

9. HIGHWAY 101

Whipple Avenue to Pulgas Creek

California Department of Transportation (Caltrans)

VULNERABILITY SUMMARY

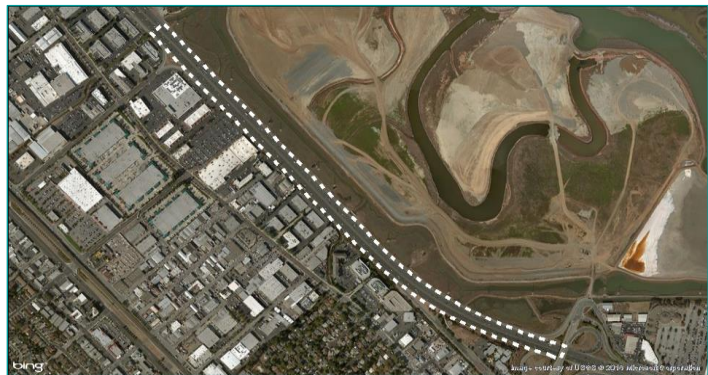
The section of Highway 101 (HWY 101) between Whipple Avenue and Pulgas Creek is a critical ground transportation route and is **highly vulnerable** to sea level rise. This section runs along the edge of San Francisco Bay and is particularly exposed to creek backup combined with high tides. It is highly sensitive to flooding, as it could close if inundated and force traffic to use alternate routes, leading to congestion, reduced levels of service, and economic impacts precipitated by these issues. Impacts from a permanent loss of the asset could be felt at an interregional level.

SENSITIVITY High	EXPOSURE Moderate	ADAPTIVE CAPACITY Moderate	CONSEQUENCES High
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ASSET CHARACTERISTICS

Highway 101 | Redwood City

Asset Description and Function:
This low-lying section of HWY 101 runs within the City of Redwood City and City of San Carlos. It's part of the primary north-south artery through the San Francisco Peninsula and provides access to the East Bay via State Routes 92 and 84. It serves local, regional, and inter-regional automobile and truck travel, averaging 222,000 vehicles per day. There are two essential bridges along this section that cross Cordilleras and Pulgas Creeks. HWY 101 is maintained by the CA Department of Transportation (Caltrans).



Asset Type	Ground Transportation
Asset Risk Class	4
Size	1 mile long, 160 feet wide
Year of Construction	Prior to 1964
Elevation	11.3-11.8 feet, NAVD88
Level of Use	222,000 vehicles/day
Annual O&M Cost	\$1,050,000
Special Flood Hazard Area	Asset is not in SFHA
Physical Condition	Fair
Landowner	State of California
Underground Facilities	Drainage and electrical conduits.

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

This section of HWY 101 is highly sensitive to flooding and inundation, and the road is already at capacity. To date, there have not been any flood-related road closures, but traffic slow-downs have occurred due to water on the freeway. When water surface elevations reach 48 inches above the current mean higher high water (MHHW) level, northbound traffic will be disrupted (due to flooding on the roadway) or stopped altogether. Southbound traffic is less sensitive to water levels in the San Francisco Bay because the 3-foot barrier dividing northbound and southbound flows delays the onset of floodwaters in the southbound lanes.

However, creek backup would likely flood these lanes from the west before the barrier was overtopped. Flooding could require the use of alternate routes, which are available but not designed to accommodate the high traffic volumes equivalent to HWY 101. Both the road and the bridges are essential components, and flooding of either would reduce the road capacity, requiring the use of alternate routes. Permanent inundation would require permanent road closure.

Aerial view of Highway 101 section adjacent to wetlands.



