HayWired Scenario

FACILITATOR TOOLS

Supply Chain & Movement of Goods

Planning & Preparedness

Discussion Guide

Version 1.0

USGS science for a changing world

Earthquake Country Alliance

CALIFORNIA RESILIENCY ALLIANCE

Facilitator Tool: Supply Chain and Movement of Goods

This Facilitator Tool is a companion document to the HayWired Scenario Exercise Toolkit. It provides additional guidance and support material for leading a discussion-based exercise focused on planning and preparedness for supply chain / movement of goods impacts using the HayWired Earthquake Scenario.

Discussion Objective: Gain an understanding of how the HayWired Earthquake Scenario's impacts to different modes of transportation may affect our supply chain.

Discussion Scenario: Imagine that several hours ago there was a magnitude 7.0 earthquake on the Hayward Fault with an epicenter in Oakland, CA. Having confirmed that all our employees and their families are safe we are now looking at how this earthquake might affect our supply chains.

Issue for Discussion: The COVID pandemic highlighted vulnerabilities in supply chains. Thinking ahead, we want to better understand how a Bay Area earthquake might affect the supply chains upon which we depend. Supply chains are more than the last mile to our facility and impacts anywhere along the supply chain can cause disruptions both up and downstream. Major earthquakes can severely damage bridges, seaport and airport facilities, railways, and warehouses/distribution centers. Damages are not limited to ground shaking as infrastructure and structures may also be impacted by liquefaction, landslides, surface rupture of the fault, and fires after the earthquake. Using the scenario data below let us identify possible impacts to our organization's up and downstream supply chains.

Before Your Exercise…

See Section 4 of the Toolkit for instructions on how to facilitate a discussion-based exercise, including how to incorporate the theme-specific information compiled below.

Review Section 5 of the Toolkit so you are prepared to make use of insights and ideas captured during the discussion.

Information from HayWired Scenario Report

The following information from the HayWired Scenario Report provides additional context for this discussion. The volume, chapter, and page information (Vol, Ch, p) is included so that you can find more details, if desired.

Visuals such as maps, charts, and figures are available for some of the information (marked with 🎞) and can be used to further support your discussion. These visuals can be found both in PDF and PowerPoint slide deck formats at EarthquakeCountry.org/haywired.

Please keep in mind that while this information is based on a plausible scenario built on extensive research and expertise, a real event may unfold differently. Changes in the location of the epicenter, extent of fault rupture, variations in shaking intensity, details of actual buildings and their occupants, and mitigation measures taken since the Scenario was created can change the damages and impacts.

🎞 **Roadways:** Roadways cross the Hayward Fault rupture zone more than any other lifeline infrastructure, with highways crossing 37 times, secondary roads crossing 127 times, and surface streets crossing 424 times. Three to five percent of the region's highways (over 100 miles) are in high liquefaction intensity areas. About 200 miles of roadways go through high landslide intensity areas, where there is less redundancy (landslides are more common in hilly areas, where road coverage is more sparse) and road repair may be more challenging (Vol 3, Ch T, p 130-131).

🎞 **Bridges:** About 290 of the highway bridges in the region (about 8%) are exposed to high shaking intensity and about 170 (5%) are in high liquefaction intensity areas. About 82 bridges are exposed to moderate-intensity landslide hazards, whereas 20 are exposed to high-intensity landslide hazards (Vol 3, Ch T, p 130-131). In the Scenario more than 65%, about 2,700, of the highway bridges in the region will require at least 2 weeks of repair time (Vol 3, Ch T, App 5, p 213). Many bridges on I–880 between Fremont and Oakland are identified as high potential impact, taking at least four months up to as many as ten months to be repaired. On the I–680 between Fremont and Pleasanton there are also several bridges that are classified as high potential impact. Getting through Alameda County will potentially be difficult. Bridge impacts on I–580 between Oakland and Pleasanton also disrupt travel from the east into the Bay Area. Contra Costa County also has some connectivity issues owing to bridge impacts, especially around the intersection of California Routes (CA) 13 and 24. Several major highways have four or more months of estimated repair time in the Bay Area, which may hamper recovery after the Scenario's mainshock, having it take longer than anticipated (Vol 3, Ch T, App 5, p 213-214).

Debris on Roadways: Shaking damage to structures along roads may dump debris onto the streets and/or cause safety closures. There are over 2,500 miles of surface roads that are in developed parts of high-intensity shaking areas. Flames from fires following the earthquake can extend into roads and flammable trees can fall onto transportation corridors (Vol 3, Ch T, p 130-131).

- **Railways:** About 55 miles of railway are in high liquefaction intensity areas (Vol 3, Ch T, p 130). Some railway lines also run through landslide hazard areas (Vol 3, Ch T, p 183). Heavy and light railway lines cross the ruptured fault four times where coseismic slip is up to 5.2 feet (1.6 meters). Eight railway lines are exposed to potential afterslip of the fault (Vol 3, Ch T, p 180). High-intensity heat from fire, which can follow earthquakes, may warp railway lines via thermal expansion (expansion due to heat) or ignite wooden railroad ties (Vol 3, Ch T, p 130).

- **Airports:** The 3 major Bay Area airports (SFO, OAK, and SJC) have terminals, gates, runways, and other structures used for airport operations such as hangars exposed to high liquefaction hazards. This is particularly the case at the Oakland International Airport where the majority of runways are exposed to high liquefaction hazards. The San Jose International Airport has some operations structures that are impacted by high ground-shaking intensity (Vol 3, Ch T, p 130-131). San Jose International Airport may also be impacted by nearby water leaks (Vol 3, Ch T, p 155). Travis Air Force Base in Solano County is exposed to low-to-moderate shaking from the mainshock, but not to any of the other earthquake hazards. Moffett Federal Airfield in Santa Clara County is exposed to moderate to high shaking from the mainshock (a small part of the northernmost part of the Moffett airstrip has high liquefaction potential) and would be in moderate or high shaking intensity areas for four or five aftershocks of magnitude 5.0 or greater (Vol 3, Ch T, p 130-131).

