

18. KAISER PERMANENTE REDWOOD CITY MEDICAL CENTER

Kaiser Foundation Hospital

VULNERABILITY SUMMARY

Vulnerability of Redwood City Medical Center to sea level rise is **moderate**. This new facility has an emergency department (ED) and has never been flooded, but could be exposed to flooding from Redwood Creek. Sensitivity to flooding is moderate, as most of the essential components are unlikely to be exposed, with the exception of the ED, the ED entrance, and the supply dock. Adaptive capacity is high as ED patients can be evacuated to a higher floor or to nearby hospitals, and backup power and supplies are on site. Consequences of a loss of the asset would be high because evacuation could create additional stress for patients and increase loads on other hospitals.

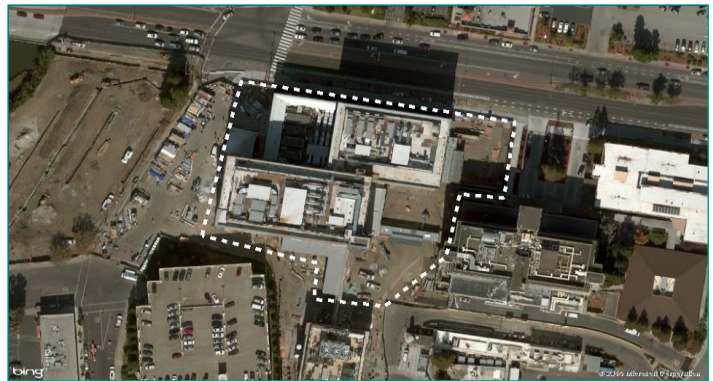
SENSITIVITY Moderate	EXPOSURE Moderate	ADAPTIVE CAPACITY High	CONSEQUENCES High
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ASSET CHARACTERISTICS

1100 Veterans Way | Redwood City

Asset Description and Function:

The Redwood City Medical Center ED is part of the larger campus, which is about 18 acres. The facility's primary components include parking lots, entryways to the facilities, clinics, a pharmacy, and an ED. The building also houses a Neuroscience Center of Excellence. There are 149 licensed beds with capacity for 175. It serves primarily Kaiser Permanente members, but also San Mateo County residents and nearby hospitals. The ED is on the ground floor with 25 beds; all other departments are on floors 2-7.



Asset Type	Hospital with Emergency Department
Asset Risk Class	4
Size	2.2 acres
Year of Construction	2015
Elevation	8-9 feet
Level of Use	149 beds
Annual O&M Cost	Unknown
Special Flood Hazard Area	Asset is in SFHA
Physical Condition	Newly Constructed
Landowner	Kaiser Foundation Hospitals

Underground Facilities

Electrical lines built for water-logged conditions. There are no conduits or entryways for water.

Environmental Considerations

Special status plants, animals, and natural communities may be present in the project area; a more detailed analysis will be needed before implementing adaptation strategies.



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ASSET SENSITIVITY

The new medical facility is moderately sensitive to flooding. The electrical (power), mechanical, and plumbing systems (including potable water), which directly affect level of service, are not sensitive to inundation as they are all located on the second floor of a Central Utilities Plant, which makes inundation of those systems very unlikely if not impossible. The electrical conduits that go into the ground and connect to the hospital are also designed with water in mind, so they should not be vulnerable to flood waters.

The underground storage tanks that store diesel fuel are sealed and regularly monitored. However, if the ground floor of the ED flooded, the ED would close and patients would need to be evacuated. Inundation of the driveway to the hospital, especially to the ED, would make it difficult to get patients in and out: a delay that could affect a patient's well-being. The extent of damage to the facility is likely to be low because the building was built with flood considerations in mind. Also, the only facility that is sensitive to flooding is the ED on the ground floor. So long as the hospital had power, clinics and other sections of the hospital serving non-emergency functions could remain in operation because they are all on the second and higher floors.

Redwood Creek can overtop and cause flooding at the facility.



