Characterization of Alluvial Fan Reach of Copeland Creek

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Abstract

Copeland Creek is a small perennial stream which runs through the northern margin of the SSU campus. Where it emerges from Sonoma Mountain and enters the valley floor, it forms an alluvial fan as the creek slows down and deposits its bed load. During the winter of 2016-2017, a series of heavy storms caused a section of Copeland Creek adjacent to Lichau Road to overflow its banks, causing major damage to the roadway. This flooding event threatened to change the course of Copeland Creek and jump watersheds to the Petaluma River, in a process known as avulsion.

This study aims to characterize the apex region of the alluvial fan, which poses the highest risk of avulsion in future flood events. A longitudinal profile and three channel cross sections were measured using auto-level and stadia-rod. Using a GIS, sinuosity was determined to be 1.2 and channel slope for the entire alluvial fan reach was calculated as 0.022. The channel slope of the study reach was measured as 0.032. Using a Wolman pebble count, the D50 grain size of the bed material was measured at ~60 mm (very coarse gravel.) We categorized this reach of Copeland Creek as a C4b using the Rogen Classification scheme.

Location Map

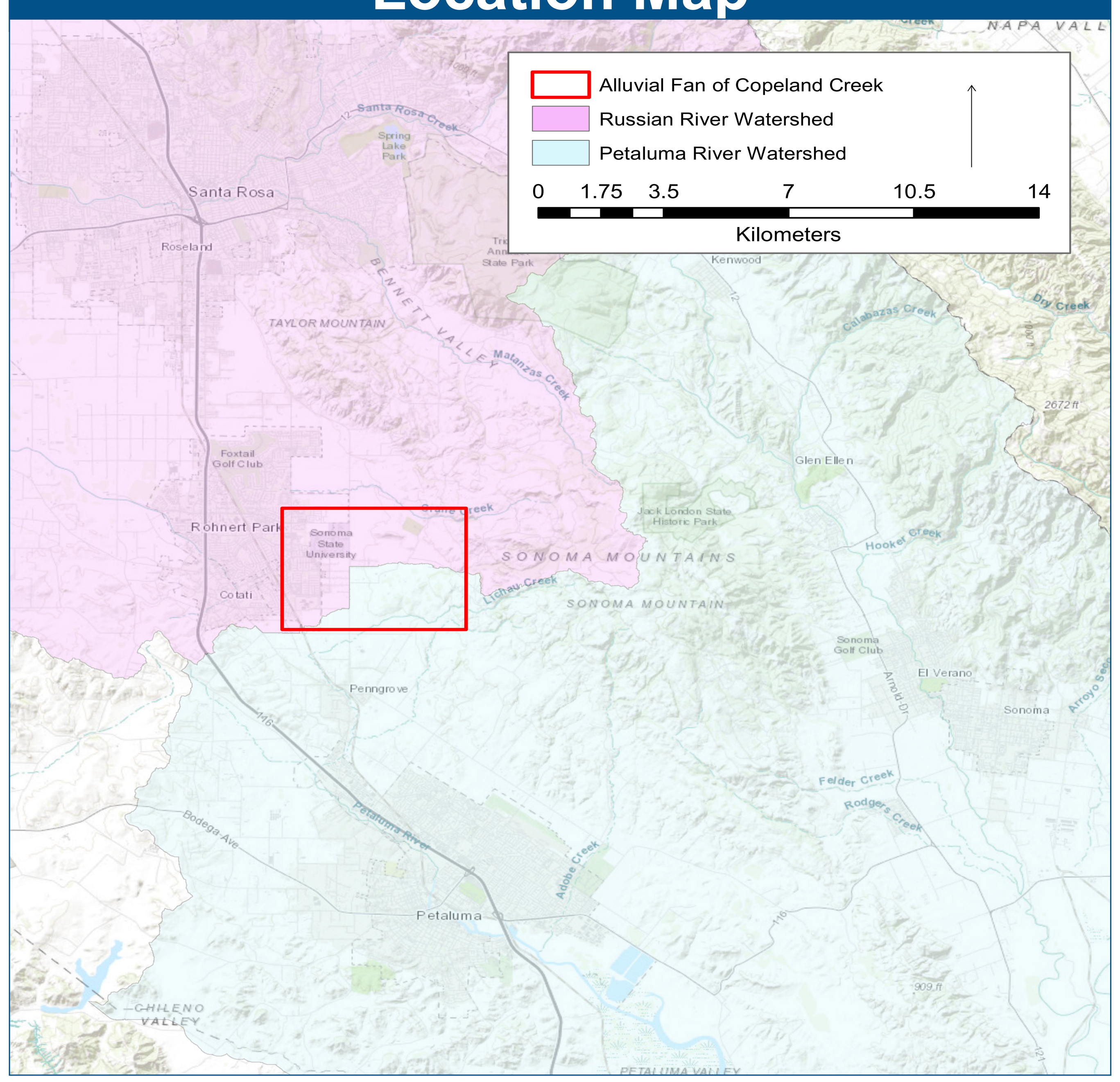


Fig. 1 Location map of study area. Red inset is area of figure 2

Methods

The longitudinal profile was mesured using a Leica NA532 autolevel and 16 ft stadia rod, using the protocol developed by Wildland Hydrology. A 150 ft tape was laid along the stream centerline and the stream thalweg, watersurface and bankfull were measured every 5 to 10 feet, taking care to capture riffles, runs and pools. This process was repeated until we had captured a reach of 422 ft - slightly more than 20 bankfull widths.

Three cross sectional stream profiles were measured again using a Leica NA532 autolevel and 16 ft stadia rod and the autolevel's rangefinding capabilities.

Bed composition was determed using the Wolman Pebble Count method. Transects in our study reach were chosen at random and a step-toe approach was used to select samples across the transect. A Gravelometer or 150 ft tape was used to measure the b axis of samples.

Maps and LIDAR Transects were generated using ArcGIS 10.5 and Adobe Illustrator, using data from the Sonoma County Vegetation Mapping & LIDAR program.

