Yosemite Watershed Restoration Project

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Abstract:

The Bay View-Hunters Point neighborhood of San Francisco has a history of significant environmental degradation and a population comprised mainly of underrepresented minorities. This highly industrialized area lies adjacent to Yosemite Slough, on the western shore of South San Francisco Bay. Under normal conditions local runoff is diverted into the city's combined sewer system. However, during heavy precipitation events the runoff is discharged with untreated sewage directly to the slough through the combined sewer overflow system. Moreover, Yosemite Slough is bordered by the San Francisco 49er's stadium parking lot, heavy industry, and the former Hunters Point Naval Shipyard, each of which provide a source of diffuse urban and industrial pollution through direct runoff and groundwater – surface water interactions.

The Yosemite Watershed Restoration Project is a community-based assessment of water quality at Yosemite Slough and is organized and led by undergraduate research assistants at the University of San Francisco. Teams of local high school students are trained on environmental concerns impacting the community and on sampling protocols necessary to conduct a detailed water quality assessment of the slough. The students examine the impact of sewage treatment plant outflow, good urban water quality practices, and sources of impervious surface runoff. Additionally, the students take part in enrichment programs and a local wildlife census. Data from this water quality assessment and wildlife census will be incorporated into a community-wide effort to influence redevelopment decisions to minimize environmental impacts. Through the community-involved environmental assessment, this project will lay a foundation for community empowerment so that decisions regarding future redevelopment projects will be scientifically sound and informed.

Background:

Yosemite Slough (Yosemite Watershed) in the Bay View-Hunters Point (BVHP) community is located in the southeast corner of the City and County of San Francisco, California. Bay View-Hunters Point is a low-income community largely comprised of people of color. Cumulative air, land, and water pollution disproportionately affect the community; it has some of the highest rates of breast and cervical cancer, asthma, and respiratory illnesses in California. Over 100 brown-field sites, two large power plants, a heavily contaminated naval base, and the city's sewage treatment facility are contained within this five square mile community.

The upper reaches of the Yosemite Watershed have been almost entirely urbanized. The middle reaches of the watershed are heavily dominated by polluting, outmoded industrial and commercial land uses mixed within a historically residential neighborhood. The lower portion of the watershed contains the Hunters Point Naval Shipyard, a Federal Superfund site which has severe land and subsurface contamination from point and non-point sources, three sewage outflow structures that negatively impact water quality during large storm events, several upstream landfills, and open space historically used for waste and fill disposal (Figure 1). Development of the area adjacent to Yosemite Slough has resulted in contamination of surface and submerged lands, resulting in significant loss of ecological function and habitat for aquatic and avian species, and presenting a health hazard to those who utilize it for recreation and subsistence. In addition to the impacts from the shipyard and industry, San Francisco's combined sewer system has three separate overflow discharge points within the slough. During periods of heavy rainfall, the sewage and storm water system overflows with runoff that contains metals, petroleum products and untreated sewage that are deposited into the slough and bay.

