Project Implementation

PWA's experience with multi-objective hydrologic projects that include habitat protection, enhancement or restoration is a key asset for the design of successful projects.

Streambank stabilization at Martin Canyon, Dublin, CA

Project implementation includes preparation of construction documents, environmental and permit support, design support during construction and post construction performance monitoring.

Hydrologic projects have traditionally focused on a single objective such as water supply or flood control. The implementation of these projects often resulted in adverse impacts to affected ecosystems. Our experience demonstrates that projects designed in concert with the natural riverine, estuarine and coastal physical processes can provide greater overall benefits in a sustainable manner. There is a need for innovative and sensitive engineering design of public works and implementation of habitat restoration and enhancement projects. Successful implementation requires integration of multiple disciplines such as engineering, geomorphology and biology into a defined project, and translation of the project goals into clear construction drawings and specifications with realistic budget and time estimates. Consistent involvement and overview throughout the construction and monitoring process is key to maintain the design intent and achieve project objectives.

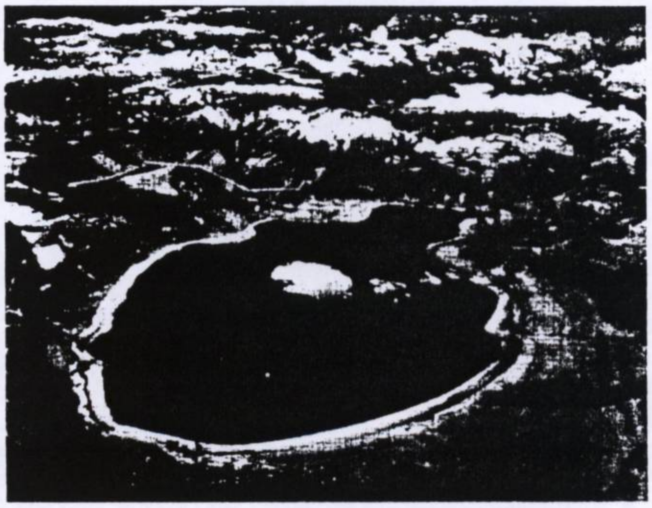
Tidal channel excavation at the Corte Madera Ecological Reserve

PWA project implementation services include:

- Preliminary design and cost estimates;
- Engineering feasibility and alternatives analysis;
- Preparation of construction drawings, specifications and estimates;
- Construction support;
- Performance monitoring and maintenance planning; and
- Environmental review permit support.

Water Resources Planning & Analysis

U.S. and international water resources management policy is changing rapidly. Priority is now placed on addressing environmental concerns on all types of water management projects. A new area of development is the reallocation of existing supplies to meet both new and newly-recognized needs for water.



Mono Lake Basin: Fresh water inflow management

Since 1976, PWA has been at the forefront in developing and implementing environmentally-sensitive approaches to address crucial water management issues.

The foundation to PWA's approach to these problems is to develop an understanding of the physical processes that support and maintain the ecosystem that is targeted for protection or enhancement. Once this element is understood, the opportunities and constraints associated with changing the hydrologic environment to meet environmental and other water management goals can be established.

The firm's work in the Owens Valley and the Mono Lake Basin contributed to the resolution of management issues at Mono Lake and provided environmental management goals that have been integrated into planning for the water supply of the City of Los Angeles.

PWA later formulated the first proposals for scientifically-based flow and salinity criteria to be used in managing the Central Valley's water resource system. This work provided a springboard for much of the current thinking behind the salinity standards being implemented in California's Sacramento-San Joaquin Bay and Delta.