Alluvial Fan Reach of Copeland Creek

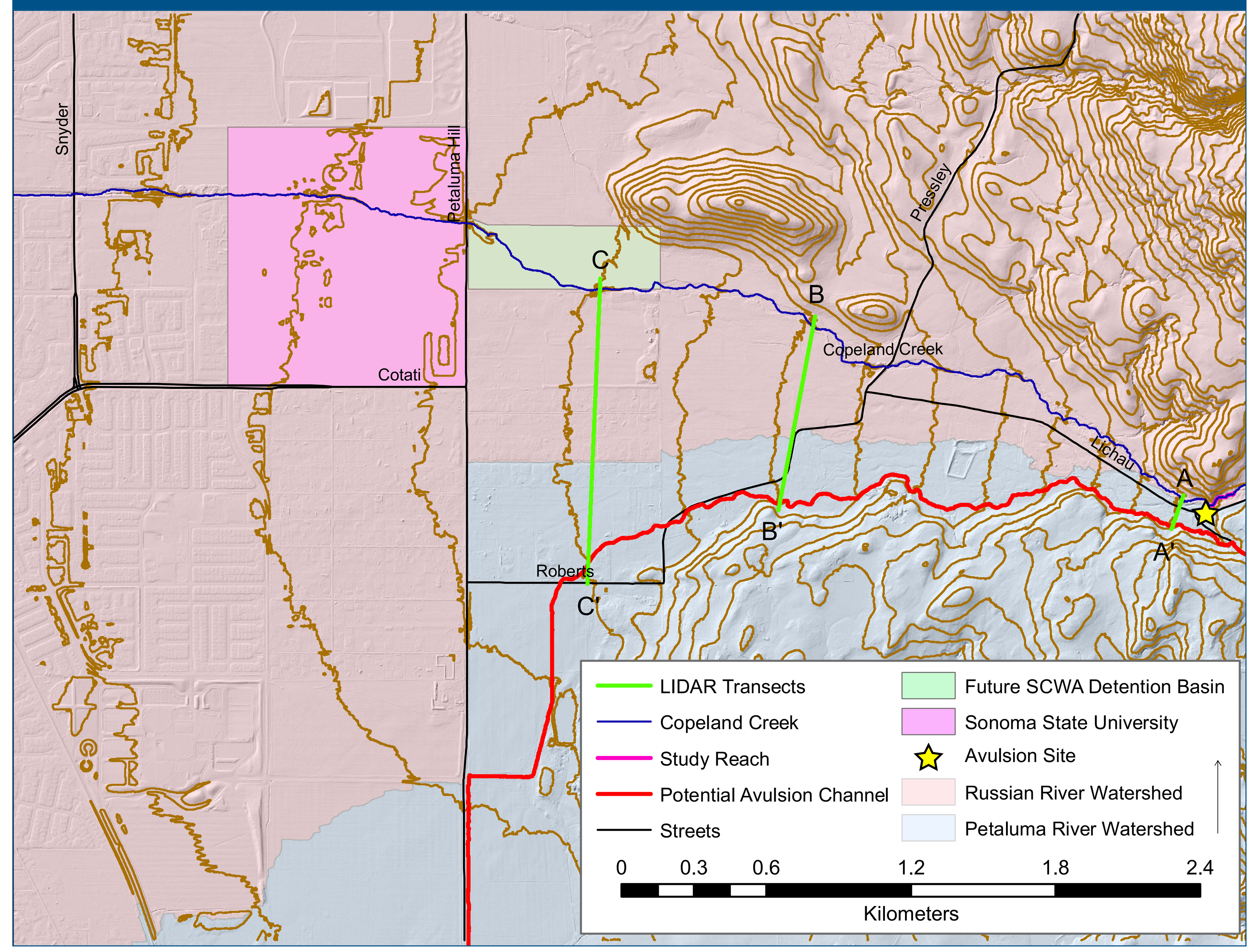


Fig. 2 Map of alluvial fan reach of Copeland Creek, displaying concentric topographic circles characteristic of alluvial fans. Potential avulsion channel, shown in red, drains into the Petaluma River watershed, where the current channel drains into the Laguna de Santa Rosa, part of the larger Russian River watershed. Study reach (pink) is area of figure 6.

