Chapter 10. Seaport

The Port of Oakland (Port) is an autonomous department of the City of Oakland. The Port manages property along 20 miles of the eastern shore of San Francisco Bay and is divided into three operating units: Maritime, which owns and operates the Seaport; Aviation, which owns and operates Oakland International Airport; Commercial Real Estate, which owns property along the shoreline. The Port was officially established in 1927 under the direct control of the Board of Port Commissioners. As an independent department, the Port funds its own operations and receives no tax revenues from the city. The Port is located to the west of Interstate 880 and south of the San Francisco-Oakland Bay Bridge (Interstate 80). The residential and industrial community of West Oakland is located immediately to the east, and downtown Oakland, the Bay Area's second largest central business district, is located to the northeast.

The Seaport is landlord-based, meaning it owns and builds most of the port infrastructure, but private shipping companies are responsible for operations at the terminals they lease. The Port is made up of a number of facilities, including

- Shipping berths, container storage areas, and intermodal rail facilities, which constitute approximately 1,200 acres
- Four major terminal areas, which together total 775 acres:
  - Outer Harbor Terminal Area
  - 7th Street Terminal Area
  - Middle Harbor Terminal Area
  - Inner Harbor Area
- 20 deep water berths (depths of 50 feet)
- 36 container gantry cranes (30 are post-Panamax types)
- Two intermodal rail yards:
  - Oakland International Gateway (OIG), operated by Burlington Northern Santa Fe on Port-owned land
  - Railport, owned and operated by Union Pacific Railroad on adjacent private property
- Oakland Army Base – while not officially part of the Port, some ancillary Port services take place on the former Oakland Army Base, also referred to as the "backland"

Exposure

Exposure is the extent to which an asset experiences a specific climate impact such as storm event flooding, tidal inundation, or elevated groundwater. The exposure of the Seaport to two sea level rise projections and three Bay water levels was evaluated using two different approaches. The two sea level rise projections, 16 inches (40 cm) and 55 inches (140 cm), correlate approximately to mid- and end-of-century. These two sea level rise projections were coupled with three Bay water levels: the new daily high tide, measured as mean higher high water (MHHW), the new 100-year extreme water level, also known as the 100-year stillwater elevation, and the 100-year extreme water level coupled with wind waves, hereafter :"storm event with wind waves," or "wind waves." These water levels were selected because they represent a reasonable range of potential Bay conditions that will affect flooding and inundation along the shoreline. For more information about sea level rise projections and Bay water levels evaluated see Chapters 1 and 2.

For each of the water levels, the exposure of selected facilities within and associated with the Port of Oakland was evaluated. As shown in Table 1, the Port is not exposed to the daily high tide or storm event flooding with 16 inches of sea level rise, although portions of two terminal areas, the Union Pacific Railport, and some of the Oakland Army Base are exposed to wind waves. With 55 inches of sea level rise, parts of the Railport, Oakland Army Base, and portions of rail track are exposed to the daily high tide; these areas and parts of the Outer Harbor Terminal Area are exposed to storm event flooding, and all of the selected Port assets except for the 7th Street Terminal Area and Oakland International Gateway are exposed to wind waves.

Table 1. Selected Port assets exposed to wind waves with 16 inches of sea level rise, and daily high tide and storm events with 55 inches of sea level rise. No areas are exposed to the daily high tide or storm event flooding with 16 inches of sea level rise.

	16" SLR	55" SLR		
	Storm Event	Daily High Tide	Storm Event	
Port Asset / Area	**Areas exposed to wind waves only**	**Areas exposed**	**Areas exposed**	**Areas exposed to wind waves only**
Outer Harbor Terminal Area	Parts of Terminal, incl. Berths 20-37		Parts of Terminal, incl. Berths 20-37	Parts of Terminal, incl. Berths 20-37
7th Street Terminal Area				
Middle Harbor Terminal Area	Parts of Terminal, incl. Berths 60-68			Parts of Terminal, incl. Berths 55-59
Inner Harbor Area			Parts of Terminal, incl. Berths 60-68	Parts of Terminal, incl. Berths 60-68
Oakland International Gateway				
Union Pacific Railport	Parts of Railport	Parts of Railport	Parts of Railport	Parts of Railport
Oakland Army Base	Parts of Port areas on Base	Parts of Port areas on Base	Many Port areas on Base	Many Port areas on Base
Rail Tracks serving Port		Tracks south of Port near Lake Merritt	Tracks north and south of Port	Tracks north and south of Port

