**MEMORANDUM**

February 4, 2022

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

**FROM:** Elaine Forbes
Executive Director

**SUBJECT:** Informational presentation on the Port's Structural Assessment Program and Overview of Load Restricted Facilities

**DIRECTOR'S RECOMMENDATION:** Information Only – No Action Required

## SUMMARY

This staff report provides an update on the structural condition of the Port's Facilities and an overview of Port Engineering's Structural Assessment Program, consisting of the Rapid Structural Assessment (RSA) Program and the recently initiated Facility Inspection and Repair Project Assessment (FIRPA). Port staff's last update regarding the RSA program was presented to the Port Commission, February 2018.

## BACKGROUND

The Port's RSA Program consists of regular inspections of approximately 150 marine structures and 200 buildings and other above grade structures. The inspection findings are also used to document maintenance and repair needs for the Port structures. Port Engineering manages the program and works with other Port divisions to inform tenants and the public of RSA inspection findings, implement load restrictions, and install safety signs and barricades. The more detailed FIRPA Program was started in 2019 to bring greater clarity of the costs to keep facilities in a "state of good repair" and concentrates on facilities which provide high economic benefit or could provide additional economic benefit to the Port.

Compared to structures on land, deterioration of the Port's piers and wharves occurs relatively quickly due to the aggressive marine environment and is not as easily detected due to the inaccessibility of areas exposed to the water. Consequently, inspection of structures built over the water has been an important function of the Engineering Division since the earliest years of the Port. Inspection findings drove the progression from short lived untreated wood piles to the durable reinforced concrete Piers that make up most of the historic waterfront that we know today. Most of these structures have now been standing for more than 100 years.

In 2015, The American Society of Civil Engineers (ASCE) published Waterfront Facilities Inspection and Assessment, a manual of engineering practice. The manual sets standards for the evaluation of marine structures and components and provides guidance on inspection intervals. The Port has adopted the inspection interval recommendations in the manual of practice to its RSA inspection program. However, due to several factors including COVID-19 and internal resource constraints, the RSA inspection program has fallen behind its inspection frequency interval goals. Port staff have recently restarted the RSA program and has engaged consultants to augment the inspection effort. In the next three years, there will be an additional sixty inspections performed in order to get back on cycle.

Rapid Structural Assessment (RSA) Program

The current Structural Assessment Program began in 2002 and has regularly inspected the Port's non-floating structures on a frequency determined by the structure's materials of construction and its occupancy or use. This is true for marine structures as well as buildings constructed over piers and on land. As the name of the implies, the Rapid Structural Assessment (RSA) provides an overall impression of a facility's condition and relies on the inspector's experience and judgement. If significant issues with a structure are spotted, a more detailed follow up survey is typical.

For each facility, the structural inspection findings and recommendations are summarized in an RSA report which includes a structural rating of the respective facility indicated by a coloring scheme shown on a schematic map of the facility. The structural rating coloring scheme is described below:

- Green (serviceable condition, no live load reductions/restrictions and unrestricted use consistent with original design)

- Yellow (restricted use, load limit signs indicating reduced live loads and/or barricades, further structural review and structural repairs required)

- Red (restricted access, unsafe, poor structural condition)

Attachment 1 graphically depicts the current substructure structural ratings of the Port Facilities as of the date of this memorandum. Attachment 2 provides graphical information on the current superstructure structural ratings.

It is important to note that a Green rated facility may still have significant repair needs. The Green rating means that damage observed by inspection has not progressed to the point where a load restriction is warranted, based on engineering analysis and professional judgement. The damage observed in Green tagged structures is documented in the inspection report for future monitoring and prioritization of repair work.

Facility Inspection and Repair Project Assessment (FIRPA) Program

In 2019, Port staff initiated the Facility Inspection and Repair Project Assessment (FIRPA) Program to perform a more in-depth inspection and assessment of selected facilities to provide accurate condition assessments and cost estimates to bring facilities state of good repair. The 2019 initial program of FIRPA included ten facilities, while a condensed 2021 FIRPA included five facilities.