LIDAR Transects

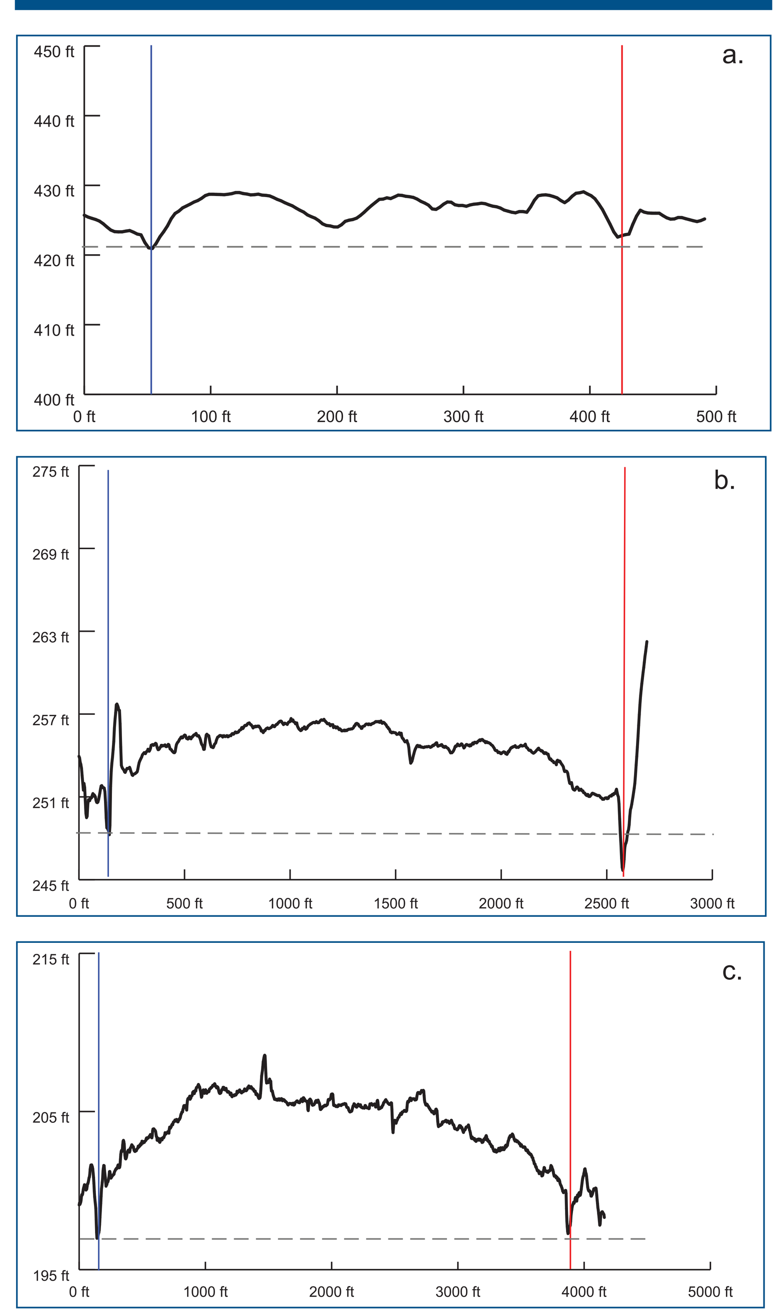


Fig 3. Cross sectional profiles of Copeland Creek's alluvial fan derived from LIDAR data. a) A-A'; vertical exageration ~ 5:1 b) B-B'; vertical exageration ~64:1 c) C-C'; vertical exageration ~12:1

Wolman Pebble Count

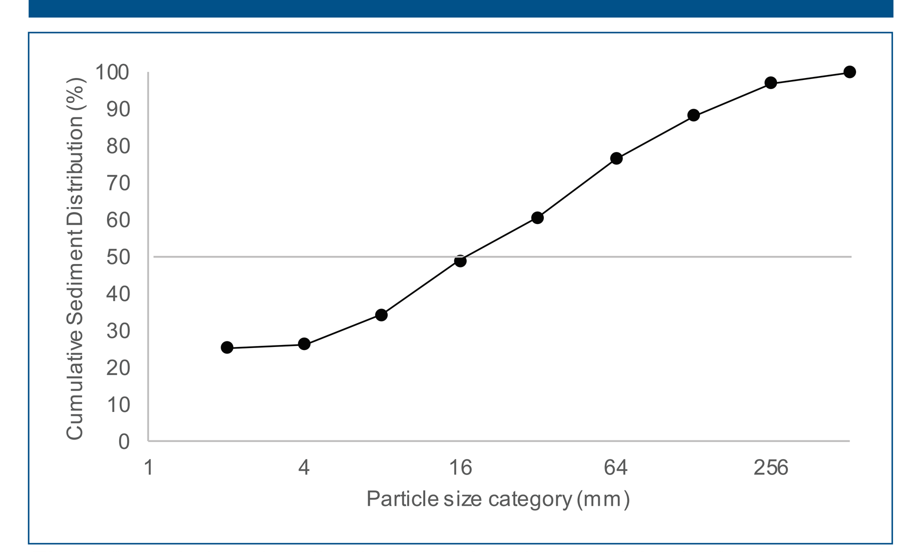


Fig. 4 Cumulative size distribution of bedding particles in Copeland Creek main channel, just below aluvial fan apex. D50 ~= 16 mm

Fig 5. Aerial image of partial avulsion on Lichau Road near Cold Springs Road. 01/20/2017

