

11. HIGHLINE CANAL TIDE GATE

City of Millbrae

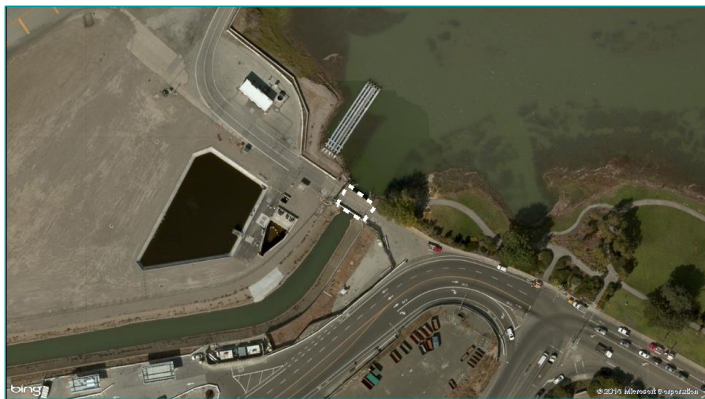
VULNERABILITY SUMMARY

The vulnerability of the Highline Canal Tide Gate (Gate) to sea level rise is **high**. The Gates were designed to protect Highline Canal from high tides while enabling the canal to discharge water from the Millbrae stormwater system, the Millbrae Intermodal Station, and Lomita Creek. The Gates themselves are not sensitive to sea level rise, but sea level rise reduces the capacity of the canal to convey stormwater. Future conditions will further reduce capacity of the canal when the Gates stick open, as this will allow higher bay water levels into the canal. This could lead to flooding at the Caltrain Millbrae Station, Lomita Creek (home to protected frog and snake species), and local neighborhoods.

SENSITIVITY High	EXPOSURE Moderate	ADAPTIVE CAPACITY Low	CONSEQUENCES High
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ASSET CHARACTERISTICS 349 S McDonnell Rd | Millbrae

Asset Description and Function:
 The Gate is a passive flap gate opened and closed by the tides in San Francisco Bay. At high tide, the Gate closes to prevent tidal water from entering Highline Canal, which serves as one of two stormwater outlets for the City of Millbrae. When the Gate operates as designed, the canal is able to release water as designed from the city's stormwater system, drainage at the Millbrae Intermodal Station, and Lomita Creek discharge. However, the Gates are in poor condition and stick open most of the time, allowing water to enter the canal.



Asset Type	Flood Control Infrastructure
Asset Risk Class	4
Size	2 gates, 15 x 15 feet each
Year of Construction	1965
Elevation	3.2 feet, NAVD88
Level of Use	Serves 15,000 people
Annual O&M Cost	Variable share of \$250K
Special Flood Hazard Area	N/A
Physical Condition	Poor
Landowner	City and County of San Francisco

Underground Facilities
 No underground facilities were identified.

Environmental Considerations
 The Gate receives discharge from Lomita Creek, which is home to protected red-legged frog and garter snake populations. Surrounding areas are potential stopover habitat for migrating avian species.



HIGHLINE CANAL TIDE GATE

ASSET SENSITIVITY

The Gate is passively operated with no underground equipment; therefore, the structure itself is relatively insensitive to sea level rise. However, the Gate currently does not operate as designed and the resulting effects on the Highline Canal and the infrastructure depending on drainage provided by the canal are highly sensitive to sea level rise. When backwater flooding conditions occur, the neighborhoods that drain to Lomita Creek and Highline Canal can be exposed and are sensitive to flooding. Currently, the Gate is in poor condition and does not always close during high tide, allowing high water levels to enter the canal.

Even when the Gate closes, it often leaks water from the San Francisco Bay into the canal. When water levels in the canal are elevated from the San Francisco Bay water, the canal can no longer accommodate the stormwater load from the city, the Millbrae Intermodal Station, and Lomita Creek. This problem would be particularly severe if high water levels (more common with sea level rise) coincided with high rainfall (see Exposure Discussion section).

Highline Canal Tide Gates.