Sensitivity and Adaptive Capacity

The sensitivity and adaptive capacity of the Port was assessed for three potential climate impacts that could occur due to sea level rise and storm events. The three climate impacts considered are:

- More frequent floods or floods that last longer due to storm events
- Permanent or frequent inundation by the daily high tide
- Elevated groundwater levels and saltwater intrusion

Sensitivity is the degree to which an asset or entire system (e.g., particular terminals or related services such as rail and roads) would be physically or functionally impaired if exposed to a climate impact. Adaptive capacity is the ability for an asset or system to accommodate or adjust to a climate impact and maintain or quickly resume its primary function. The sensitivity and adaptive capacity of the Port was evaluated, considering not just physical sensitivity, but also functional sensitivity and the sensitivity of the regional goods movement network.

Rising groundwater could increase the potential for liquefaction-induced damage. The seaport is located on sandy Bay fills which are subject to liquefaction. Damage to facilities at the Port of Oakland in the 1989 Loma Prieta earthquake was due primarily to liquefaction of the hydraulic fill (ABAG 2001). All of the terminals were affected, with the most extensive damage to the Seventh Street Terminal (Berths 35-38). Ground acceleration at the Port caused widespread liquefaction and sand boils in several terminals, resulting in up to one foot of settlement and distress to backland pavement, utilities, and small buildings. The damage to wharf structures at the Seventh Street Terminal was severe enough to close the terminal for several months and reduce its operations for over a year until emergency repairs were completed.

Redundancy and excess capacity at the seaport can help reduce potential impacts of sea level rise if terminal areas and/or berths are temporarily impaired. At its present size and with its existing rail infrastructure, the Port is projected to have adequate capacity through 2021 (Tioga Group 2009). Infrastructure improvements on rail and road connections would enable the Port to meet forecast demand through 2030. Thus, the Port of Oakland is not faced with immediate capacity constraints based on projected cargo demand and could potentially absorb additional goods movement at its other terminals should one be rendered inoperable. This sort of adaptive capacity was observed when the Loma Prieta Earthquake forced the closure of the 7th Street Terminal for over a year. The ability of other terminals to compensate for the temporary closure of other parts of the Port is only possible when impacts are confined to small areas.

Some Port assets are not directly exposed to tidal inundation or storm event flooding with sea level rise, but are sensitive to potential impacts on the terminal areas' substructure support systems. Terminal decks are supported by concrete pilings embedded in a rock dike embankment that slopes down to the terminal water depth, which ranges from 42 to 50 feet below mean lower low water. The potential for these structures to be exposed to more climate impacts could compromise their integrity, leading to increased damage and maintenance costs. An example of indirect climate impacts comes from the Port of Los Angeles, which predicts that an increase in sea levels would affect its storm drain system (Vera 2009), which would act as a conduit for sea water, flooding the terminals and surrounding streets.

Regular maintenance and the ability to quickly repair damaged facilities could contribute to the adaptive capacity of terminal areas and substructure support systems, but operations and maintenance costs are very high and the financial mechanisms to improve seaport infrastructure are complicated. In its five year 2012-2016 Capital Needs Assessment, the seaport budgets $146 million for maritime projects (Port of Oakland 2011). About two-thirds of this total is to come from Port-generated cash and must be used to pay for operations, debt service, and other obligations first, with any remainder to fund capital projects. The remaining one-third of the budget is expected to come from grants from government agencies including the Federal Maritime Administration, California Air Resources Board, Bay Area Air Quality Management District, and Metropolitan Transportation Commission. The high cost of budgeted infrastructure improvements does not include protecting against future sea level rise and flooding impacts. Such protection would increase budgets substantially – for example, the Port of Los Angeles estimates that hardening its terminals and berths to withstand projected mid- to end-of-century sea level rise would cost 25% more than current upgrade costs (Rand 2011).