The goal of the FIRPA inspections is to inform the Port's capital plan with realistic costs to bring facilities into a state of good repair. The FIRPA inspection includes inspection and assessment of facility structural systems, fire protection systems, mechanical, electrical, piping, building envelope (i.e. watertightness), and accessibility issues. The results of the FIRPA inspections are used to develop capital projects with the added benefit of identifying deficiencies that could become life-safety or regulatory issues, augmenting the RSA program. The results from the structural portion of the FIRPA inspections are incorporated into the Structural Assessment program tracking.

The facilities that have been inspected in the FIRPA program (and year of inspection) are:

- Roundhouse 1 and 2 (2019)
- Pier 54 (2019)
- Pier 50 Sheds B & C (2019)
- Pier 45 Sheds B & D (2019)
- Pier 35 (2019)
- Pier 33 (2019)
- Pier 9 (2019)
- 501 Cesar Chavez (2021)
- 401 Terry Francois (2021)
- Shipyard (Pier 70) Building 109 (2021)
- Shipyard (Pier 70) Building 105 (2021)
- Shipyard (Pier 70) Building 36 (2021)

## IMPROVEMENTS SINCE FEBRUARY 2018

Several Port buildings and substructures have been repaired though Port capital projects as well as developer and tenant lead projects since the last presentation to the Port Commission in 2018. As projects are completed, the structural rating map is updated and the cycle of regular inspections begins for the renewed facility. The following is a list of facilities with upgraded structural ratings since February 2018.

- Pier 35 Roof Truss Repair (Red to Green)

One roof truss at Pier 35 recently failed and the Port designated the situation an Emergency and Red-Tagged a 60' x 60' area under the failed roof truss. The Port hired Power Engineering Construction to design and implement the roof truss temporary shoring and final structural repair plan. The construction work is complete, and the red-tagged area will soon be rescinded and designated 'green'.

- Pier 33 South Apron (Yellow to Green)
  The Marine Structural Project (MSP) IV Project included repairing a section of the Pier 33 South Apron substructure.

- Wharf 31.5 (Yellow to Green)
  The MSP IV Project included repairing a section of the Wharf 31.5 substructure.

- Pier 29 Substructure (Yellow to Green)
  The MSP IV Project included repairing a section of the Pier 29 substructure at the bulkhead.

- Pier 92 Timber Apron Repair (Yellow and Red - to Green)
  Port Maintenance has completed the repair of 770' of the Pier 92 Timber Apron. Work scope included driving over 300 timber replacement piles and installing 77 pile cap beams. For the most part the Apron is now rated 'green'. Subsequent to completion of the apron repair project, an uncontrolled barge allision caused damage to structural piles, fender piles, and the deck structure at a repaired section of the apron in May 2021. In addition to the barge allision incident, a July 5, 2021 fire occurred on the same relatively very small damaged area of the Apron, further damaging more of the Apron structural framing. These allision-damaged and fire-damaged areas are currently red-tagged.

- Pier 45 Apron Repair by Port Maintenance Apron at Shed C (Red to Yellow)
  Port Maintenance has completed the partial repairs to a section of Pier 45 east apron that was red tagged. The scope of work included the installation of 6 replacement pile bents with 4 piles each adjacent to the SS Jeremiah O'Brien gangway landing.

## LOAD RESTRICTED FACILITIES – YELLOW RATING

Load restricted or yellow tagged facilities have experienced deterioration to structural components that reduces their ability to resist loading. Throughout the Port's facilities, the most common forms of deterioration are corrosion of structural steel and rebar in concrete, and biological damage to wood from marine borers and dry rot. In some cases, deterioration has been accelerated by excessive loading from heavy vehicles and moored vessels. The time frame from when a facility is load restricted to when some or all of the facility must be completely vacated (red tagged) depends on the type of deterioration, the amount of redundancy and overdesign in the original structure, and

the use of the facility. In general, wood structures tend to deteriorate the most quickly once deterioration is detectable by a Rapid Structural Assessment.

The following is a partial list of Yellow Tagged facilities that have significant operational/usage constraints as a result of lower allowable loads. In a few cases, there are active projects to repair these facilities and restore full functionality. In most cases there is no funding identified to perform such repairs. Facilities are listed in geographic order from north to south.

