

High Tides, Flooding, and Dredging

by Sandy Goldman

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We sometimes hear people say that it only floods in Fairfax and San Anselmo when the tide is high, with the follow-up statement that dredging in the earthen channel in Kentfield and Greenbrae would solve the problem. Unfortunately, flooding cannot be solved so simply. Here are some basic facts about Corte Madera Creek, high tides, flooding, and dredging.

High Tides and Flooding: San Francisco Bay has two unequal high tides every day. Out-of-bank flow during major flood events typically lasts several hours. Therefore, it is almost inevitable that during a flood event there is coincidentally a high tide. FEMA's latest flood insurance rate maps of base flood elevations in the tidal areas show that the water surface during a flood event with a 1% chance of occurring in any one year is calculated to be at elevation 10 feet above the North American Vertical Datum 88. This datum is

approximately at mean sea level. It follows that any location at or below 10 feet in elevation is at risk of flooding due to this high tide. This covers large areas in Greenbrae, Larkspur, and Kentfield. These floods are probably worse when the ground is saturated and there are heavy flows from upstream. However, the lowest elevation in San Anselmo, located near the corner of Sir Francis Drake and Bolinas Road, is about 40 feet and Fairfax is even higher in elevation. In other words, the tide would have to be almost 30 feet higher at Bon Air Bridge for it to contribute to flooding at the lowest part of San Anselmo. Low barometric pressure, storm surges, and warmer ocean water can cause higher tides, but not 30 feet higher. It is clearly not plausible for high tides to cause flooding in San Anselmo or Fairfax.



A cyclist follows a path flooded at high tide near Marin General Hospital. Photo by Sandy Goldman

Flooding in San Anselmo and Fairfax is caused by runoff from saturated soil that cannot be accommodated in stream channels or on adjacent flood plains. (FEMA's flood maps are available through a link on the Marin Map home page at www.marinmap.org)

Dredging and Flood Management: The shape and depth of the creek downstream of the concrete channel were surveyed at 11 cross-sections in 2004, 2010, and 2014. These measurements show that although sediment has increased in some areas, there is adequate capacity in the earthen channel to carry the water reaching the creek, even in a flood with a 1% chance of occurring in any year. Dredging may be necessary if more sediment is deposited.

The channels in natural marshes tend to be narrow and deep and these channels are maintained in equilibrium, without dredging, by the movement of the daily tides in and out of the adjacent tidal marshes. However, as tidal marsh has been developed and eliminated, the ability of natural processes to maintain a channel becomes reduced, requiring dredging more deeply and more often. Because the next round of dredging is expected to cost over \$6 million, Marin County Water Conservation and Flood Control District is evaluating if a configuration of the earthen channel of Corte Madera Creek that is in better equilibrium with the available tidal prism can meet district goals to maintain flood-flow capacity with minimal dredging. The design of a dredge footprint, profile and cross-section that is in accordance with the available tidal prism is called a "geomorphic dredge" because it works with the available tidal prism to maintain the channel for longer periods between dredging operations. The geomorphic dredge design allows sediment to accumulate outside the channel in what is now part of the trapezoidal channel favored by the US Army Corps of Engineers in years gone by. This will require changing some stormwater outfalls in the tidal section of the

creek to discharge into the deeper water areas.

Note that the level of water in the creek when the tide is high is minimally affected by the shape or depth of the channel bottom. No matter how deep the channel is, the tide reaches an elevation established by the water surface elevation in San Francisco Bay and ultimately the Pacific Ocean, which provides unlimited water to fill in dredged holes or channels.

Dredging and Navigation: Certain areas in Corte Madera Creek are regularly dredged, but only for navigation. Golden Gate Bridge, Highway and Transportation District dredges to maintain access for the ferries; Larkspur Marina and Marin Rowing Association dredge around their docks so boats can be used even when the tide is fairly low. Dredging to improve navigation generally does not reduce the risk of flooding.

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