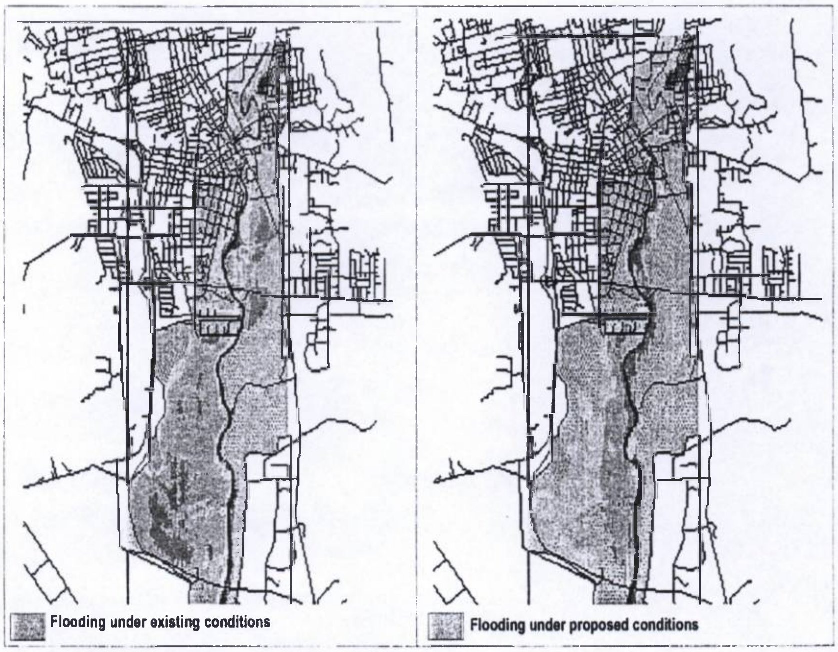
PWA also participated in EPA's landmark study of the impact of climate change on U.S. water resources, analyzing required changes in reservoir operation to repel salt water intrusion in San Francisco Bay and the Delta.

The firm's water resources management work further broadened in the 1990's, including investigation of reservoir reoperation scenarios for flow enhancement, operation of Sacramento Valley rice fields for winter waterfowl habitat and changes in large-scale water system management for restoration of floodplains and aquatic habitat.

Computer Modeling of Physical Processes

Mathematical modeling and computer simulation are integral components of technical analyses undertaken by PWA. In the last decade, we have led in applying innovative computer models to solve problems in watershed, riverine and estuarine systems.

PWA offers a comprehensive range of computational capabilities.



Flood mapping using Digital Terrain Models in Napa, CA

Hydrodynamics and Mass Transport Modeling

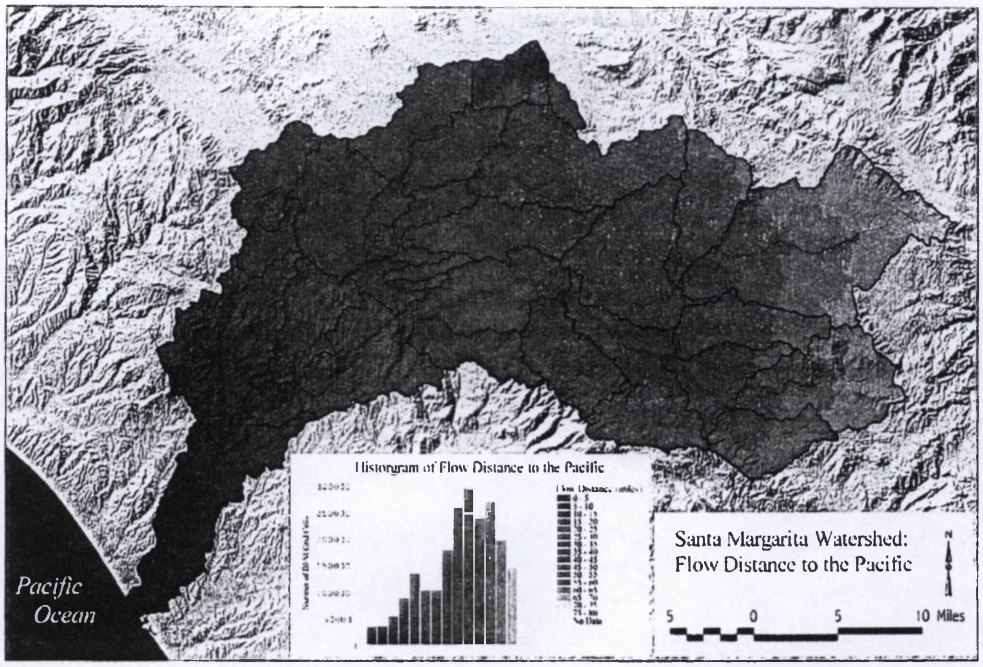
PWA uses models to simulate one- and two-dimensional hydrodynamics, sediment transport, salinity and water quality parameters in rivers, estuaries and tidal wetlands. We have extensive experience working with models such as the Danish Hydraulic Institute MIKE package, DIVAST, ESTFLO, FLO-2D, COE HEC package and the RMA modeling package.