- Wharf J9 Timber Seawall
  This historic timber seawall has experienced biological deterioration which partially compromises its ability to retain the soil backfill behind the wall. This seawall provides support to an adjacent timber wharf on the water side and influences some building foundations on the land side. Port Engineering hired a consultant to provide structural repair plans. This design work is currently on hold while the Port's Resilience team evaluates the Wharf J9 project for inclusion in the Waterfront Resilience Program Early Projects list.

- Pier 35 Substructure
  The Pier 35 substructure and adjacent marginal wharf are constructed of reinforced concrete beams, deck slab, and piles. Rebar has corroded and resulted in concrete spalls throughout the substructure. Port Engineering has completed structural repair drawings and specifications to repair the most critical damage. No funding source has been identified to repair the Pier 35 substructure.

- Marginal Wharves From Pier 33 to Pier 31
  The marginal wharf substructures are immediately adjacent to the sea wall. They support the bulkhead buildings and provide access to the rest of the piers. The concrete deck and piles have corroded and spalled in various locations throughout this area. The Marine Structural Project IV (MSP IV) scope included repairs and strengthening for heavier vehicle loads at the marginal wharf adjacent to the National Park Service's Alcatraz Landing facility, and this work was completed in year 2019. No funding source has been identified to complete the remaining Marginal Wharves substructure repair work.

- Pier 29 Substructure
  The Pier 29 substructure and adjacent marginal wharf are constructed of reinforced concrete beams, deck slab, and a combination of concrete piles and large diameter concrete cylinders. Rebar has corroded and resulted in concrete spalls throughout the substructure. Some of the tested concrete cylinders from the site indicate chemical degradation of concrete in the tidal zone. The MSP IV scope of work included repairs to the entire Pier 29 marginal wharf and approximately 7,000 square feet of the main pier adjacent to the marginal wharf. This work was completed in year 2019. However, no funding source has been identified to complete the remaining Pier 29 substructure repair work.

- Agriculture Building
  As reported in the 2015 and 2016 presentations, the East and South Aprons surrounding the Agriculture Building have significant deterioration due to corrosion of slab and beam rebar. The substructure directly supporting the building is in better condition due to repairs and protective coating installed in the 1950's but still has areas of deterioration. The building's steel frame is structurally sound but there is widespread cracking at various façade elements. At present, the South Apron is restricted to light passenger vehicles while no vehicular traffic is allowed on the East Apron. No funding source has been identified for repair of the Agriculture Building and further deterioration of the substructure may lead to more stringent load restrictions in the future.

- Pier 30-32 Substructure
  Pier 30-32 was originally built in 1912 and this 1912 construction comprises most of the current facility. This portion of the Pier has deterioration of deck slab and beams due to rebar corrosion and deterioration of concrete cylinder columns piles due to a combination of chemical degradation of concrete and rebar corrosion. The remainder of the Pier 30-32 substructure is in better condition but still has some deteriorated structural components. At present, the majority of Pier 30-32 is used for passenger vehicle parking due to substructure load restrictions. No funding source has been identified for the repair of the Pier 30-32 substructure.

- Pier 50 South Timber Apron
  The Pier 50 South Timber Apron has a significant number of wood piles that have severe biological deterioration. As a result, the entire apron is either yellow tagged or red tagged depending on the extent of the damage in specific areas. The apron is frequently inspected to verify that it is still safe to use as emergency egress where required for certain tenant operations in Shed B. Port Engineering has prepared engineering plans to repair a small section of the South Apron at the west end. Port Maintenance will be executing this repair work in the very near future.

- Pier 54 Substructure
  As reported in 2015 and 2016, Pier 54 has a widespread damage to reinforced concrete beams and girders due to corrosion of rebar. Recent inspection has reinforced the need to increase enforcement of existing load restrictions. Within the past two years, a 3,800 square feet portion of the north apron constructed with timber piles was red tagged and barricaded due to severe deterioration. Port Real Estate has held discussions with serval tenants about load restrictions and the effect on tenants' business activities. Port has constructed an overhead barrier that prevents larger vehicles from accessing the Pier. No funding source has been identified for the repair of the Pier 54 substructure, which is estimated to cost tens of millions of dollars.