SHORELINE VULNERABILITY

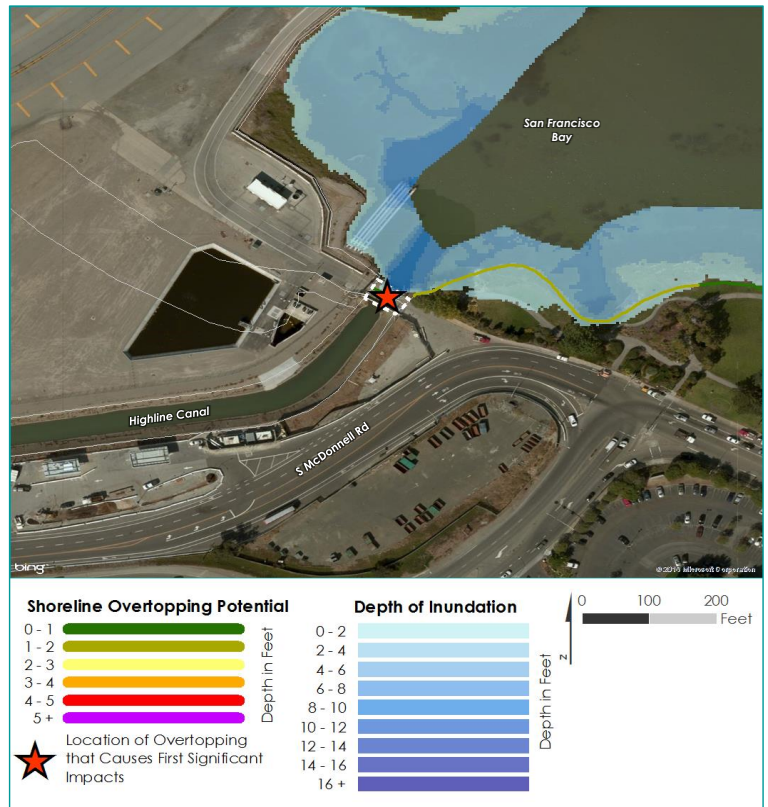
Shoreline Overtopping Analysis

When water surface elevations reach between 12 and 24 inches above the current mean higher high water (MHHW) level, water from San Francisco Bay overtops the Highline Canal Gate, indicated by a red star on the map to the right.

Cross-Cutting Vulnerabilities

Millbrae Intermodal Station drainage system was designed to direct rainfall from a 0.2% annual chance (500-year) storm into the canal, which is only sized for a 4% annual chance (25-year) storm; meanwhile, protected species in Lomita Creek prevent measures to accommodate potential excess flows. Together, these make the system more likely to exceed its capacity and cause backup or flooding. Backup at the Millbrae Intermodal Station (AVP #10) or Lomita Creek (adjacent to Highway 101) (AVP #9) could interrupt train and/or automobile service.

First Significant Impacts: 24 inches above MHHW.



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SEA LEVEL RISE EXPOSURE ANALYSIS

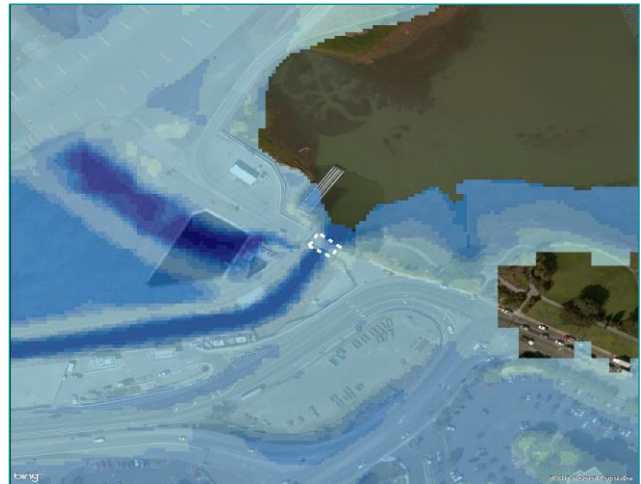
Exposure Discussion

The Gate is moderately exposed to sea level rise. To date, the Gate has not been exposed to surface flooding, and it would take roughly 24 inches of sea level rise to cause overtopping of the gate and fill the Highline Canal (assuming the gate operates as designed). However, when the Gates are stuck open (or if the tide gates were overtopped) then San Francisco Bay water fills the canal, reducing its drainage capacity. When high tides coincide with major rain events, the surrounding areas, such as Lomita Creek and other parts of Millbrae, cannot discharge effectively into the canal (because the canal loses drainage capacity). This causes backup and flooding in the Bayside Manor, Marina Vista, and Landing Lane neighborhoods in Millbrae. If the gate remains unfixed (open), higher water levels from sea level rise will create the backwater flooding conditions more frequently.