SHORELINE VULNERABILITY

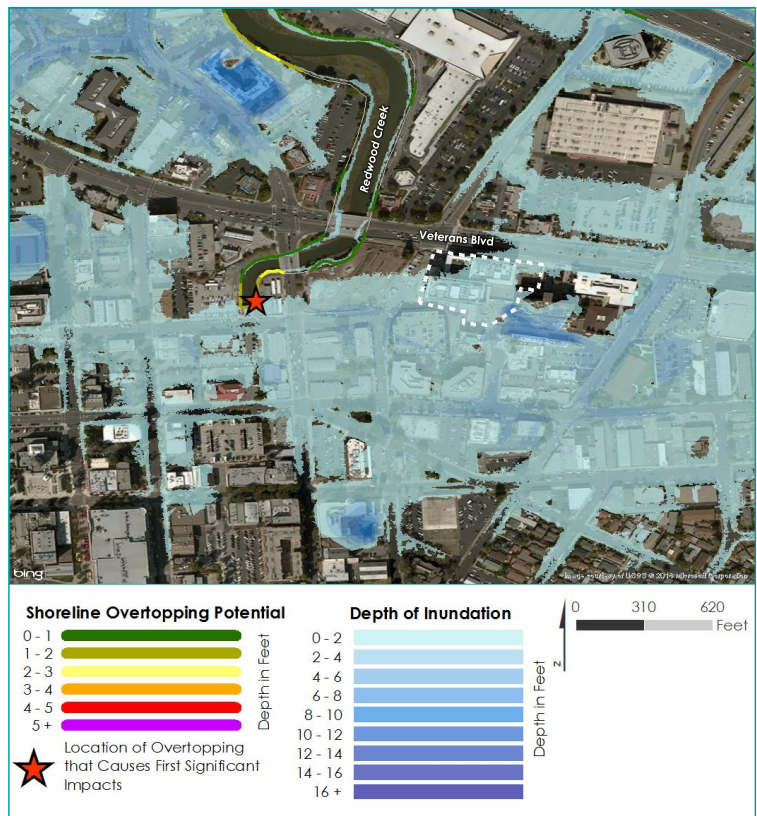
Shoreline Overtopping Analysis

High water on Redwood Creek would be the source of flooding nearest to the asset. When water surface elevations increase around 12 inches above mean higher high water (MHHW), Redwood Creek would overflow the bank about 600 feet west of the asset (see red star to the right). The first level of inundation that would cause significant disruption to the asset, however, does not occur until water levels reach between 24 and 36 inches above MHHW. This water level affects facility access roads, parking lots, and the entrance ways to the ED, as well as the supply chain loading dock.

Cross-Cutting Vulnerabilities

In the past, stormwater overflow has affected roads and parking lots on the Kaiser campus when Redwood City's storm pump station on the corner of Maple Street and Veteran's Boulevard stopped working.

First Significant Disruption: 36 inches above MHHW.



KAISER PERMANENTE REDWOOD CITY MEDICAL CENTER SEA LEVEL RISE EXPOSURE ANALYSIS

Exposure Discussion

Exposure of the Kaiser Medical facility is moderate. While the asset has not previously experienced flooding or groundwater impacts, the site is vulnerable to flooding from the nearby Redwood Creek. Under a condition with heavy rain and a high tide, the creek may not discharge to San Francisco Bay, causing backup and overtopping near the asset. Historically, Redwood Creek overtopped and caused flooding in the nearby parking lot.

Flooding from the combination of rain and higher tides will likely occur more frequently in the future due to sea level rise. If water were on site, the lower-lying areas of the facility would flood first, including the parking lot, the loading dock, the entrance to the ED, and the ED itself. At 10 and 13 feet deep (the depth of flooding in the mid-level and high-end scenarios), the ED would be flooded, but the second floor - and therefore additional hospital clinics and the backup power system - would not be flooded. All access roads in the area would be underwater, however, thereby preventing intake and discharge (or evacuation) of patients.

