Article 12

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Characterization of Heavy Metals in Santa Clara Valley

Watershed monitoring efforts have traditionally focused on water chemistry. Watershed managers attempt to use this data to quantify temporal and spatial differences in pollutant concentrations, and by extrapolation, improvements (or declines) in water quality conditions. However, the variability of water quality monitoring data and differences in station conditions often compromise the statistical validity of observed data trends. The total cost associated with use of traditional water quality monitoring then incurs a large, and often neglected, additional expense: statistical analysis to separate actual trends from masking variations attributable to background sources, hydrologic events, and sampling frequency.

Since 1986, the San Francisco Regional Water Quality Board has required that stormwater discharges into the southern end of San Francisco Bay be characterized and controlled (see Figure 1). In response, 13 municipalities situated along the southern end of San Francisco Bay, Santa Clara County, and the Santa Clara Valley Water District joined together to form the Santa Clara Valley Nonpoint Source Pollution Control Program. The Program implemented a proactive watershed management effort targeting heavy metal pollution in the 700 square mile watershed, particularly in the southern end of San Francisco Bay which, in 1989, was declared an impaired water body due to frequent exceedance of heavy metal water quality standards.

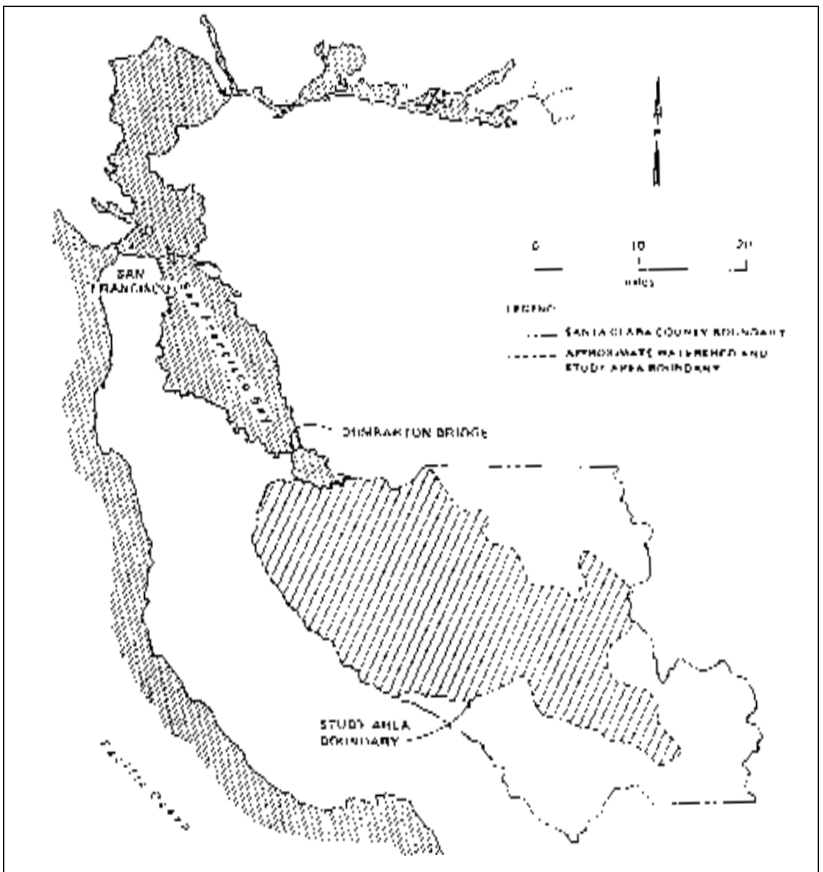

Figure 1: Study Area

The monitoring portion of the watershed management effort is built on traditional stormwater monitoring and toxicity testing. The objectives of the monitoring program include evaluation of spatial and temporal trends, land use impacts, examination of urban versus erosional sources, and comparison of automatic versus grab sampling methods.

Four years of monitoring data, representing approximately 200 station-events, were examined. Statistical analysis was used to examine differences in water quality between monitoring stations and monitoring years using analysis of variance (ANOVA) and analysis of covariance (ANACOVA). Power analysis was used to determine the number of stations and the sampling frequency required to ensure detection of long-term trends in heavy metal concentrations.

Sampling was conducted at 15 stations (see Table 1). Eleven land use stations, situated in small streams or storm drain pipes, represent relatively small catchments (12 to 8,500 acres) with one predominant land use. Water quality data from the land use stations are used to characterize urban runoff water quality. The remaining four stations, waterway stations, represent larger drainage basins (15,000 to 80,000 acres). The waterway stations are used to characterize local receiving water quality, collect compliance data, characterize upstream and non-urban metal inputs, and examine stream sediment contributions.

Automated set-ups, consisting of an automatic sampler, data logger and controller, and pressure transducer, were used to collect most of the stormwater data. Flow was rated using established flow rating curves or a weir and weir equations. Samples were analyzed for ten heavy metals (dissolved and total fraction). Various organic, inorganic, and physical parameters were also examined (see Table 2).

Heavy metal concentrations were correlated with land use using two years of data from nine of the land