- **Ports:** Most of the Oakland seaport and the southern half of the San Francisco seaport is exposed to high liquefaction. 6% of seaport docks/berths are in areas with high liquefaction intensity, and 3% of docks/berths are in high shaking intensity areas (Vol 3, Ch T, p 130-131).

- **Warehouse and Industry Sector Damages:** Industrial buildings in Alameda County are older than in many other parts of the region, with an average age of 60 years. The prevalence of these older vulnerable buildings near the epicenter of the earthquake intensifies concentrations of damage in the Scenario. Concentrated building damages could disrupt the efficiency of industrial clusters of manufacturing, research and development, corporate offices, and suppliers in the Bay Area for the high-tech sector (Vol 3, Ch V5, p 618-9).

- **Refineries, Terminals, and Storage Facilities:** Of the 5 refineries* in the Bay Area one is in an area of high-intensity ground shaking and another is in a high intensity liquefaction area. All refineries are expected to be shut down after the mainshock. One third of petroleum, oil, and lubricant terminals (bulk storage of crude oil and refined petroleum products), storage facilities, and tank farms (a group of oil or gas storage tanks) are found in areas with high liquefaction intensity (Vol 3, Ch T, p 131-2). For all refineries it will be at least 7-10 days before fuel production resumes (Vol 3, Ch T, p 165).

  Fuel Distribution: Most gas stations in the Bay Area do not have back-up power supplies to operate fuel pumps. In the Scenario, electric power restoration is estimated to take days in the less affected counties to weeks in the more affected counties (Vol 3, Ch S, p 79). Furthermore, generator usage due to power outages would place further demands on fuel (Vol 3, Ch T, p 165).

* In 2020 Marathon's Martinez Refinery was shut down and in 2023 it began operations as a renewable biofuel manufacturing and terminal facility.

Individuals to Consider Including in the Discussion

Who you include in your exercise should be determined by who can add value to the discussion. This could include key information about your organization's facilities, vulnerabilities, plans/policies/practices, etc. The size of the group will also influence the quality of the discussion; in a large group important points may be lost, while a small group may not have the needed information.

Consider including person(s) with knowledge or responsibility for:

- purchasing and procurement
- organization's suppliers and vendor management
- emergency management and/or business continuity planning
- depending on your relationship with your supplier you may even consider inviting someone for that organization to participate

Suggested Questions for your Discussion

Depending on who is participating and how long you have, you may decide to use all of these questions or only a few. The list of questions is not all inclusive and you may decide to adapt some to better fit your organization. An in-depth discussion of just a few questions may have more value than covering and only scratching the surface of many questions.

- How well do we understand where the products that are important to our operations come from, including how they get into the region? (e.g. do they arrive in a port, are they brought into the region by railcar, are they flown in via plane, where are the warehouses located etc.)
- How would disruptions to major highways in the Bay Area region affect our supply chain?
- How would disruptions to railway lines in the Bay Area region affect our supply chain?
- How would disruptions to airports in the Bay Area region affect our supply chain?
- How would disruptions to the ports in the Bay Area and/or up the Sacramento River affect our supply chain?
- What major roadways are important to our supply chain?
- Does our supply chain rely on public transit to move any goods?
- Where are local warehouses critical to our supply chain located?
- What arrangements do we have with suppliers in the eventuality of a catastrophic event? Are those arrangements in writing?

- What arrangements do we have with our customers in the eventuality of a catastrophic event? Are those arrangements in writing?
- How many days can we continue to operate using only our in-house inventories?
- How might demand for critical supplies be affected by supply chain disruptions?
- How might demand for critical supplies be affected by the earthquake response and recovery?
- If we have a fuel provider, are they able to source fuel from outside the region? Are they able to meet California fuel requirements in the event those requirements are not lifted?

Additional Elements to Consider

Here are some additional factors and variables you may want to take into account during your discussion.

- **Product Demand and Shortages:** After an earthquake there will be increased demand for certain products and materials, which will create localized supply shortages.
- **Transportation Disruption:** Disruptions to one mode of transportation can cause cascading impacts and disruptions in other modes of transportation.
- **Cascading Impacts:** In addition to damages to infrastructure, supply chain disruptions can also be caused by staffing shortages and damages to other infrastructures such as power and telecommunications.
- **Fuel:** The refineries in the Bay Area supply the fuel for most of Northern California and parts of northern Nevada. There are no inbound refined fuel pipeline connections into the Bay Area from outside the region. Bringing goods and materials in from outside the region also increases transit mileages and uses more fuel, which may be in short supply.
- **Impact to Manufacturers:** Damage from a large earthquake could cause specialized industrial clusters in older manufacturing areas and move manufacturing to more affordable places, creating ripple effects to suppliers, customers, research and development, and headquarter operations.
- **Sinkholes:** Broken water and wastewater pipes can lead to sinkholes.
- **Traffic Signal Outages:** Traffic signals require power to function and most do not have any pack-up power sources. Traffic signal outages will cause additional disruptions on surface streets.
- **Rotating Outages:** Initially there may also be rotating outages, in the event the power grid cannot meet the demand. This may mean organizations gain and lose power on a daily basis for a while, until the grid is restored. As a result, equipment that survived the initial loss of power may be impacted by subsequent losses of power.