- Pier 68 – Shipyard High Water Platform Substructure

The High-Water Platform substructure at the Shipyard facility has a significant number of deteriorated beams with corroded rebar. Much of the damage is concentrated along the only access between the larger Dry Dock No. 2 and shore, which was a constraint on yard operations. No funding source has been identified for the repair of this platform structure.

The entire list of fully or partially yellow tagged facilities are listed in Exhibit No. 1.

## FULLY RESTRICTED FACILITIES – RED RATING

Fully restricted or red tagged facilities have more advanced deterioration and usually have experienced localized failures of primary structural elements. Red tagged facilities must be completely vacated before more widespread failures and/or collapse occur. In some cases, red tagged facilities can be repaired but it is often more cost effective to demolish and replace structures that have advanced levels of structural deterioration.

Even after a facility has been red tagged and vacated, Engineering Staff continue to perform regular inspections to monitor for any signs of imminent collapse. Port Pile Removal funds, Port Capital Project funds and Port Maintenance resources are directed to demolishing the highest risk red tagged structures.

In some cases, buildings may be red tagged due to serious life safety concerns about safe exiting and egress features. The structure of the facility may be adequate (i.e. not a collapse risk) but without proper egress the building is not safe for occupancy. These egress issues are not a part of the Structural Assessment Program, but are brought to the Engineering Division's attention after regular Fire Inspections performed by Fire Marshall staff.

All fully or partially red tagged facilities are listed in Exhibit No. 2.

## FUTURE ENVIRONMENTAL FACTORS

A combination of future environmental factors will likely contribute to accelerated deterioration of the Port's substructure assets and make inspection and repair of these assets more difficult and costly. With sea level rise, the underside of pier decks will be more frequently exposed to damaging sea water. The available windows to inspect and perform repair work underneath the piers will also decrease as sea levels rise. Simultaneously, environmental degradation of the reinforced concrete that makes up most of the Port's historic finger piers tends to be an accelerating process unless repairs are made. This degradation both increases the amount of structural repair needed and also restricts the future use of heavy construction equipment above the pier decks. Both of these factors will likely drive up the cost of future repair projects beyond the typical year to year escalation in construction costs. The Port's Engineering Division is working with the Waterfront Resilience Program (WRP) to consider sea level rise and seismic issues at Port facilities.

Port Staff have been actively engaging the public at large about the challenge of preserving the Port's historic piers in the face of increasing environmental threats. In October 2016 the Embarcadero Historic District was named as one of eleven *Most Endangered Historic Places* by the National Trust for Historic Preservation precisely because of the "major physical threats" to the District's infrastructure.

## CAPITAL PLANNING

The latest update to the Port's 10 Year Capital Plan identifies, at a high level, $2.0 billion in deferred maintenance needs over all the Port's facilities. Structural repair and building envelope repair represent the majority of the Port's capital needs. The Structural Assessment Program provides valuable data to the biennial updates to the 10 Year Capital Plan.

The list of *Improvements Since February 2018* demonstrates the variety of mechanisms for funding structural repairs and improving the status of the Port's Red and Yellow Tagged facilities: Port capital projects constructed by Port Maintenance or bid out to construction contractors, projects performed by other public agencies, tenant repairs with and without rent credits, and developer lead projects. For Port funded projects, the structural condition of a facility is one of several factors evaluated by the Port's senior staff and Finance division when allocating capital project funding through its capital ranking process (where senior staff discuss and rank proposed capital projects).

Given this extent of the Port's deferred maintenance backlog compared to the Port's limited two-year Capital Budget it is clear that not every yellow or red tagged facility can have a fully funded repair project. The Structural Assessment Program seeks to provide Capital Planning decision makers with accurate and up to date information on the condition of the Port's structures so that projects can be prioritized appropriately among other competing priorities for capital.