The seaport is dependent on berths and terminals to dock shipping vessels and unload their cargo and also on the adjacent rail yards and freeways that carry those goods to other parts of the region, state, and country. Thirty percent of goods moving into and out of the Port are transported by rail (Port of Oakland 2008). As noted in Table 1, portions of track and other rail assets that serve the Port are exposed to wind waves with 16 inches of sea level rise, and all Bay water levels with 55 inches of sea level rise.

The rail system that serves the Port of Oakland cannot function when flooded. Inspection and work pits at railroad maintenance facilities have pumping equipment meant to keep them dry in the event of storm event flooding or groundwater intrusion. However, this pumping equipment has limited capacity so its effectiveness would depend on the severity of flooding. While the tracks could return to use quickly after a floodwaters recede, frequent inundation would result in unacceptable delays, essentially forcing the system's infrastructure to either be upgraded or abandoned. To improve the adaptive capacity of the asset to withstand flooding events, the existing right-of-way could be used to build a higher railbed. However, raising the railroad requires related structures to be raised, which would be difficult if not impossible without complete reconstruction.

Seventy percent of the goods moving into and out of the Port are transported by truck to Interstate 880, the primary freeway that connects the Port with points south such as San Jose and Silicon Valley. The segment of I-880 between Oak Street and 23rd Avenueis exposed to inundation from all scenarios except the daily high tide with 16 inches of sea level rise. While trucks could be re-routed in the event of flooding on I-880, this would have impacts on local neighborhoods.

The function of the Port is extremely sensitive to disruption because of the nature of the goods exported. The top commodities exported in 2010 were fresh fruits and nuts and meat products, accounting for over 33% of the total export value (Port of Oakland 2011). These perishable products require quick transport between their source and the market and cannot tolerate delays or the inability to access the Port. Transport of California's agricultural products does have some adaptive capacity. Ninety-nine percent of containerized goods moving through northern California travel through the Port of Oakland, but the Port of Richmond and the Port of San Francisco have the infrastructure in place to handle containerized goods. However, these ports do not currently handle such goods and do not have the capacity of the Port of Oakland. Further, these ports have a maximum water depth of 38' and cannot handle the largest container ships that Oakland's 50' channels can.

Consequences

The potential consequences of sea level rise are considered for the Port and supporting transportation infrastructure. Consequences are the magnitude of the effects on the economy, society, environment, and governance if an impact occurs. Factors that inform the magnitude of the potential consequences include: the type and severity of the impact on O&M or capital improvement costs; the size and demographics of affected communities; the potential impact on employers and employees; and the type of natural resources affected.

Economic

By number of annual TEUs (twenty-foot equivalent units; a standardized size of the containers in which goods are shipped), the Port of Oakland is the 3rd busiest container port on the West Coast of the United States and the 5th busiest in the country. In 2010, 1,973 cargo vessels imported over 2.33 million TEUs through the Port. Primary imports include machinery, electrical equipment, knit apparel, furniture, and beverages, mostly from Asia. The Port's primary exports include fruits, nuts, and meats. In sum, over $39 billion worth of imports and exports flowed through the Port in 2010.

In the Bay Area alone, this cargo activity generated 28,833 direct, induced, and indirect jobs (Martin Associates 2011). Fifty-two percent of the direct jobs created by the Port are within Alameda County, with nearly 20% in the City of Oakland. Eighty-seven percent of the direct jobs are created within northern California. These jobs range from rail and truck operators to unionized longshoremen to bar pilots. The average salary of a Port-related employee is $40,400, better than the average wage of $37,890 for production workers in the Oakland-Fremont-Hayward Metropolitan Area. In total, nearly 444,000 jobs are related, in some way, to the movement of cargo at the Port of Oakland.

In addition to jobs, the revenue brought in by Port activity helps local businesses and communities. In 2010, cargo handled at the Port supported about $2.2 billion of total personal income, $2.1 billion in revenue for businesses providing maritime services for cargo and vessels, and $233 million in state and local tax revenue. Each year, depending on the revenue surplus, the Port makes financial contributions to the City of Oakland. Past large-scale disruptions have had large monetary impacts to the Port. For example, a one-day closure of four berthing areas caused an estimated loss of $4 million (Kuruvila 2011).

