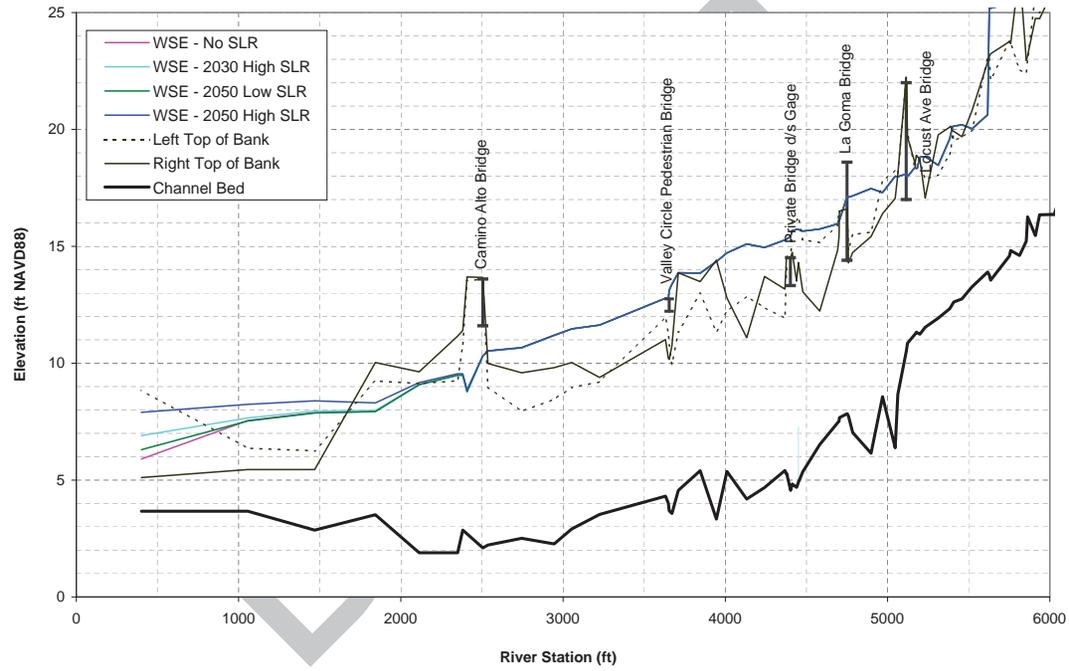


Figure 23 ACMdP 100-Year Water Surface Profile (with 100-Year Flood Protection Measures in Place) under Different Sea Level Rise Scenarios