## CONCLUSION

The safety of the Port's facilities is critical to tenant businesses, the public, and the Port's day-to-day operations. Maintenance and repair of the Port's historic buildings, piers and wharves are major economic factors in the Port's land use planning and capital planning. The Structural Assessment Program (including both RSA and FIRPA) provides valuable, up-to-date information on the structural condition of these facilities. The primary function of these assessments is to identify and mitigate public safety issues. The Structural Assessment Program also provides a basis for the Port's maintenance and repair programs, capital improvement programs, and land use strategy. The restarted RSA program will be back on cycle in three years using consultants to augment the inspection effort.

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For: Rod Iwashita, Chief Harbor Engineer

## EXHIBITS

1. List of Yellow Rated Facilities – Restricted Use
2. List of Red Rated Facilities – No Use Permitted Without Repairs

## ATTACHMENTS

1. Substructure Structural Rating Map
2. Superstructure Structural Rating Map

# Exhibit 1

# List of Yellow Rated Facilities – Restricted Use

## Yellow Rated Facilities – Restricted Use

| Facility | Structural Problem |
|---|---|
| Pier 47 Substructure | Damaged piles and deck framing |
| Wharf J9 | Damaged section of timber seawall |
| Pier 45 Aprons | Deteriorated wood piles |
| Pier 43½ Unleased Area / Public Access | One missing pile |
| Pier 35 Substructure | Corrosion damage in structural concrete piles, beams, and slab |

| Facility | Structural Problem |
|---|---|
| Pier 33½ Marginal Wharf - North End | Corrosion damage in structural concrete piles, beams, and slab |
| Pier 33 Substructure | Corrosion damage in structural concrete piles, beams, and slab |
| Pier 31 Substructure | Marginal wharf, east end, and outer end have corrosion damage, mainly in concrete beams |
| Pier 29½ Substructure | Corrosion damage in structural concrete piles, beams, and slab |
| Pier 29 Substructure | Corrosion damage in structural concrete piles, beams, and slab |
| Pier 23.5 Substructure | Spalling of beams, girders, and slab panels |
| Pier 17½ Marginal Wharf | Corrosion damage in structural concrete piles, beams, and slab |
| Pier 17 | Corrosion damage at marginal wharf deck and east end |
| Pier 9½ Marginal Wharf | Corrosion damage in structural concrete piles, beams, and slab |
| Pier 9 – Portions of North Apron | Deteriorated wood piles |
| Pier ½ | Motorcycle parking area beams and slab show spalling, deterioration, racks. |
| Agriculture Building Substructure | Corrosion damage in structural concrete piles, beams, and slab |
| Pier 22.5 | Damage to wood friction clamps |

| Facility | Structural Problem |
|---|---|
| Pier 26 Shed | Superstructure elements have incurred dry rot, roofing needs replacement |
| Pier 26½ Marginal Wharf | Corrosion damage in structural concrete slab and structural steel beams |
| Pier 28½ Marginal Wharf | Corrosion damage in structural steel beams |
| Pier 30-32 | Corrosion damage in structural concrete piles, beams, and slab |
| Pier 38 Substructure | Corrosion damage in structural concrete slab and structural steel beams. Un-permitted modifications by past tenant. |
| Pier 40 | Corrosion damage in structural concrete slab and structural steel beams |
| Pier 50 Shed A (North) Apron | Deteriorated wood piles |
| Pier 50 Shed B (South Apron) | Deteriorated wood piles |
| Pier 50 - Portions of Valley | Corrosion damage in structural concrete piles, beams, and slab |
| Pier 54 Substructure | Corrosion damage in structural concrete piles and beams |
| Pier 68 – Portions of High Water Platform | Corrosion damage in structural concrete beams. |
| Pier 68 Building 105 | Non-bearing brick wall is deteriorated and has been identified as a seismic hazard. Lateral force resisting members have been removed. |

| Facility | Structural Problem |
|---|---|
| Pier 68 Building 109 | Lateral force resisting members have been removed |
| Pier 68 Building 109C | Open steel structure is not safe for occupancy. Falling hazards from failed glazing and roofing. |
| Pier 68 Building 111 | Building identified as a seismic hazard and is not occupied |
| Pier 90 Wharf Section, West End | Deteriorated wood piles |
| Pier 92 Substructure | Past concrete deck failures due to overloading by past tenants. Failed areas have been repaired. |
| Pier 94-96 North East Sea Wall | Rip-rap shore protection is undermined. |
| Pier 96 South Sea Wall | Corrosion damage to steel sheet pile wall. Flooding at high tide due to settlement of overall site. |