Computer simulation of estuarine tidal circulation

For some specific problems, PWA has developed new approaches or expanded existing models. In many instances, PWA uses Geological Information Systems (GIS) technology to develop bathymetric model grids and present results.

Rainfall-Runoff Modeling

PWA has extensive experience in the modeling of rainfall-runoff processes, from simplified techniques (e.g. rational method and SCS methods) to physically-based hydrologic process modeling. Watershed basin delineation, flow distance calculations, precipitation analysis, etc. have been integrated with GIS.



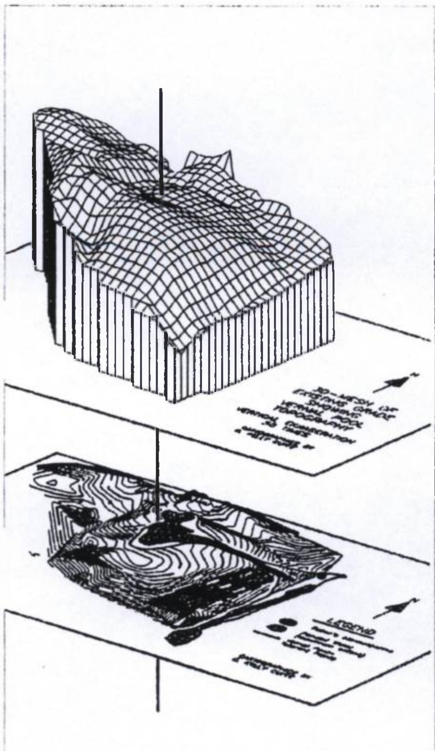
GIS model of the Santa Margarita watershed

Coastal Processes Modeling

PWA maintains a suite of computer programs (including software packages developed by the U.S. Army Corps of Engineers) for the calculation of wind-wave generation, wave transformations in shallow water, wave runup and littoral processes.

GIS and Computer Aided Graphics

GIS is used extensively for analysis, visualization of hydroponic information and spatial data management. PWA uses GIS technology to develop spatially distributed hydroponic models. Example applications of GIS at PWA include digital terrain modeling, volumetric calculations, land use change analysis, soil mapping, landslide susceptibility mapping, marsh erosion analysis, precipitation modeling, watershed delineation, wetland mapping and analysis, aerial photo analysis, flood mapping and distributed model pre- and post-processing. PWA uses data from a variety of system formats, including Intergraph, AutoCad, ArcView and graphics illustration programs. We have the capability to translate amongst various GIS and CAD file formats. PWA uses graphic presentations and animated displays to quickly and effectively convey complex modeling results.

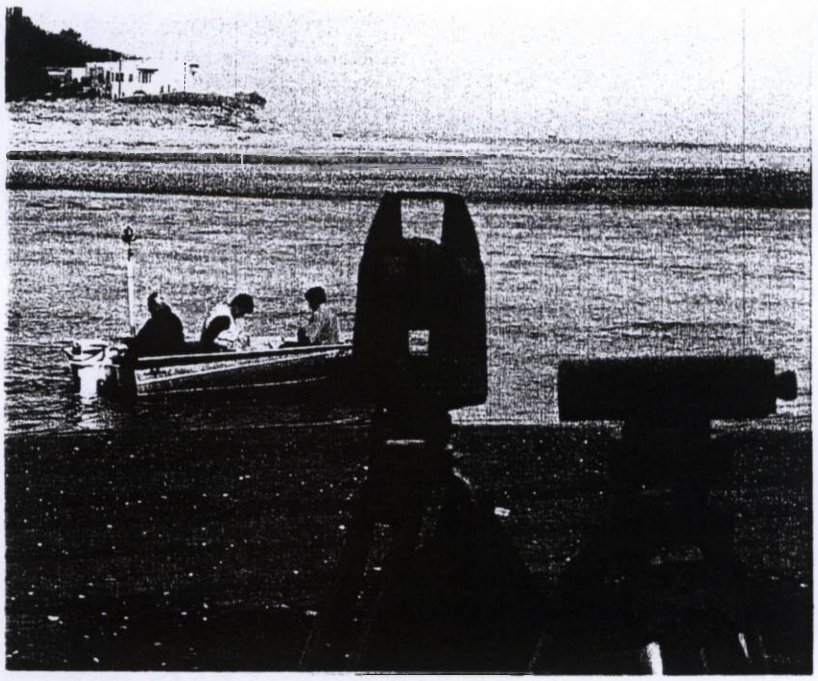

Representation of vernal pool typography

Computer Aided Design and Drafting (CADD)