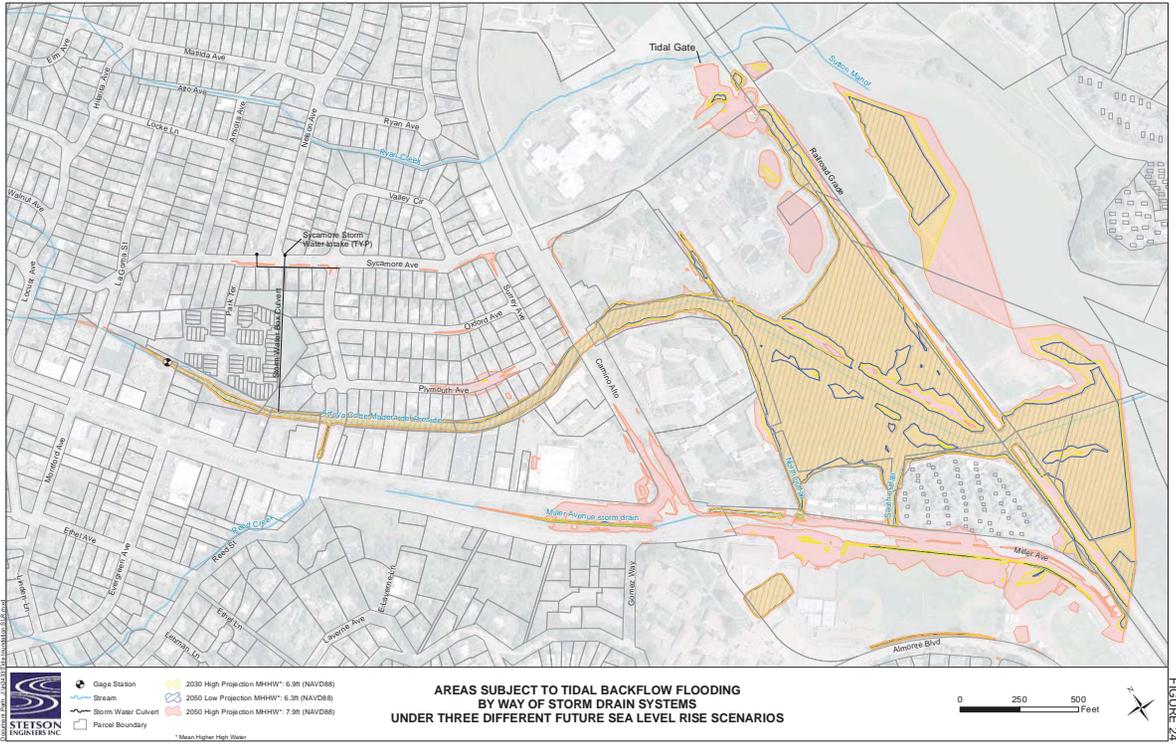


As shown in Figures 22 and 23, both the 10-year and 100-year water surface profiles above Camino Alto Bridge have relatively steep gradients and are higher than the three future MHHWs. Steep water surface gradients limit the effect that the higher downstream boundary conditions have on the water surface profiles above Camino Alto Bridge. This suggests that the three downstream boundary conditions should not have an important effect on the proposed flood protection measures because all the proposed flood protection measures are located above Camino Alto Bridge. Table 12 is a summary of the analysis results.

Figure 24 shows the areas subject to tidal backflow flooding by way of storm drain systems under the three different sea level rise scenarios. The land surface in these areas is lower than the MHHWs. During heavy storms coincident with the MHHWs, interior stormwater flooding due to inadequate storm drain hydraulic capacity would cover larger areas. Note that the floodplain of Ryan Creek would not have any areas subject to tidal backflow flooding because Ryan Creek is currently isolated from the bay by a tidal gate and pump station located at the downstream end of the creek (see Figure 24).

Table 12. Summary of Analysis Results for Future Sea Level Rise Scenarios

Sea Level Rise Scenario	Future Level of Flood Protection Provided by the Flood Protection Measures		Alterations and/or Additional Measures That Would Be Needed to Maintain Intended Level of Flood Protection under Future Sea Level Rise	
	10-Year Measures	100-Year Measures	10-Year Measures	100-Year Measures
2030 High SLR Projection	10-Year Flood	100-Year Flood	No change	No change
2050 Low SLR Projection	10-Year Flood	100-Year Flood	No change	No change
2050 High SLR Projection	8-Year Flood	100-Year Flood	Raise floodwalls between Camino Alto Bridge and Valley Circle Pedestrian Bridge by 0.4 ft	No change



Assumption: A barrier system along the Railroad Grade is assumed to be put in place to prevent tides greater than MHHW from propagating upstream.