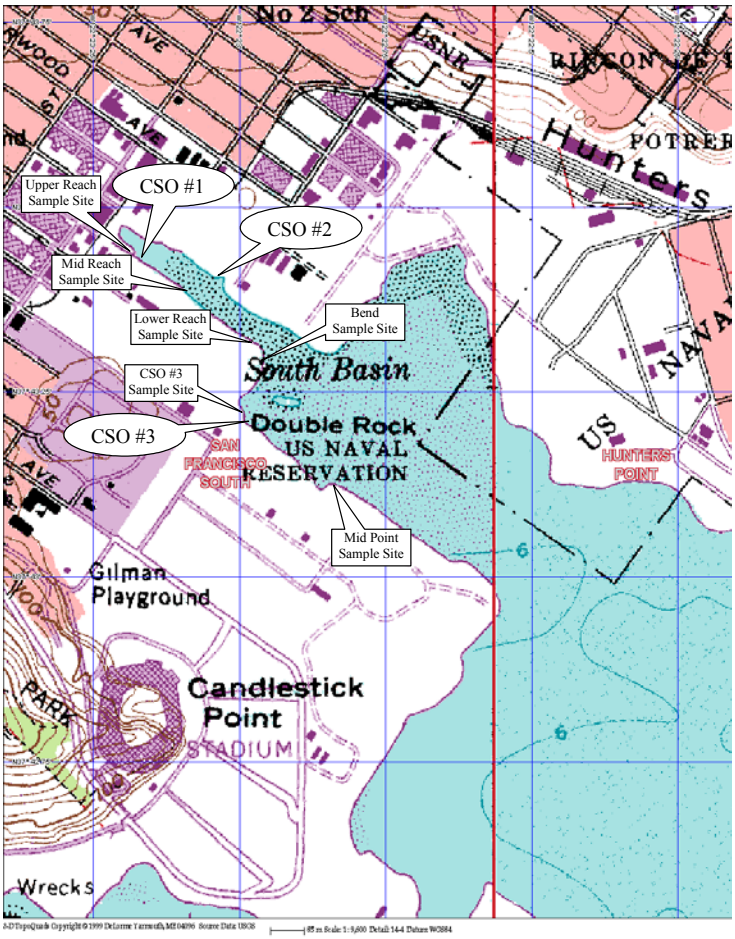

Figure 1: Diagram showing location of Yosemite Creek in relation to Hunters Point Naval Shipyard and Candlestick Point, home of the San Francisco 49er football team[1]. This diagram also shows the location of combined sewer overflows (CSOs) and sample locations.

This paper focuses on the training program for community members, teaching them how to sample water quality parameters relevant to the predominant environmental impacts of the slough, namely the impact of combined sewer overflow events. Additionally, our work focuses on how to provide the community with the information and knowledge they may require to successfully influence redevelopment while minimizing environmental impacts.

Project Description:

This project consists of a consortium of six nongovernmental organizations and the University of San Francisco (USF), all working with the community to establish a benchmark of the current state of water quality and ecosystem health within the slough and immediately surrounding area. The predominant focus of this project is to empower the local community with an understanding of ecosystem impacts on this watershed so that they are more aware of environmental impacts resulting from redevelopment and will use their knowledge to mitigate these impacts. The project's primary goals are:

- To identify and address the water quality impacts on Yosemite Slough;
- To improve water quality for the BVHP community and that portion of San Francisco Bay impacted by Yosemite Slough; and
- To improve access to restored habitats and natural areas in the BVHP community.

The project goals necessitate a thorough training program that involves community members in developing a baseline environmental assessment of the watershed. As described by other authors[2], the training for this project is organized around a problem statement of the local environment so that students see a link between sampling protocols and their community. This link helps to provide relevance and increasing interest in this project to the community. The project seeks to establish a water quality base line for use in establishing restoration goals for Yosemite Slough and follows guidance prescribed by the United Stated Environmental Protection Agency (US EPA) for community sampling programs[3] and the stream doctor project[4]. The assessment consists of a water quality sampling program using standard, nationally accepted, water quality assessment protocols[5]. Additionally, the water quality assessment and analysis process provides hands-on experiential learning for community members participating in the project helping to reinforce scientific principles[6]. Using this water quality assessment, the community may examine the impact of sewage treatment plant outflow and best management practices for urban water quality on the water quality of the slough. Also, it is expected to investigate the opportunities to daylight creek/stream function, identify impervious surface/non-point source runoff, and provide baseline data to examine the opportunities for the restoration of wetlands between the slough and neighborhood.

Bimonthly sampling will produce a database for a broad range of water quality parameters. These parameters were selected based on the urban-industrial environment of the watershed and the direct contact with combined sewer overflows. Using the combined results of nine of these parameters, a water quality index (WQI) is calculated for each location and sample time, providing a standardized method for spatial and temporal changes of water quality. The WQI method was previously adapted to Hach field sampling kits and is used for educational

monitoring of streams in Michigan[7]. The nine parameters for calculating this index are dissolved oxygen, fecal coliform, pH, biochemical oxygen demand, temperature, total phosphorous, nitrates, turbidity, and total solids. To calculate the WQI, the values for each parameter are converted to a numerical Q-value and are then multiplied by a weighting factor. These sub-totals are then added together resulting in an overall WQI value ranging from 0-100. While the WQI is defined for protection of human health rather than protection of wildlife, aquatic life, or uses of the water, it provides a combined indicator of overall water system health that may be used as a relative value for changes in water quality over time.

Additional secondary parameters were selected to gain further knowledge of the water quality in this watershed. These are measured on at least a quarterly basis and include alkalinity, ammonia, color, conductivity, nitrites, odor, oxidation reduction potential, visual, complete solids analysis, copper, nickel, and zinc. Additionally, benthic macro-invertebrates will be collected, identified, and recorded at multiple locations within the slough.