# Exhibit 2

# List of Red Rated Facilities – No Use Permitted Without Repairs

### Red Rated Facilities – No Use Permitted Without Repairs

| Facility | Structural Problem |
|---|---|
| North end of Pier 47 at former Alber's Lease | Deteriorated wood deck and piles. Corroded structural steel building frame. |
| Pier 45 Aprons | Deteriorated wood piles |
| SWL 302 Lease Parcels | Section of deck with dry rot and damaged pile |
| Wharf J9 Railing | Failed railing |
| Pier 35.5 | Dry rot in deck boards and girders (Maintained by Pier 39) |
| Pier 43 | An inaccessible portion of the deck is red tagged due to pile deterioration, timber deck deterioration and lack of guardrails. |

| Facility | Structural Problem |
|---|---|
| Pier 33 and 31 Timber Wales | Deteriorated and missing wood piles at wales (outer end of pier at corners). These are relatively small areas of the entire pier. |
| Pier 33 North Apron | Depressed track not infilled and thus not suitable for pedestrian use |
| Pier 19 North Apron | Deteriorated wood deck and piles. |
| Pier 9 North Apron – Lower Rail Deck | Deteriorated lower rail wood deck |
| Ferry Plaza Gate C | Weld cracks of structural steel members (Maintained by Golden Gate Ferry) |
| Tidal Steps at Rincon Park | Corrosion damage to reinforced concrete steps. |
| Tidal Steps at Pier 14 | Corrosion damage to reinforced concrete steps. |
| Pier 26 North Apron | Depressed track not infilled and thus not suitable for pedestrian use |
| Pier 28 South Apron | Wood framing infill over depressed rail track is deteriorated |
| Pier 38 Bulkhead | Bulkhead building is structurally adequate. Building was red tagged due to inadequate egress and other safety issues associated with unpermitted construction. |
| Pier 38 North and South Aprons | Deteriorated and missing wood piles, deteriorated and missing wood deck |
| Pier 40, North-east corner | One steel girder has severe corrosion damage that was not addressed in past repairs by Redevelopment Agency. |

| Facility | Structural Problem |
|---|---|
| Pier 48 North and South Aprons | Deteriorated and missing wood piles. |
| Pier 50 Shed B (South Apron) | Deteriorated and missing wood piles. |
| Pier 52 | Deteriorated and missing wood piles. Partial collapse during storm in 2017. |
| Pier 54 North Apron - Timber Portion | Deteriorated and missing wood piles. |
| Pier 60 | Deteriorated and missing wood piles, deteriorated and missing wood deck |
| SWL 345 - 671 Illinois Street | Superstructure has fire damage and noticeable floor deflection. |
| Pier 68 - Portion of High Water Platform (Area 8) | A portion of the High Water Platform with concrete cylinder columns has excessive settlement. |
| Pier 68 - Building 38 and 119 | Various deterioration, including severe deterioration at reinforced concrete façade of Building 38 |
| Pier 70 - Building 6 Warehouse | Deteriorated and missing timber piles at substructure. Corrosion to structural steel and cladding at superstructure. General unsafe for occupancy. |
| Pier 70 Wharf 7 & 8 | Pier structures are partially collapsed |
| Pier 84 and Pier 88 in Islais Creek | Pier structures are partially collapsed |
| Pier 90 Timber Wharf | Pier structures are partially collapsed |

| Facility | Structural Problem |
|---|---|
| Pier 90 Grain Silos and adjacent facilities | Steel structures have corrosion damage. Concrete structures are structurally adequate but are unsafe for occupancy. |
| Pier 96 LASH Barge Mooring Pier | Pier structures are partially collapsed |

# Attachment 1

# Structural Rating Maps (Substructure)

# Attachment 2

# Structural Rating Maps (Superstructure)