FIGURE 24

7.0 IMPLEMENTING FLOOD DAMAGE REDUCTION MEASURES IN ACCORDANCE WITH FEMA FLOODPLAIN REGULATION

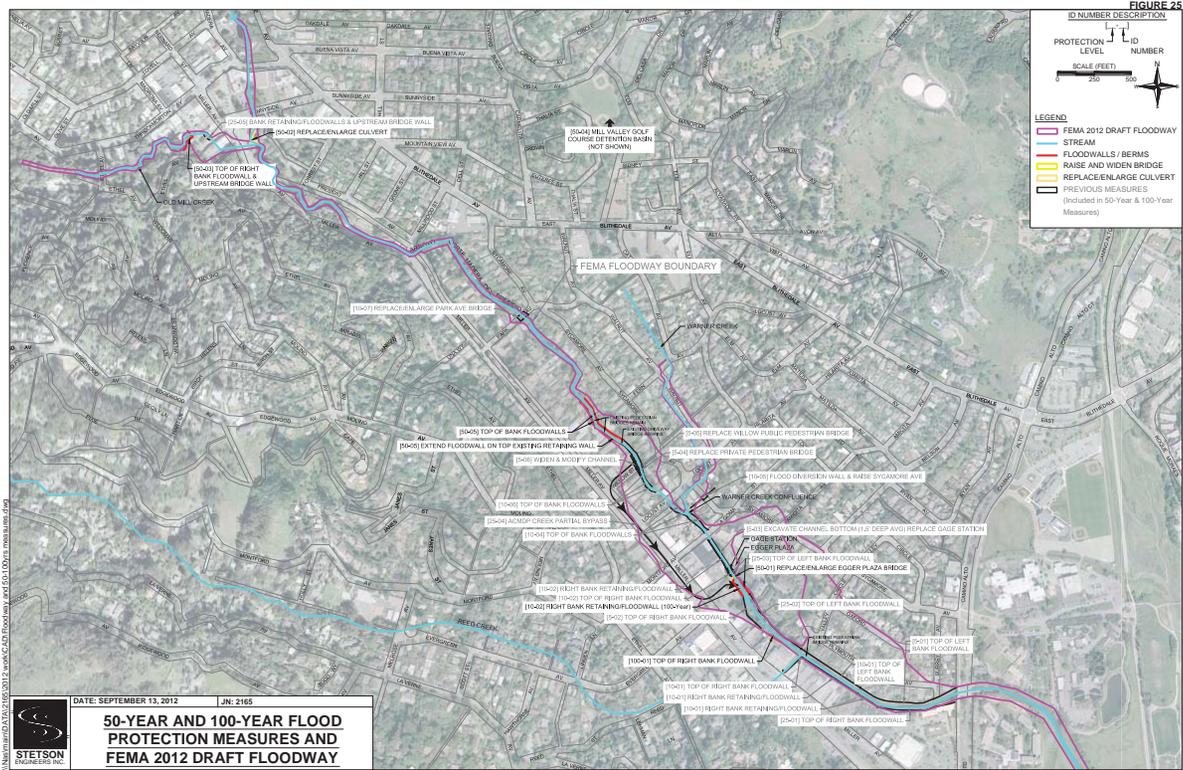
FEMA is in the process of revising its Flood Insurance Rate Maps (FIRMs) for Ross Valley and Mill Valley. This process involves flood studies including new hydraulic and hydrologic models to determine water surface elevations for the 100-year flood, or the 1-percent-annual-chance flood. These elevations are referred to as “base flood elevations (BFEs)” from riverine and coastal flooding sources. The FIRM for Mill Valley was revised in 1979 and most recently in 2009. The new FIRM for Mill Valley is expected to become effective in 2014.

In April 2012, FEMA offered affected communities the opportunity to review and comment on the flood studies from riverine sources and the “working maps,” which are essentially draft FIRMs, before they are officially released for public review and comment in November 2012. The City of Mill Valley commissioned Stetson Engineers to review the riverine flood source working map for Mill Valley. The working map delineates the riverine Special Flood Hazard Area (SFHA); that is, the area contained within the 1-percent-annual-chance flood boundary. Unlike previous FIRMs, this working map also delineates the regulatory floodway, which is the area within the SFHA that must be reserved in order to discharge the base flood. Communities must regulate any new development in the regulatory floodway to ensure that there are *no* increases in upstream flood elevations. Figure 25 shows the delineated regulatory floodway and its spatial relation to the flood damage reduction measures described in this report. All of the flood reduction measures described in this study are also located within the regulatory floodway and, as such, would be subject to FEMA’s floodplain regulations.

Flood reduction measures described in this study include floodwalls. By design, floodwalls raise the water surface elevation of the 1-percent-annual-chance flood; up to 3.5 feet in some reaches of the creek. However, it is important to point out that flooding is not exacerbated because the floodwalls keep the floodwater contained in the creek, just at a raised elevation.

Nonetheless, the issue arises as to how the flood damage reduction measures, floodwalls in particular, can be implemented in accordance with FEMA floodplain regulations regulating new development in the regulatory floodway and prohibiting a rise in upstream flood elevations. A Letter of Map Revision (LOMR) is the vehicle that would enable these measures to be implemented. A LOMR is an official revision to a FIRM. LOMRs reflect changes to the mapped SFHAs, BFEs, floodplain widths, and regulatory floodways. LOMRs are issued after a floodplain has been remapped due to a major flood event, after better mapping data becomes available, or after structural flood control improvements have been constructed.

Through the LOMR process, flood damage reduction measures can be implemented. Prior to constructing any measure(s) that may trigger the need for a LOMR, the City will need to submit an application to FEMA requesting FIRM revision. The application will need to include design plans and other technical information concerning the proposed flood reduction measure(s). If FEMA approves the application, it will issue a Conditional Letter of Map Revision (CLOMR). A CLOMR is similar to a LOMR, but is based on proposed conditions and does not change the FIRMs. A CLOMR is the method used by FEMA to let people know that if a project is constructed per the design submitted to and approved by FEMA then revision of the FIRM with a LOMR is likely. If FEMA issues the CLOMR, the City can be assured that a LOMR for the project will be approved upon completion of the flood reduction measure.