Study Reach

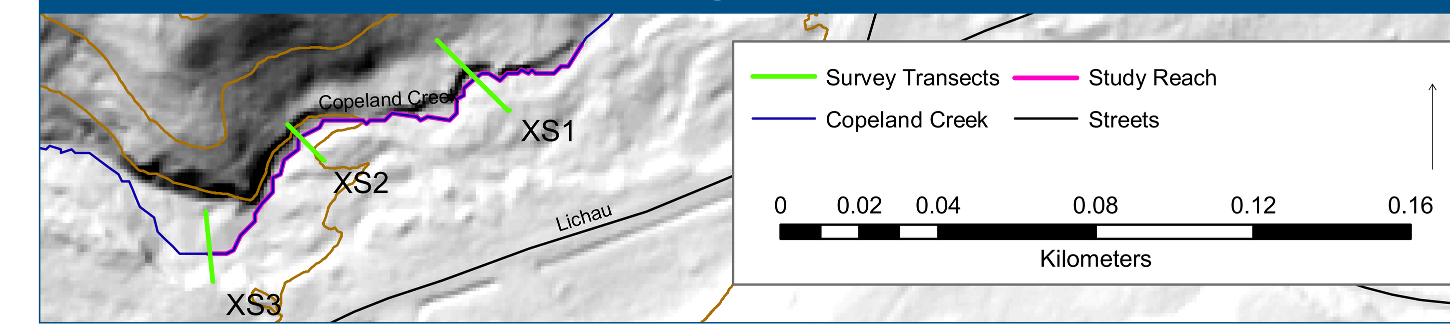


Fig. 6 Map of study reach of Copeland Creek.

