCs are intended to provide the PDT with a stable framework from which to develop alternatives. The POOCCs also provide a way to communicate the work with stakeholders and were used to ensure that Port staff, City staff, community members and others could provide input into the process. The POOCCs, which are iterative, started at a waterfront wide scale and informed the development of the Initial Array. Based on the experience that the PDT had at a waterfront wide scale, the team decided to downscale the approach to the POOCCs and developed subarea scale POOCCs. The subarea POOCCs were critical to reflecting the varied conditions that is found from Fisherman's Wharf to Heron's Head Park.

A robust engagement approach was developed in order to ensure that the subarea POOCCs reflect the expertise and priorities from community members, the Port divisions, City partners and others. The Port divisions were provided with draft subarea POOCCs and provide input and refinements based on their expertise and knowledge of the subareas. City departments were also provided with the material in order to ensure that City knowledge and expertise was incorporated and the Flood Study team used the Citywide Sea Level Rise Vulnerability and Consequences Assessment to build Citywide content into POOCCs. The POOCCs received input from the community beforehand, having been built at the front end from input from the community meeting series (e.g. community priority assets and services, input on goals and

evaluation criteria), discussions with community advisory group members and what we have heard at community events and mixers. Additionally, in order to provide as much opportunity as possible for input (particularly during this time of Covid-19), we put all of the subarea material online in the Waterfront Resilience Program story maps.

Here are some examples of the subarea POOCCs and a link to the full list of the subarea POOCCs:

Flood Risk Profiles

Resilience team members developed Flood Risk Profiles for each subarea of the waterfront. These measures build on the Citywide Sea Level Rise Vulnerability and Consequences Assessment, and provide a more detailed and neighborhood scale understanding of the lowest elevation locations along the waterfront, the timing of projected sea level rise impacts, what community assets and services at risk, and the qualitative assessment of those risks. Each Flood Risk Profile includes the following information:

- Subarea Description and Asset Locations:
- Timing of Exposure of the shoreline and identified assets and landmarks
- Depiction of the flood progression
- Adaptation Focus, including a description of shoreline vulnerabilities (e.g., overtopping locations) and flood pathways when select Bay water elevations occur, priority shoreline locations for adaptation responses, and a Description of adaptation considerations

Measures

Measures are the building blocks of alternatives. During the focused array iteration, the PDT developed a more robust list of flood risk reduction measures for consideration, with particular attention to adding non-structural (policy and zoning) and nature-based measures. The PDT completed a detailed screening of measures by subarea, to complete a documented screening of measures not considered applicable at the subarea scale. To support alternatives development and stakeholder engagement, Measures Profiles were developed to define measures and support alternatives development.