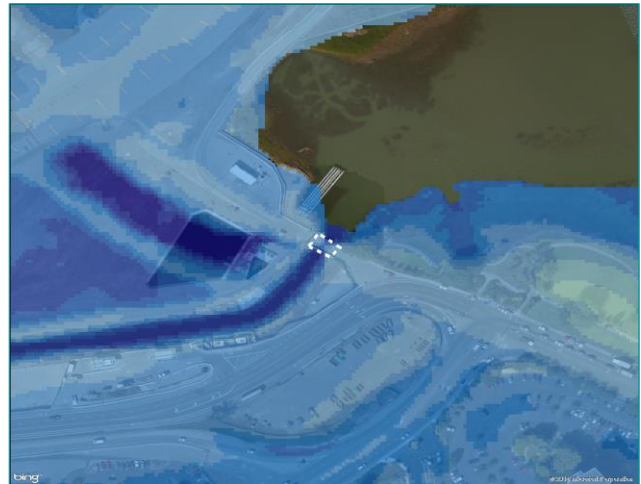
Baseline Scenario: Asset is not overtopped.



Mid-Level Scenario: Asset is fully overtopped.



High-End Scenario: Surroundings fully inundated.



Exposure Analysis Results

Potential Inundation Depth (feet)		
Scenario	Minimum	Maximum
First Significant Impacts (24 inches)	0	9
Baseline 1% Flood	1	8
Mid-Level 1% + 3.3 feet	2	12
High-End 1% + 6.6 feet	5	15

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ADAPTIVE CAPACITY, CONSEQUENCES, AND POTENTIAL ADAPTATION

Adaptive Capacity

The Gate has low adaptive capacity. It does not rely on electricity so power is not an issue, but there are no alternate or redundant systems to perform the Gate's function. Because it often fails to operate as designed, infrastructure depending on the Gate functions with a variable level of service. Under future conditions, however, the drainage infrastructure that leads to Highline Canal would likely not be able to adapt to continual high water in the canal. Even if the Gate were operational, there is no redundant or alternate system that could relieve stormwater or prevent flooding of the surrounding areas if the Gate were overtopped. Lomita Creek cannot be altered to accommodate more water because it is home to protected frog and snake species.

Consequences

Consequences from damage to the gate or a permanent loss of functionality would be high. The Gate itself is unlikely to fail from flooding, though it could suffer structural damage if overtopped, leading to a direct replacement cost of roughly \$1.5 million. More likely, when the canal behind the Gate fills, either due to a broken tide gate or future sea level rise and overtopping, the flooding of surrounding neighborhoods or parts of Highway 101 and San Francisco International Airport could be substantial. This could lead to property damage and major disruptions to traffic for an important expressway (see asset profile for Highway 101 between Pulgas Creek and Whipple Avenue), both of which have economic impacts. Such flooding could also affect up to 15,000 people through property damage in surrounding neighborhoods and exposed areas. This level of flooding in the canal could also cause Millbrae Intermodal Station's drainage system to back up.

Additional Important Information

The Gates currently stick in the mud and stay open during much of the year. In addition, clearing sections of Lomita Creek of vegetation could help alleviate backflooding, but would be difficult due to permitting issues related to protected species. Rehabilitating the Gate could also alleviate the backflooding issues in the canal. The city is also considering replacing the gates, though this is currently unfunded.

Asset-Specific Adaptation

This asset could be modified by repairing and increasing the height of the Gate. Vulnerability to the area could also be reduced nonstructurally by floodproofing neighboring communities that flood when the canal overflows. Alternatively, the canal could be closed off permanently with a flood wall with the addition of a pump station for drainage during storms. Outside the Gate toward the bay, wetlands could be enhanced to reduce wave and surge impact.

Vulnerable Tide Gates

This is the only Asset Vulnerability Profile on vulnerable tide gates in the County. All tide gates will be vulnerable to sea level rise due to their location on the shoreline. A comprehensive inventory of tide gates in the County was unavailable at the time of this assessment.

Location where vegetation is growing into concrete channel.



Highline Canal.