Survey Data

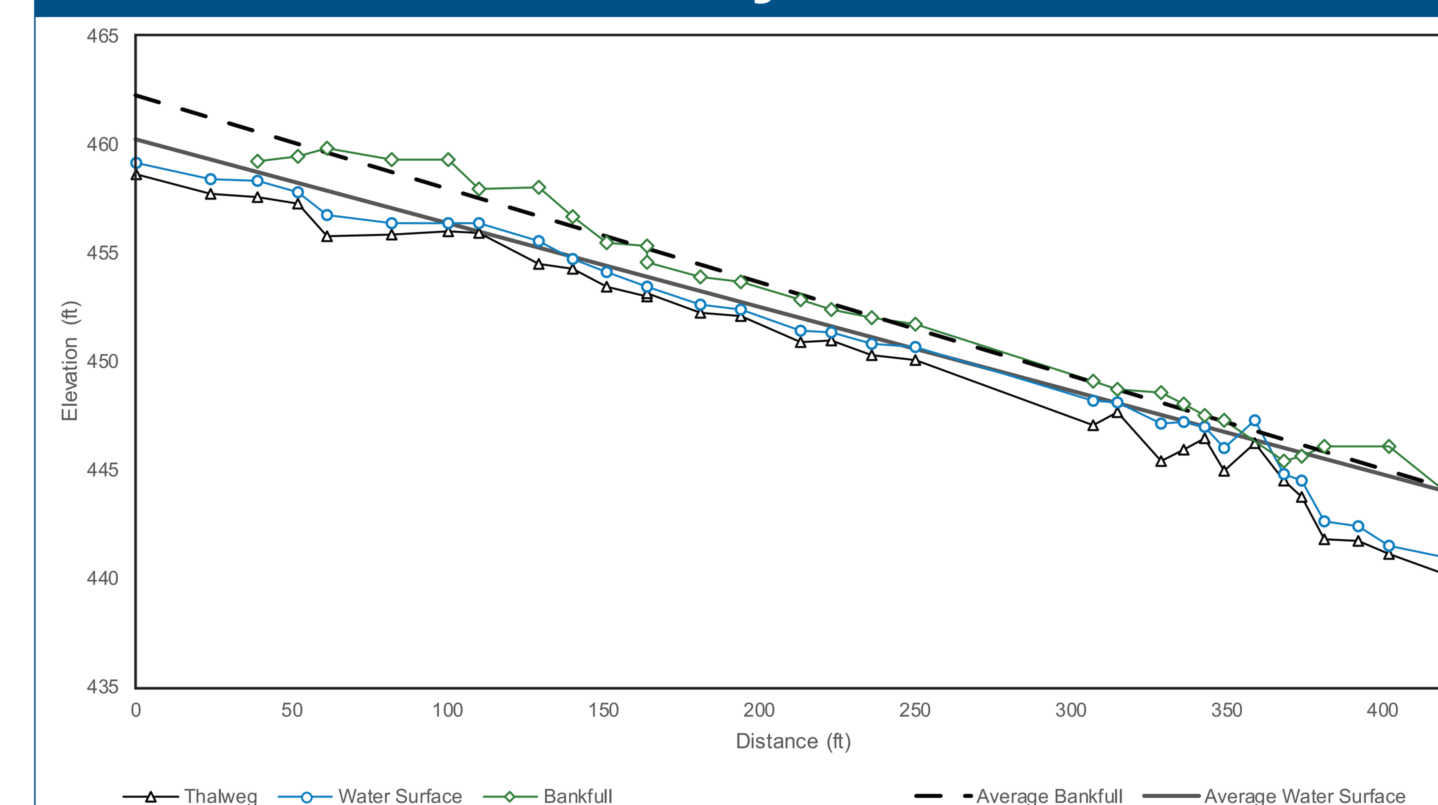
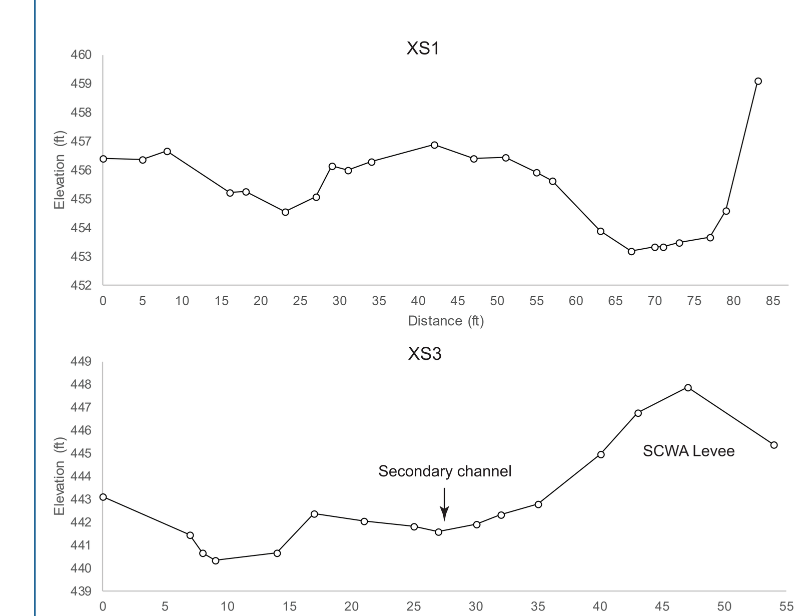