Figure 2: Flood Measures

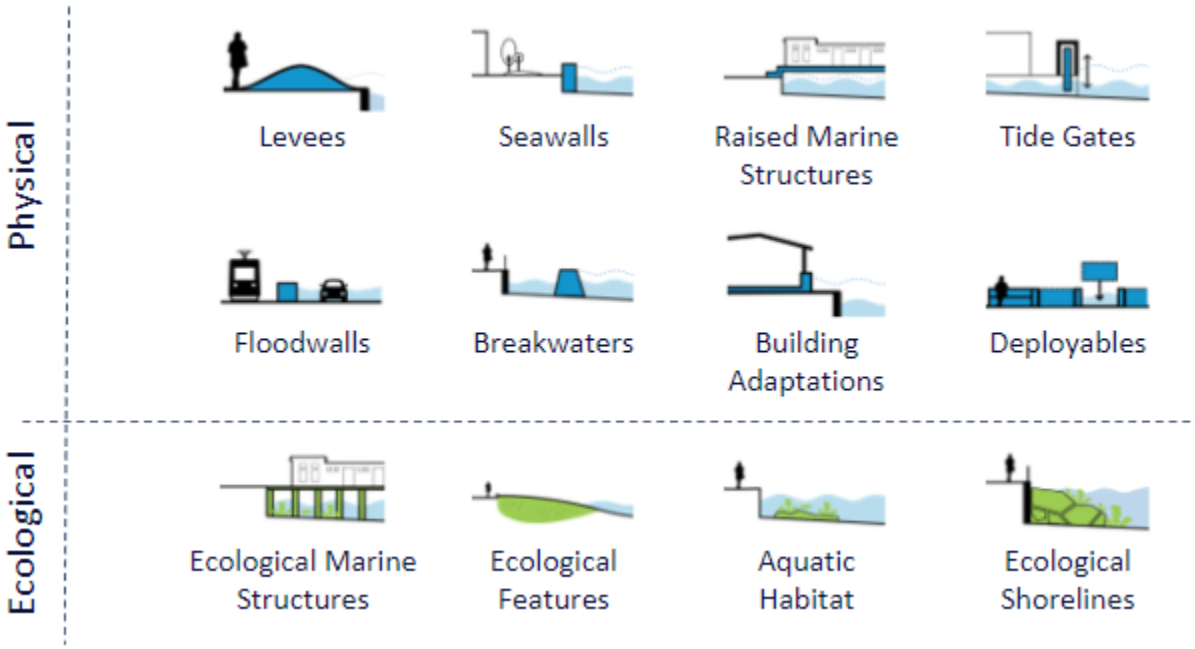

Table 4 shows how the PDT deployed these measures in the different geographies in the study area.

Table 4: Focused Array Structural and Ecological Measures		
Geography	**Structural Measures included in Focused Array**	**Ecological Measures Included in Focused Array**
Embarcadero	• Raised Wharves • New Bayward Seawall • Raised roadway along entire Embarcadero • Raised Pathway along entire Embarcadero + raised roadway in front of Ferry Building only • Breakwaters • Deployables	• Ecological seawalls • Native vegetated terraces at Pier 39 and Rincon Park • Beach nourishment at Aquatic park • Ecological breakwaters • Ecological tidepool units
Mission Creek	• Tidal Gates and Barriers • Raised feature • Raised pathway • Earthen levee • Deployables • Raised bridges	• Native vegetated terraces • Stepped slopes • Ecological tidepool units
Mission Bay	• Levee with revetment • Raised pathway / Raised feature • Deployables	• Native vegetated revetments • Bayward beaches
Islais Creek	• Tide Gates and Barriers • Levee with revetment	• Stepped slopes and edge softening • Native vegetated terraces

	• Raised pathways / Raised features • Shoreline reconfiguration • Earthen levee with revetment • Breakwaters • Deployables • Raised bridges	
Piers 80, 94, and 96	• Raised features including floodwalls • Raised wharves • Deployables	• Stepped slopes and edge softening • Ecological breakwaters
Pier 92	• Raised pathway • Raised features including floodwalls • Earthen levees • Deployables	• Stepped slopes and edge softening

Focused Array Themes

The Focused Array themes provided the PDT with an opportunity to understand how to apply specific considerations to each subarea and determine the best measures for addressing the flood problem within the context of the theme. Some of the findings from the Focused Array work were waterfront wide, such as the fact in order to reduce risk to critical assets all of the measures and alternatives need to be placed within the zone from the nearest roadway to the nearshore environment. Another waterfront wide finding is that no single theme applies across the entire waterfront. For example, non-structural measures are not a good fit for the Financial District that contains a high density of buildings, utility and infrastructure.

Some findings were specific to a smaller geography. For example, the importance of commercial fishing and maritime in Fisherman's Wharf reduced the range of alternatives that could be considered in that subarea to ensure access between the Bay and the shoreline. Below are a range of findings that the PDT identified during the development of the Focused Array:

Preliminary Findings from the Focused Array

- The majority of the Port's piers are not likely to be included in the Federal Interest because the NED cost benefit ratio for these assets will likely not meet required thresholds.
    - **Breakwaters** outboard of piers were determined by the PDT to be 1) too costly, and 2) not adaptable to sea level rise, as the main benefit of breakwaters is knocking down wave action.
    - **Using the piers to provide future City flood protection** was determined by the PDT to be unworkable because 1) as 100 year old structures, the piers will not meet FEMA standards for coastal flood protection, and 2) filling the area under the piers or building flood protection around the piers would be too costly.

  The Port continues to advance resilience for the piers in efforts such as the Historic Piers Rehabilitation work, the Floodproofing the Piers studies and FEMA grants and other opportunities.

- The approaches for flood risk reduction at the creeks are very challenging. The choice that the PDT confronted for both creeks was either placing gates across the creek or raising the bridges over the creeks combined with elevated shoreline protection.