PWA uses the AutoCAD civil software with SoftDesk civil survey enhancements for digital terrain modeling, volumetric calculations of earthworks and rapid preparation of cross-sections or long-sections.

Field Capabilities

PWA emphasizes the collection and documentation of accurate field data because it is essential to the understanding of natural processes. It is PWA's policy to integrate direct knowledge of field conditions at each project site. We use the appropriate technologies available when designing and implementing monitoring projects and calibrating and validating computer models. PWA field capabilities include:



Hydrographic surveying at the Bolinas Lagoon inlet

Geomorphic/ Hydrographic Surveys and Mapping

Detailed topographic and hydrographic maps of wetlands, lagoons, coastal areas, rivers and floodplains are essential tools for site analyses. PWA utilizes GPS, Total Station and standard-level surveying technologies to build detailed maps, cross-sections and profiles. The resulting data is then entered directly into either AutoCad, spreadsheet programs or various computer models.

Continuous Tide, Wave, Current and Wind Monitoring

Self-contained digital instruments and dataloggers are installed in the field to record tide or wave heights at assigned time intervals. PWA utilizes fully submersible pressure transducers and dataloggers as well as land-based, vented dataloggers. An integrated pressure and velocity gauge (purgauge) records tide and wave heights and horizontal water velocities and allows estimates of wave spectra, including directional spectra. PWA has deployed these instruments in open-ocean, estuarine and riverine environments.

PWA recognizes the fundamental importance of field work and field-collected date in understanding and modeling hydrologic systems.

Hydrographer installing tidal current meter

Sediment and Erosion Monitoring

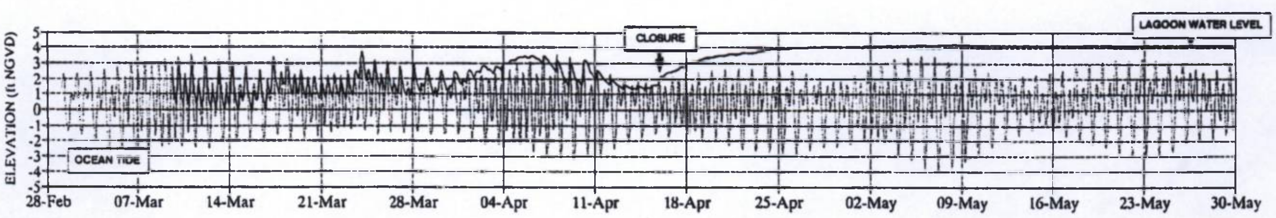
Field monitoring through the use of topographic surveys, SETs (Sediment Erosion Tables), erosion pins and sedimentation plates is combined with analysis of historic topographic maps and aerial photographs to document geomorphic change in riverine, estuarine and coastal environments.

Freeborn Creek geomorphic reconnaissance

Discharge Measurements

PWA uses Electromagnetic, Acoustic Doppler and custom-made datalogging current meters to measure current velocities. The data are then used to:

- develop rating curves
- calibrate rainfall-runoff volumes
- calculate sediment transport
- develop flood frequency models
- assist in environmental restoration designs



Tidal monitoring at Estero de San Antonio showing lagoon mouth closure

Regulatory Compliance Support Services

During the past three decades, extensive local, state and federal legislation have been enacted to protect fluvial, estuarine, wetland and coastal environments.

A variety of agencies at various governmental levels have either regulatory or planning responsibilities in the implementation of this legislation. This has resulted in a complex and somewhat daunting project planning and implementation environment.

PWA has assisted numerous public agencies and private clients in understanding regulations and then developing projects which comply with applicable requirements.

Our consulting work with several of the key agencies allows us to stay abreast of the evolving requirements. Our excellent reputation and working relationship with all of the government agencies involved in the permitting process represent a major benefit to our clients.