Fig. 7 Plot of surveyed longitudinal profile of Copeland Creek study reach. Note the average bankfull and average water surface lines converging in the downsteam direction.



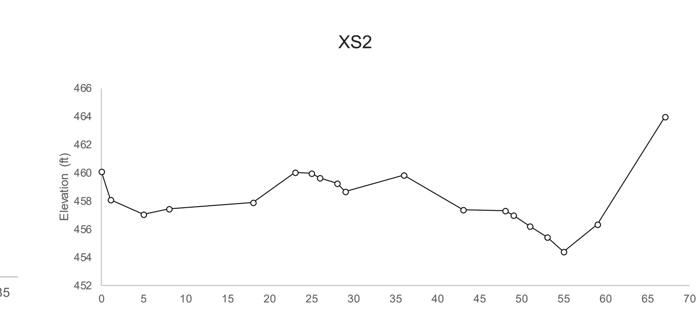


Fig. 8 Plots of surveyed cross-sectional profiles across Copeland Creek. Not the secondary channel and the temporary Levee installed by the Sonoma County Water Agency during the 2016-2017 floods.

Conclusion

- Established baseline measurements for longitudinal profile and cross sections.
- Future classes may use our baseline measurements to determine long-term changes in channel morphology.
- Convergence of bankfull and water level shows increased chance of avulsion in downstream direction.
- LIDAR data shows that some portions of the avulsion channel lie at a lower elevation than the channel of Copeland Creek.

Ackowledgements

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