    - **Gates at Mission Creek and Islais Creek:** Gates are costly and are suboptimal for addressing sea level rise, would have ecological and water quality impacts and would ultimately require pumping (also costly).

    - **Raising Bridges**: Raising existing vehicle and rail bridges requires land use and transportation changes around the bridge touchdowns that could be challenging and costly.

    - **Creek Shoreline Protection**: Elevated creek shoreline protection must be combined with raising bridges, but provides the best approach for adaptive management over time.

    - Other alternatives such as closures and deployable measures, which are less costly, would result in widespread mobility challenges during periods when flooding occurs and would require the City to build more redundancy and service into the these north/south corridors.

- USACE policy requires the consideration of non-structural measures such as relocation, waterproofing, ring walls and structure elevation increases for assets located within areas subject to coastal flooding, and local policies and zoning. This approach is challenging in an area that is as urbanized and that contains as many critical assets as the study area. The non-structural alternative resulted in a number of assets being identified for site specific measures, floodproofing and/or relocation.

- Ecological enhancements to structural measures are broadly applicable throughout the waterfront. These could include measures such as creosote pile removal, tide pool units, textured concrete, shellfish reefs, and vegetated revetments.

- In many areas of the waterfront, there is a narrow space within which to place flood measures. In these areas, it will likely be necessary to move into the Bay or into the roadway or both to gain the necessary elevation to provide coastal flood risk reduction for the City and to retain shoreline assets.

- The Port, the City and USACE will need to arrive at a determination as to which water levels we are planning for, which will enable the PDT to understand, evaluate, and explain at a more refined scale the impacts to the shoreline assets, shoreline access and the Bay, and risk reduction benefit to applying these measures along the shoreline.

- An integrated alternatives process that combines both seismic and flood risk measures is critical for most of the San Francisco Waterfront. Ensuring the alternatives address both seismic and flooding is necessary for waterfront resilience.

- A significant amount of the flood risk is inland of the Port's jurisdiction and engagement and partnership with City departments has been and will remain critical as we move forward.

- Many of the flood risk reduction approaches will require a large construction areas and at least temporary disruption.

- Flood risk reduction measures in the Embarcadero segment will likely require modification of the historic bulkhead buildings, particularly to provide flood resilience at higher water levels.

- The economic cost of damages in Study area are clustered in the area from Pier 27 to Mission Creek, including the inland areas that are at risk from future flooding. This has resulted in a discussion of whether or not the study area should continue to include Fisherman's Wharf and Aquatic Park in the north and Islais Creek/Bayview to the south where the economic damages appear to be lower. The PDT has continued to advocate for keeping the entire area from Aquatic Park to Heron's Head Park in the Study area.

With the knowledge that the schedule over the coming months will allow for significant engagement with the Port Commission regarding seismic and flood alternatives, Port staff requests feedback on the preliminary findings from the Focused Array.

A few key questions:

- Should the USACE Flood Resiliency Study include historic piers?
- In addition to core maritime functions that must remain at the water's edge, are there other specific functions that cannot be moved upland?
- Is ecological enhancement along the Seawall and in the creeks an important value to the Port Commission?

More context:

- **Historic Piers:** If successful, the Flood Resiliency Study will result in Federal funding for a coastal flood protection project to protect San Francisco from flooding and sea level rise, subject to a benefit cost ratio that determines a Federal Interest. As Port staff who are participating in the PDT advance this analysis with USACE, are there any objectives and guidance from the Port Commission we should consider in relation to historic piers? There remain other investment strategies – including pier rehabilitation and floodproofing individual piers – that can allow the piers to function through much of this century.

- **Non-Structural Measures:** In addition to evaluation of structural and ecological measures, USACE requires that alternatives include policy measures, such as building code requirements to flood proof or elevate buildings in a flood plain, building or asset relocations, and coastal setback limits. As the PDT advances the analysis of non-structural measures, are there any objectives and guidance from the Port Commission that the team should consider? For instance, in addition to core maritime functions that must remain at the water's edge, are there other specific functions that cannot be moved upland?

- **Ecological Measures and Enhancements:** While parts of the Port's waterfront are human-made and include steep and often vertical slopes, the Resilience team has identified that are potential ecological enhancements that can improve Bay habitat along most of the Port's waterfront. We are pursuing a pilot called the Ecological Seawall pilot

project to test this approach. Is ecological enhancement along the Seawall and in the creeks an important value to the Port Commission?