SHORELINE VULNERABILITY

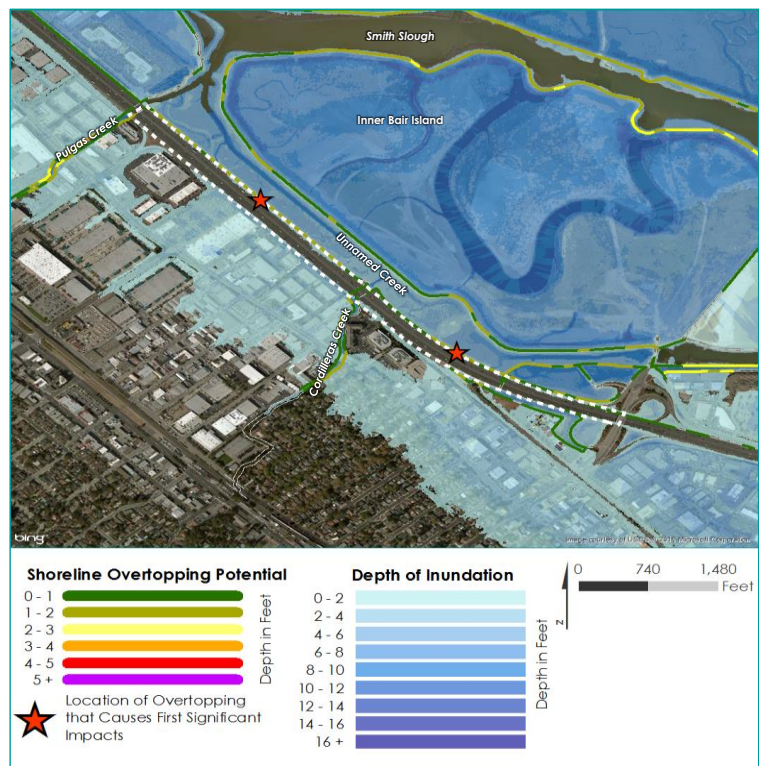
Shoreline Overtopping Analysis

The unnamed creek between Pulgas Creek and Smith Slough at the southern border of Inner Bair Island will likely lead to coastal flooding along HWY 101. When water surface elevations reach 24-36 inches above MHHW, the creek overtops HWY 101 (locations indicated by the two red stars on the map to the right), though the first inundation that is expected to cause significant or disruptive impacts to HWY 101 occurs when water reaches 36-48 inches above MHHW.

Cross-Cutting Vulnerabilities

This section of HWY 101 connects north and south bay communities and provides access to the east bay for commuters, trucks, and others. Loss of service could have rippling economic impacts as commuters were delayed, and it would significantly slow shipping through the region. This includes reduced bus service for SamTrans and reduced access to Caltrans facilities, which would have a disproportionate effect on those dependent on public transportation, including low-income residents and those with access needs.

First Significant Impacts: 48 inches above MHHW.



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SEA LEVEL RISE EXPOSURE ANALYSIS

Exposure Discussion

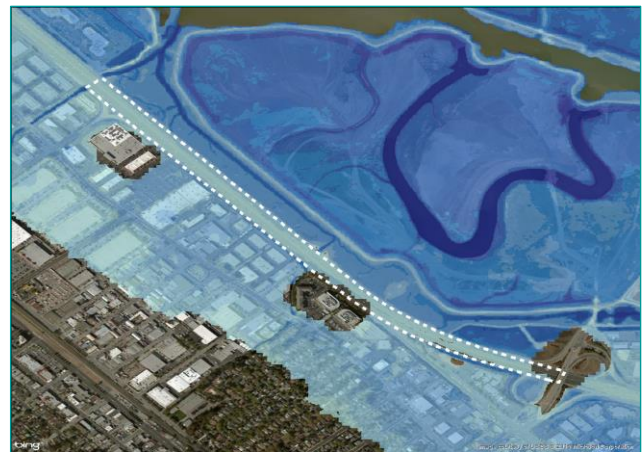
This section of HWY 101 is moderately exposed to sea level rise. HWY 101 section lies roughly between 11.3 and 11.8 feet (NAVD88), and already experiences temporary, localized nuisance flooding when high tides coincide with larger storms. This has occurred near the northbound shoulder of HWY 101 near Cordilleras Creek. Because there are no tide gates, the two creeks that empty at the bay can back up when the tide is too high to allow them to discharge, flooding neighboring areas and causing more severe or widespread flooding west of HWY 101. The area near Pulgas Creek regularly ponds during high tides.

With sea level rise, higher tides will flood the freeway and back up the creeks (inundating neighborhoods) more frequently, and the depth and extent of flooding will likely increase as well. With 48 inches of sea level rise, water may flood the eastern portions of HWY 101 to a depth of up to 2 feet. This may also cause flooding on the entrance and exit ramps at Whipple Road. Inundation will also occur on the western side of HWY 101 because of the culverts and creeks that connect under HWY 101. After 77 inches of sea level rise, the barrier in the middle of HWY 101 will also overtop, though at this point, the rest of HWY 101 will likely have flooded from high water on the east and west sides.

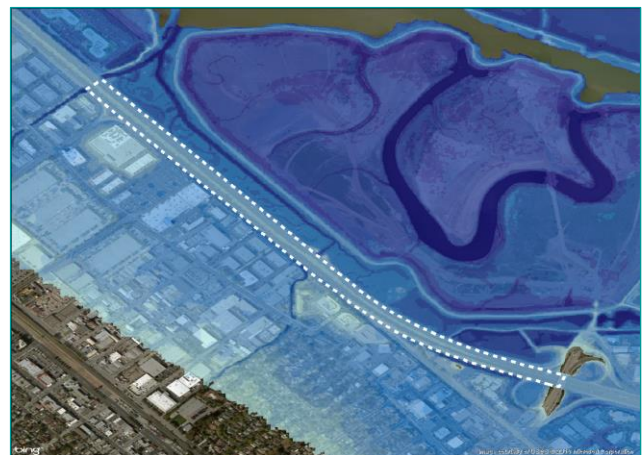
Baseline Scenario: Asset is not inundated.