By integrating agency and permit issues with the planning and design process, we are able to develop projects that reduce permit approval time without costly redesign.

PWA also has extensive experience in conducting environmental analyses and preparing NEPA/CEQA documents. Our design approach allows us to develop projects with minimal impacts, incorporating required mitigation into the project. The development of these "pre-mitigated" designs speeds the CEQA or NEPA approval process.

Recent environmental permitting has expanded the requirement for performance monitoring of mitigation projects. We have assisted a variety of clients in designing and implementing successful, cost-effective monitoring and reporting programs.

As part of this effort, we have implemented the concept of "adaptive monitoring," in which the monitoring program is regularly reviewed and updated based on project performance. In a recent monitoring study for permit compliance, the frequency and cost of subsequent monitoring were reduced by 30 percent, based on the initial successful project performance.

Commitment to Education & Research

In addition to work on technical projects, PWA staff are actively involved in hydrologic education and research.

Numerous staff articles on both the basic science and field applications of fluvial, estuarine, and wetland processes have been published in books, journals, conference proceedings, and popular publications.

PWA principals and senior staff have served as visiting lecturers at the University of California, Berkeley and San Diego State University. Short courses on physical processes in estuarine and coastal wetland manage-ment and multi-objective river corridor manage-ment at the University of California, Berkeley have also been devel-oped by PWA principals.

In addition, staff are actively involved in the organization of national and international conferences, and participate in national and international technical committees. PWA maintains an active professional development program in which staff are encouraged to attend short courses, take university courses, and publish in professional journals.

The firm also provides a "Schools Outreach" program, providing speakers and material to schools, civic, and non-profit groups on fluvial, wetland, and environmental issues.

Current research projects under-taken by PWA staff include simulation of flows in tidal wetlands, long-term monitoring of tidal marsh restoration sites, and modeling flow and solute transport processes in coastal embayments. Funding for research projects are solicited from a wide range of sources, in-cluding private and research foundations. For example, a coastal embayment modeling project has been un-dertaken in collabora-tion with the Uni-versity of Washing-ton, University of Bradford (UK), and the Middle East Technical University (Turkey), with fund-ing from NATO.

Dr. Williams explaining salt marsh processes at China Camp, Marin County.

Representative Projects

River Corridor and Flood Hazard Analysis

Wetlands Hydrology
Coastal Processes and Analysis
Applied Geomorphology
Implementation
Water Resources Planning and Analysis

Cosumnes River Floodplain Analysis

For Nature Conservancy, 1996-97. PWA developed an analysis of historic geomorphic trends, existing hydrologic and hydraulic conditions and floodplain requirements to assess the potential for floodplain restoration along 17.5 miles of the Lower Cosumnes River. An ultimate floodplain restoration alternative was identified.

The Napa River Flood Protection Project

For U.S. Army Corps of Engineers, Sacramento District, Napa County Flood Control District, and the State Coastal Conservancy, 1991 to present. The project is designed to provide 100-year flood protection for the City of Napa combined with restoration of historic tidal marshlands and alluvial floodplains. This strategy—termed the "Living River Strategy" by the Napa Community Coalition—is considered a national model for flood protection and river restoration by the Corps.

Wildcat and San Pablo Creek Flood Control Plan

For Urban Creeks Council and East Bay Regional Park District, 1985-88. PWA designed a flood control plan to preserve riparian corridor, protect downstream marshes and enhance recreational opportunities for North Richmond. Over a period of several years, PWA was instrumental in obtaining a consensus on the plan from both environmentalists and Federal/County flood control agencies.

San Lorenzo Flood Control and Enhancement Plan

For the City of Santa Cruz, 1986-93. PWA designed flood control improvements and provided hydraulic analysis of a riparian enhancement plan and other proposals for the river corridor.

Northern California Flood Studies

For FEMA, 1989-93. PWA conducted flood insurance studies delineating 100-year flood zones on more than ten northern California streams in four counties.

Willamette River Floodplain Restoration Feasibility Study

For the River Network, Portland, Oregon, 1995. PWA demonstrated the value of restoring floodplain lands in the Willamette River Valley for multiple purposes including fish and wildlife habitat, flood water storage, water quality enhancement and public open space. Using GIS data on land use, regulatory floodplains and hydric soils, promising regions for floodplain restoration were identified.