- **Seismic and Flood Protection:** Staff has been operating on the assumption that it is better to build projects that increase seismic safety and provide future flood protection, wherever possible or having the seismic safety alternatives serve as a foundation for future actions to reduce future flood risk. Port staff will also be evaluating this objective as we develop Proposition A project alternatives for Commission consideration early next year. When staff presents Proposition A alternatives, we will share any tradeoffs associated with this approach compared with options that focus primarily on seismic safety, and look forward to Port Commission input next year.

Staff also welcomes any other guidance on the Focused Array or questions about the approach in the Flood Resiliency Study.

Next Steps

Agency Technical Review

USACE is currently conducting an internal independent technical review (Agency Technical Review) of its coastal flood science and economic modeling methodologies, inputs, outputs, and documentation. It is anticipated that the review will identify additional work needed, especially in the areas of capturing damages due to future frequent tidal flooding. This additional work will support the finalization of the Future Without Project, and provide the toolset necessary to evaluate the benefits and residual risk of alternatives. Results of the USACE Agency Technical Review are likely to result in the adjustment of scope and schedule for the Flood Resiliency Study.

Port Seismic and Flood Alternatives Formulation

From August to December, the Resilience team will use the information from the MHRA, public outreach to date, City department engagement, seismic measures and the flood measures from the Focused Array to develop conceptual project alternatives for the entire waterfront.

With the information available and building on the work to develop flood and seismic measures, the Resilience team will prepare 2-3 project alternatives per subarea – incorporating seismic and flood risk reduction wherever possible – for the Port's entire waterfront. As the team develops these alternatives, staff will work closely with Port divisions to confirm that identified alternatives are consistent with the Port's Strategic Plan, Port operations, and key Port strategies including the Historic Piers Rehabilitation Program and related Port planning efforts.

This work is intended to inform both Proposition A project selection and the USACE Flood Resiliency Study Final Array.

The Resilience team expects to present this work for public review and comment and to the Port Commission for policy direction. It is through this process that the Resilience team will embed the Commission's policy and strategy direction in the work of the Resilience Program. The schedule allows for a series of meetings in January, February and March to make sure we gain appropriate direction from the Commission.

The high-level schedule for this work is:

- Alternatives development and evaluation – September/October
- Synthesis/Executive Sponsor review/Recommendations – November/December
- Port Commission staff reports/presentations – January/February/March

Final Array

After the Resilience team, in consultation with Port Divisions, City departments, the Executive Director and the Port Commission, receives policy direction on preferred seismic and flood alternatives for the Port's waterfront, the team will work within the PDT to advance these recommended alternatives to the Final Array, potentially as part of the Locally Preferred Plan or the NED Plan.

Upcoming Public and Agency Meetings

On September 24 and 25, the Resilience team hosted digital community meetings for the Embarcadero Seawall area. The measures engagement activity was hosted in breakout rooms, supporting small group discussions led by Port staff and attendees. Attendees were asked which seismic and flood measures they would apply in specific geographies based conditions, characteristics and priorities in these areas, how to match seismic and flood measures in locations, whether to phase flood measures after seismic measures and what the trade-offs were among measures.

The community meeting series for each of the three geographies–Embarcadero, Mission Creek, Islais Creek/Bayview–will continue in the Fall and the Winter. This includes the next meetings in Mission Creek and Islais Creek/Bayview which will be similar to the meeting recently held in the Embarcadero segment of the waterfront described above. The subsequent meetings in all three geographies will focus on early engagement and input on draft alternatives, with the Resilience team presenting a range of draft alternatives that are based on prior stakeholder input and providing a way for community members and stakeholders to better understand the way the alternatives address risk and are consistent with priorities, as well as the trade-offs among them.

The Program team will continue to coordinate with the Interagency Coordination Team and Resource Agency Working Group to ensure that alternatives consider City department, agency partners and resource agency concerns and considerations and refine alternatives based on their engagement and participation in the Program work.

The end of the early NEPA scoping comment period was October 21, 2020. Publication of a NEPA Notice of Intent is planned for April 2021 to formally begin the NEPA process. The public draft NEPA document is scheduled for March 2022.

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