Mid-Level Scenario: Asset is extensively inundated.



High-End Scenario: Asset is under 11 feet of water.



Exposure Analysis Results

Scenario	Potential Inundation Depth (feet)	
	Minimum	Maximum
First Significant Impacts (48 inches)	0	5
Baseline 1% Flood	0	0
Mid-Level 1% + 3.3 feet	0	10
High-End 1% + 6.6 feet	3	11

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ADAPTIVE CAPACITY, CONSEQUENCES, AND POTENTIAL ADAPTATION

Adaptive Capacity

This section of HWY 101 has moderate adaptive capacity. If temporarily disrupted, traffic could use alternate routes such as Industrial Rd and El Camino Real, though those detours were not designed to accommodate high traffic flows (HWY 101 is already near capacity, which exceeds side road capacity). To date, there is no long-term adaptive capacity, as these routes are not suitable as permanent alternatives. There are no tide gates along this section of HWY 101 to prevent creek backup during high tides. If there were significant flooding, such as that caused by a 10% annual chance (or 10-year) storm coincident with a 2% annual chance (or 50-year) high tide, Caltrans would need to deploy a portable pumping system to clear the roadway. Exacerbating this flooding is the fact that most drainage systems in the area are functioning below design capacity due to sedimentation, and the presence of protected species limits the times during which the sediment can be cleared from the system.

Consequences

This section of HWY 101 would be expected to experience high consequences from flooding. Temporary flooding is not likely to damage the roadway, though it could affect underground facilities, such as electrical conduits. The more immediate effect is to the roughly 222,000 vehicles per day that use this section, including critical commercial vehicles. Flooding on this section could cause major delays due to detours and reduced highway speeds, both of which would have an economic impact on commuters and shipping. Implementation of detours would increase traffic and accelerate wear on alternative routes. Drivers attempting to cross the flooded HWY 101 could also be injured or killed (i.e., hydroplaning accidents). If the entire HWY 101 were damaged or permanently inundated, it could cost up to \$52,530,000 to replace or move the section of roadway. Finally, urban development (including businesses and neighborhoods) west of HWY 101 lies below the freeway grade and could be inundated by freeway overflow or creek backup.

Additional Important Information

There are plans by Caltrans to replace Cordilleras Creek Bridge that incorporate sea level rise considerations, though these focus on the Caltrans infrastructure, not the region. This is the link for SamTrans service among north, south, and east bay communities, offering public transportation to the region, including disadvantaged communities. Additionally, in current preliminary Federal Emergency Management Agency (FEMA) maps, the highway is shown as having a Special Flood Hazard Area of "AE11".

Asset-Specific Adaptation

While it is more likely that HWY 101 will be part of a regional strategy, asset-specific measures include a barrier along HWY 101 and creek flow controls (tide gates or levees). Relocating HWY 101 inland is less feasible and undesirable because of surrounding dense urban development. Constructing traditional flood protection options to the east side of HWY 101 are limited and complicated because of the presence of wetlands; however, these wetlands could play a role in attenuating wave and surge energy during high tides. Regional strategies to reduce flood risk to HWY 101 could incorporate natural benefits.

Vulnerable Highways

There are Asset Vulnerability Profiles on the following vulnerable highways: SR 1 (AVP #3) and SR 84/HWY 101 Interchange (AVP #19). The vulnerability assessment analysis shows that there are 99.6 miles of vulnerable highways in the project area, including SR 54, 92, and 114.

Northbound US Highway 101 at Whipple Road exit.



Image from Google Street View

Southbound US Highway 101 at Pulgas Creek.

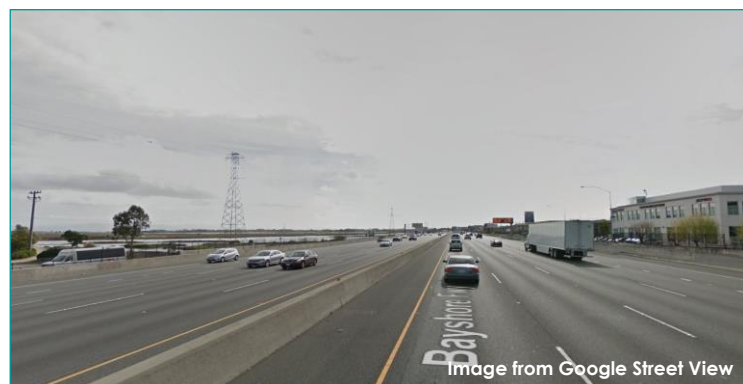


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