Exposure Analysis Results

Potential Inundation Depth (feet)		
Scenario	Minimum	Maximum
First Significant Impacts (36 inches)	0	7
Baseline 1% Flood	0	0
Mid-Level 1% + 3.3 feet	0	10
High-End 1% + 6.6 feet	2	13

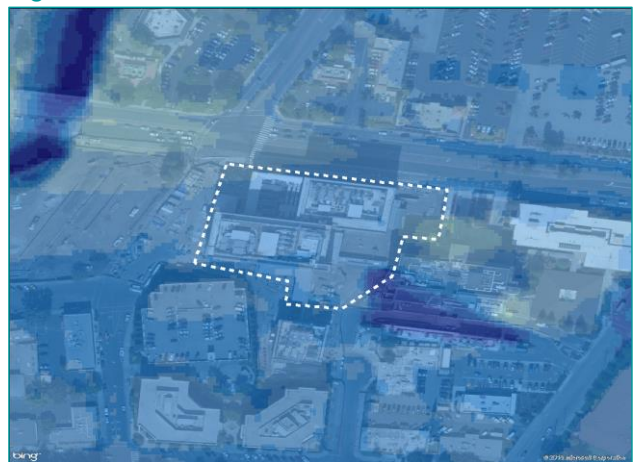
Baseline Scenario: Asset not yet inundated.



Mid-Level Scenario: Flooding up to 10 feet deep.



High-End Scenario: Asset under 13 feet of water.



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ADAPTIVE CAPACITY, CONSEQUENCES, AND POTENTIAL ADAPTATION

Adaptive Capacity

In the near-term, the hospital has a relatively high adaptive capacity, as it is a new facility and its design incorporates lessons learned from the impacts of Hurricane Sandy on healthcare facilities in 2012. Each Kaiser building on the campus has a business continuity plan that includes backup supplies, power, and alternate staging areas or other medical facilities in the event of evacuation. Specifically, the medical facility has two diesel generators with 3 MW capacity and enough fuel to operate for 96 hours. Both generators are elevated, and the storage tank that provides the diesel fuel is located underground, sealed to prevent water intrusion, and regularly monitored. There is an automatic transfer switch (on the second floor) that allows for uninterrupted transition from regular power to emergency power. If power and backup power were lost and elevators became inoperable, special chairs are available to evacuate patients down stairs. The hospital also has additional food to last 96 hours, and additional medical supplies to last 72 hours; there is also a 35,000-gallon sealed underground potable water tank.

If the ED were flooded, some patients in less critical condition could be taken to a higher floor out of harm's way, as the hospital has additional capacity (175 beds in total). ED patients or would-be patients that could not access the ED entrance could also be evacuated and taken to nearby Kaiser hospitals or other county hospitals if necessary. If the entire hospital were shut down, patients would be evacuated to any number of Kaiser hospitals in nearby Santa Clara, San Jose, Oakland, etc. Kaiser has a memorandum of understanding with nearby hospitals to accept additional patients. Because the hospital was built with flood considerations in mind, materials were used so that damage to the facility itself would be low or unlikely. Though the hospital has a high present-day adaptive capacity, more frequent flooding expected with sea level rise may reduce the effectiveness of current measures and a new broader adaptation strategy will need to be developed.

Consequences

Consequences of loss of service of the medical facility would be high, and the scale of impact would be regional. Flooding could cause direct damages to the facility and its major components; however, because of measures in place and the design of the facility, it is unlikely that damages would be significant.

If the site were inundated long enough (beyond 96 hours), the hospital would likely shut down until the site could be drained and the building cleaned out for reoccupancy; this would force an evacuation of all hospital patients (and staff) and relocation of some patients to nearby Kaiser facilities in South San Francisco, San Francisco, Santa Clara, or Oakland. Evacuation could create additional stress on already vulnerable patients and possibly compound health concerns or injuries. Increasing the load on other hospitals could create additional stress, though most hospitals in the area have additional surge capacity. A permanent loss of this facility would result in a loss of the Neuroscience Center of Excellence, which is unique in the region.

Additional Important Information

The hospital facility hosts evacuation drills to ensure they are prepared for a real emergency. This increases their adaptive capacity even more and may reduce impacts to hospital facilities and patients.

Asset-Specific Adaptation

Adaptation of the hospital may include elevating or floodproofing access roads to the entryways to the ED and supply center. It could also involve dry floodproofing the facility to prevent any flooding of the ED so overnight patients could shelter in place and not have to evacuate.

Vulnerable Hospitals with EDs

This is the only Asset Vulnerability Profile on vulnerable hospitals in the County. The vulnerability assessment analysis shows that this asset is the only medical facility with a vulnerable ED in the County.

ED entranceway for ambulance is a critical component of asset.