8.0 RELATED STUDIES

MCFCWCD commissioned Stetson Engineers for two studies related to flooding in Mill Valley. The Evaluation of the Ryan Creek Pump Station Study is provided in Appendix I. This study analyzed the Ryan Creek pump station and local drainage issues. Ryan Creek has its own watershed separate from Arroyo Corte Madera del Presidio. The Evaluation of the Camino Alto North Outfall Study is provided in Appendix J. This study addressed drainage issues regarding the Camino Alto North Outfall. These studies have little bearing on the flood damage reduction measures covered in this report, but they are included herein to provide a more complete compendium of studies that address Mill Valley flooding issues.

8.1 Camino Alto North Outfall Evaluation

The North Outfall functions as the discharge outlet to Richardson Bay for the Camino Alto North storm drain system. During normal storm events, the Camino Alto North system drains a local area of about 38 acres covering both sides of Miller Avenue from about Valley Circle down to the North Outfall. During high tides, tidal inflows enter through the outfall and back up into the storm drain system. During very heavy storm events, overtopping of Arroyo Corte Madera del Presidio and Reed Creek farther upstream can spill over into the system, joining with the local runoff flowing along Miller Avenue to the North Outfall, as demonstrated during the approximate 50-year recurrence flood event on December 31, 2005. If coupled with a high tide, these heavy storm events can inundate the Miller Avenue-Camino Alto intersection making it impassible as well as affecting adjacent properties.

Stetson performed an engineering analysis and prepared conceptual designs for improvements at the North Outfall. These improvements aim to prevent tidal backflow, handle runoff generated within the 38-acre drainage area, and also handle additional runoff originating farther from overtopping of Arroyo Corte Madera del Presidio and Reed Creek that may reach the North Outfall. These improvements to the Camino Alto North storm drain system could be integrated with the greater Miller Avenue streetscape project.

8.2 Ryan Creek Pump Station Evaluation

MCFCWCD operates a tidal gate and pump station on lower Ryan Creek at its discharge to Richardson Bay. Ryan Creek drains an area of about 117 acres composed of a 100-acre residential area above Camino Alto and a 17-acre area below Camino Alto, which includes Mill Valley Middle School and a 3-acre marsh. The average depth of the marsh is about 3 feet and it holds about 9 acre-feet of water. Marsh storage attenuates flow in Ryan Creek during heavy

storms and reduces the peak discharge in the outlet channel reaching the tidal gate and pump station. This attenuation effect is dependent on the antecedent water level in the marsh – the effect is diminished if the marsh is partially or completely filled prior to a heavy storm.

The tidal gate is normally kept open in the dry season to help support the marsh and keeps it closed in the wet season to prevent tidal waters from backing upstream into Ryan Creek. This mode of operation also preserves storage space in the marsh for attenuating heavy storm flows. The pump station is needed to convey water over the tidal gate to the bay. Discharge from the marsh is controlled by the hydraulics of the outlet channel and the pump discharge. The Ryan Creek pump station consists of two pumps, each with a capacity of 8,000 gallons per minute (18 cfs), for a total combined installed capacity of about 16,000 gallons per minute (36 cfs). If discharge from the marsh exceeds the capacity of the pump, the water level in the marsh would rise. This rise, if sufficiently high, could have a backwater effect extending upstream and affecting creek water levels in the residential area above Camino Alto.

The purpose of the study was to analyze the hydraulics of lower Ryan Creek and assess the adequacy of the existing pump station to convey heavy storm flows and maintain protective water levels in the marsh. The study found that the current pump station capacity does not substantially differ from the originally designed capacity. When two pumps are in operation as designed for heavy storms, their combined capacity is adequate to prevent flood damage to buildings upstream along Ryan Creek; that is; none of the first finished floor elevations of buildings upstream along Ryan Creek would be inundated, even during a 100-year flood event although there would be some inundation of the lands along the creek corridor.

REFERENCES CITED

- Dawdy, David R. "Analysis of the Flooding on Arroyo Corte Madera." March 28, 2006.
- Far West Restoration Engineering. Tech Memo "Preliminary Fish Barrier Culvert Modifications and Flood Assessment, Arroyo Corte Madera/Old Mill Creek." November 15, 2004.
- Federal Insurance Administration. "Flood Insurance Study, City of Mill Valley, Marin County, California." July 1978.
- Federal Insurance Administration. "Flood Insurance Rate Map, City of Mill Valley, Marin County, California." Panel Number 060177 0005B. Effective January 3, 1979.
- National Research Council. "Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future." June 2012.
- Ross Taylor and Associates. "Marin County Stream Crossing Inventory and Fish Passage Evaluation." July 2003.
- U.S. Army Corps of Engineers, 1967. Survey Report for Flood Control and Allied Purposes, Stream Flowing into Richardson Bay.