In addition to the direct economic losses from a disruption of the Port's operations and facilities, planned projects are expected to increase the economic role the Port of Oakland plays in logistics in the Bay Area, state, and nation. The former Oakland Army Base closed in 1999, with segments transferred to both the City of Oakland and the Port of Oakland. Redevelopment of the site will entail three projects: Marine Terminal Redevelopment on Port-owned property; construction of an Intermodal Rail Terminal also on Port-owned property; and construction of Trade, Logistics, and Industrial Facilities on city-owned property. The Marine Terminal Redevelopment project will entail facility improvements located at Terminals 20-26 in the seaport's Outer Harbor area. The Intermodal Rail Terminal will be located between Maritime Street and Interstate 880 with the goal of increasing rail's share of goods movement to and from the seaport. Finally, the Trade, Logistics, and Industrial Facilities center will develop over 100 acres of land south of the Bay Bridge toll plaza and north of the Port of Oakland's marine terminal facilities into new industrial and cargo processing space for goods movement companies. The City of Oakland hopes to attract manufacturing, research and development, and green technology uses to this area.

The Oakland Army Base redevelopment projects are projected to create roughly 3,000 direct jobs in the near term and 12,000 jobs over the next 20 years; generate $4 million per year for the City of Oakland's general fund; and improve air quality in West Oakland and adjacent communities by reducing truck traffic. However, sea level rise and storm events may affect this site. Much of the former Army Base will be exposed to wind waves with 16 and 55 inches of sea level rise, and to the daily high tide and storm event flooding with 55 inches of sea level rise. The potential for future inundation could prevent development or negatively affect businesses as well as cargo movement if the project is completed as planned.

Society

The Port of Oakland is a key gateway for the export of California's agricultural products. The Port is unique among American ports in that, by volume, it exports more than it imports. More than 60% of all California exports of beverages, spirits, vinegar, coffee and tea, fruits, nuts, citrus, and melon leave the state through Oakland. In 2010, more than $10.1 billion in California-made goods and commodities were shipped through the Port of Oakland, representing over 29% of all exports produced in the state. In the absence of viable alternative export points, disruptions to the Port of Oakland would seriously affect California's agricultural communities.

Because of the Port's location adjacent to residential communities, it has major public health impacts. Goods at the seaport are moved primarily by diesel trucks, which cause air quality problems in the West Oakland community as well as increased traffic congestion on regional freeways. Emissions from Oakland's port operations, rail yards, and freeways cause diesel particulate matter (PM) concentrations that are three times higher in West Oakland than the Bay Area average. Additionally, 40 excess cancers per million residents of West Oakland are attributed to seaport-related truck drayage, and diesel PM is responsible for higher premature deaths and hospital admissions for respiratory and cardiovascular disease, as well as asthma-related and lower respiratory symptoms (CARB 2008). Diesel trucks are the greatest contributor to these emissions, compared to trains, cargo handling equipment, and ocean going vessels. The Port's air quality goals include a reduction of excess community cancer risk caused from Port-related diesel particulate matter by 85% from 2005 to 2020. A major initiative to achieve this goal is to increase the amount of goods traveling by rail with the proposed Outer Harbor Intermodal Terminal on the former Oakland Army Base. As discussed above, this area is exposed to several sea level rise and storm event scenarios.

Environment

Port activities affect the surrounding environment with air emissions and noise. Any disruption caused by sea level rise and storm events could prompt other ports to accept more containerized goods. This could result in potential air quality, noise, and quality of life impacts on the environment near these ports, particularly if construction is necessary to upgrade and expand facilities.

Port property includes many sites that are contaminated with chemicals and substances toxic to human health and the environment. For example, soil and groundwater near Berths 25 and 26 are listed by the State of California as being contaminated with volatile organic compounds), polycyclic aromatic hydrocarbons, and metals. A Leaking Underground Storage Tank is located near the old Albers Milling Company site at Berth 30 and includes gasoline contamination, and former Oakland Army Base lands, contain significant amounts of metals, polychlorinated biphenyls, and total petroleum hydrocarbon. Rising groundwater, tidal inundation, and storm event flooding could cause the release of these contaminants, which could affect adjacent wildlife habitat.