Materials and Methods

Standardized testing methods and protocols[5] and strict quality assurance standards[7] are used in this project to provide legitimacy to the results and the capacity to use results for consideration of future redevelopment plans[6]. Dissolved oxygen, pH, temperature, specific conductance, and oxidation-reduction potential are measured using a Hydrolab (Loveland, CO) Minisonde 4a with a Datasonde data logging system. Fecal coliform is measured using the most probable number technique and Hach (Loveland, CO) MEL/MPN Total Coliform and E. Coli Laboratory. Biochemical oxygen demand is measured using either a Hach BODTrac apparatus or standard methods specified by the American Public Health Association[5]. Total phosphates, nitrates, turbidity, and total solids are measured using standardized procedures associated with the Hach CEL/890 advanced portable laboratory.

Training Requirements

The University of San Francisco is responsible for coordinating all training requirements regarding water quality sampling. Avian, reptile, and mammalian census data is also conducted in parallel under the supervision of Golden Gate Audubon, a local nongovernmental organization. The detail of that study is beyond the scope of this paper but is a vital part of the watershed assessment and provides an additional set of information to the community regarding local environmental conditions. Research teams consist predominantly of local high school students, referred to within this text as research assistants (RAs). These students were selected and hired from a pool of applicants based on their basic scientific knowledge, interest in working on the project, and desire to be part of this community-based project. Training was designed to develop the RA's analytical capabilities and to develop their independence and self-assuredness by making them accountable for all data collected[8]. All those that participate in the monitoring project are certified before sampling is under-taken using the following four-steps training process.

1. The RAs participate in an initial lecture on contaminants of concern, sampling equipment, and monitoring procedures.

2. Working in small groups, RAs actively participate in a hands-on demonstration of the equipment conducted by USF undergraduate researchers.

3. In the same small groups, university researchers observe and evaluate each RA as they use the sampling equipment, in turn. The focus of this observation and evaluation is on safety, proper equipment handling, and sampling techniques. The small group interaction allows for each RA to observe colleagues as they individually use the equipment for the first time helping to reinforce their understanding and retention of the information.

4. Following these steps, each RA is required to take a written certification examination. The examination covers material on reasons for sampling the selected parameters, personal safety, use of equipment, and other areas of quality assurance and quality control.

During the entire process, university researchers observe and note performance correcting any deficiencies promptly with explanation helping students to further develop their expertise and reinforce training expectations. Once certification is attained, annual refresher training and re-certification will be conducted for all RAs. During any stage of the project, if a RA is deemed to not meet minimal certification criteria, they will be removed from sampling duties until additional training and recertification occurs.

Sampling is conducted in small groups consisting of four RAs and two university undergraduate researchers. Group work is distributed to all members in the following manner. One RA reads the procedure step by step from the procedure manual, one RA conducts the actual sample analysis, one RA assists the person conducting the analysis and records results, and one RA observes the entire process and verifies that the procedure is accurately followed. Individual responsibilities are rotated during the sampling event to evenly distribute responsibilities and to provide experience in all aspects of water quality analysis. University researchers monitor the entire process for accuracy, completeness, and safety, and answer questions as they arise. Additionally, as some sample procedures have significant wait times, university researchers may use this time to discuss results attained and further train the RAs on water quality parameters being sampled.

Sample results are recorded by one student and certified by another student within the working group at the time the sample is taken. Certified RAs record each site location, date and time sample was collected, results, if determined, and the name and responsibility of each team member. Following a sample event, data are entered into a master database within two weeks and further certified by USF. This database will then be made available to the community for planning uses.

Current Status and Expected Project Future

All RAs completed certification by passing the required written examination on the first attempt, a score of 60% was considered passing. Results of the examination following a four-hour training session show an average score of 85%, a median score of 87%, with a standard deviation of 13% (n=15). Three RAs scored a perfect 100% and only two scored below 70%. The latter two students were monitored closely and further trained as routine twice-monthly sampling commenced in January 2003. Sampling is currently funded through January 2004.

Data analysis will be conducted following each sampling event and results provided to the community through a local watershed council currently being developed. The expectation is that this data will be used by the community to develop:

- A community-based watershed planning process and design of a restoration and management plan for the Yosemite Slough watershed, informed by the results of the assessment; and

- A much-needed watershed management perspective and baseline data to inform on-going redevelopment plans and water infrastructure investments.

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