Representative Projects

River Corridor and Flood Hazard Analysis

Wetlands Hydrology

Coastal Processes and Analysis
Applied Geomorphology
Implementation
Water Resources Planning and Analysis

Sonoma Baylands Wetland Restoration Project

For the Sonoma Land Trust, California State Coastal Conservancy, and U.S. Army Corps of Engineers. 1991-97. PWA developed the design for the restoration of 322 acres of subsided former tidal marsh using 2.5 million cubic yards of dredged material from the deepening of shipping channels to the Port of Oakland. This project was completed and opened by Vice President Al Gore in 1996.

Warm Springs Development Marsh Restoration Design

For Fremont International Partners, 1981-92. In conjunction with planners, engineers and biologists, PWA developed a conceptual marsh restoration design for 250 acres of diked wetland in South San Francisco Bay. PWA is carrying out a long-term study on slough channel adjustment, sedimentation and marsh development resulting from the project.

Tidal Channel Design Guidelines

For the U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi, 1995. Since 1981 PWA has developed a new empirical approach for developing design criteria for tidal slough channels based on correlations of hydraulic geometry with tidal prism and marsh plain area. The Corps asked PWA to summarize its work as a design guideline report for use in planning tidal wetland restoration projects.

Hamilton Airfield Tidal Wetland Restoration

For IT Corporation and the State of California Coastal Conservancy, 1996 to present. PWA developed a conceptual design for the restoration of 700 acres of tidal wetland and 150 acres of nontidal wetland in northern San Francisco Bay. The restoration design reintroduces tidal action within the site, establishes a template for site evolution, and provides conditions for natural sedimentation and vegetation colonization to reestablish tidal wetland habitat.

Tillamook Bay Project

For the Tillamook Bay National Estuary Project, Garibaldi, Oregon, 1994. PWA produced an Environmental History and Assessment of the Tillamook Bay Estuary and Watershed.

Representative Projects

River Corridor and Flood Hazard Analysis
Wetlands Hydrology

Coastal Processes and Analysis

Applied Geomorphology
Implementation
Water Resources Planning and Analysis

Tijuana Estuary Enhancement Study

For State of California Coastal Conservancy, 1990. PWA developed a restoration and management plan for the 2,500-acre Tijuana National Estuary. The project included calibration and use of a tidal hydrodynamics model to predict existing estuary flow conditions. Restoration alternatives were recommended—including slough channel excavations and protection of sensitive wetland vegetation.

San Francisco Bay Freshwater Inflow Study

For Romberg Tiburon Center and BCDC, 1987. PWA carried out an analysis of hydrology and hydrodynamics of San Francisco Bay to develop recommended standards for freshwater inflow to protect the estuarine ecosystem. This analysis was presented to the State Water Resources Control Board in the 1987 San Francisco Bay Delta hearings.

Lower San Joaquin Water Quality Model

For the City of Stockton, 1992-93. PWA conducted field studies, calibrated a numerical water quality model, and used the model to help the City develop management solutions for local water quality problems.

Bolinas Lagoon Hydrographic Data Collection

For the U.S. Army Corps of Engineers, San Francisco District, 1997-98. PWA collected and analyzed hydrographic data in support of the Corps' Feasibility Study for Habitat Restoration Enhancement within the Bolinas Lagoon. PWA developed and implemented a data collection program to characterize existing conditions and to support numerical modeling of hydrodynamic and sediment processes. The program included multiple water level recorders, point and acoustic Doppler current meters, directional wave and tide gauging outside the Lagoon entrance, cross-section surveys, sediment accretion tables and sediment grab samples.

Corte Madera Marsh Erosion Study

For the Golden Gate Bridge, Highway and Transportation District, 1989-98. PWA conducted a series of shoreline erosion studies of marsh lands at Corte Madera Ecological Reserve, Shoreline Center, Triangle Marsh and Tiscornia Marsh (Pickleweed Park) to monitor recent and historic shoreline erosion rates. PWA also conducted an investigation of ferry wave energies versus natural background wave energies effecting the Corte Madera shoreline to determine the relative impact of ferry waves on shoreline erosion.