Governance

Many government agencies contribute to the Port's operational and infrastructure decisions. As an autonomous department of the City of Oakland, the Port's Board of Port Commissioners has primary control over the planning and development of its landside infrastructure. However, any waterside development, including the expansion and renovation of its berthing facilities and piers and the maintenance/deepening of harbor channels, is regulated by a complex web of government agencies. The primary state and federal agencies and the laws they administer in permitting such port development projects are:

- San Francisco Bay Conservation and Development Commission administers the McAteer-Petris Act's requirement for permits that require Bay fill.

- United States Army Corps of Engineers regulates the placement of dredged and/or fill material into waters of the United States pursuant to the Clean Water Act. Also maintains the Port's primary federal channel.
- United States Environmental Protection Agency oversees disposal of dredged material and water quality pursuant to the Clean Water Act.
- San Francisco Bay Regional Water Quality Control Board administers permits for water quality pursuant to the Clean Water Act.
- State Lands Commission has ownership of all state tidelands subject to the public trust doctrine.

Additionally, the California Department of Fish and Game and United States Fish and Wildlife Service issue takings permits when state and federally listed endangered species are known to be affected by Port projects, as is the case with California Least Tern, salmonids, and herring in the Bay. To protect water quality and endangered species, the Port is only allowed to dredge in certain times of the year, known as "dredging windows" (LTMS 2001). The dredging window is August 1 through November 30 of any given year. Should the Port need to dredge outside of this window, it would need to engage in a lengthy permitting process through various resource agencies to ensure that aquatic habitats are not disturbed.

Thus, the seaport's ability to develop its infrastructure and protect against impacts from sea level rise and storm events is complicated if development requires filling or dredging of the Bay. Sea level rise may damage the Port's facilities and result in shorter operational life spans of critical infrastructure. The need for emergency repairs may also increase. With different infrastructure investment needs and timeframes, the current regulatory structure that dictates when and how to develop waterside seaport facilities may be inadequate to address future circumstances.

Key Findings

The majority of seaport facilities are only exposed to the more extreme scenarios of 55 inches of sea level rise with a storm event. Some infrastructure that is located under the wharves may be exposed earlier than the rest of the seaport. Due to its location and nature, this infrastructure is the most sensitive to storm events and may need to be moved as sea levels rise. Due to the life-cycle of seaport infrastructure, it is likely that most of the seaport facilities will be replaced or significantly rehabilitated prior to this exposure and could be designed to reduce or eliminate sea level rise and storm impacts. For these reasons, the seaport has low exposure and medium to high adaptive capacity, provided that the financing is available to replace and rehabilitate seaport facilities and factor in sea level rise and storms in those projects.

The primary vulnerability to the seaport will be to the rail system that moves cargo to and from the seaport and the roadways that surround the seaport. The seaport is only able to function if the rail and roadways that serve it are functional. Portions of both the rail and roadway systems serving the seaport are exposed to sea level rise at 16 inches and this exposure increases with a storm event. By 55 inches of sea level rise, the effects on system of rail and roadways that serve the seaport are much greater. So, while the seaport facilities are not exposed at the earlier scenarios and not very exposed at the later ones, the infrastructure that is critical to seaport function – rail and road – is exposed and therefore the seaport function is vulnerable.

The seaport serves a significant role in the economy and society of the region. It is the primary seaport in the region and creates a number of jobs and economic activity, both directly and indirectly. The Port of Oakland's seaport moves agricultural and perishable products out of the region, and California's agricultural industry relies on the seaport to move its goods. Any disruption to seaport operations would have a significant effect on the region and the state. The other seaports around the Bay Area – including Richmond, San Francisco, Redwood City – do not have the capacity to meet the demand met at Oakland's seaport and therefore, the system lacks redundancy.

It is important to recognize the societal and environmental consequences of flooding to the rail or roadway systems that serve the seaport. If the rail system were to be affected, this would result in an increased number of trucks necessary to move goods to and from the seaport. This would have effects on the residential and commercial areas that already face health and quality of life problems due to truck traffic and ancillary truck services through and in their neighborhoods, as well as increased congestion on the surrounding interstates such as Interstates 880, 238, and 80. A disruption to the roadway systems serving the seaport may require rerouting of truck traffic through neighborhoods not designed to accommodate such traffic.

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