

Recommended design for Sonoma Bayland Marsh

state agencies concerned with estuarine, marsh and coastal hydrology management.



Clapper Rail

These include:

- The U.S. Environmental Protection Agency (EPA)
- The California State Coastal Conservancy
- The San Francisco Bay Conservation and Development Commission (BCDC)
- The U.S. Army Corps of Engineers

We have completed over 400 wetland restoration plans and analyses of coastal, seasonal, inland, and riparian wetlands. Our experience has shown that successful wetlands management requires a comprehensive understanding and integration of hydrologic and geomorphic analysis with biological, legal and land-use planning considerations.

Urban Stormwater Management

The management of urban runoff represents a major challenge to city and county governments across the country. The recent changes in the regulation of stormwater discharges have increased the emphasis on improving stormwater quality.

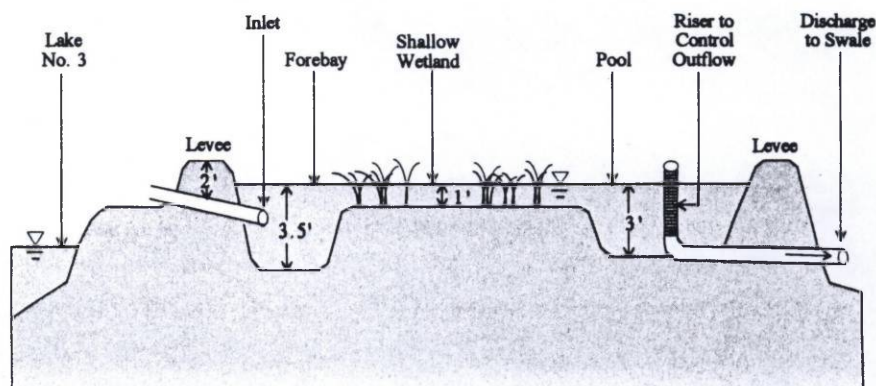
PWA provides services in all areas of stormwater management, including drainage design and planning, stormwater monitoring, characterization of pollutant loadings, and design of stormwater quality treatment systems.

We have specialized expertise in the management of stormwater discharges to wetland and riparian resources: our analyses include the important interactions between water quantity, water quality, erosion, and sediment transport.

We have applied our stormwater management expertise to projects ranging from the design of site-specific facilities to the development of regional Master Plans. Our clients include flood control districts, local governments, public interest groups, and private developers.

PWA's unique background in the design of wetlands allows us to design detention/retention facilities that combine water quality functions with natural resource values. We have direct experience in applying Best Management Practices (BMP's) for stormwater treatment, including constructed wetlands, first-flush retention basins, oil

and grease traps, debris basins, and source control measures. We can also monitor stormwater quantity and quality to develop site-specific data for our designs. Our watershed modeling capabilities allow for the simulation of design flows and pollutant loading. Our staff has experience with a variety of tools for estimating urban runoff loading, ranging from planning-level empirical models to complex watershed pollutant transport models. In addition, we can assist our clients by providing permit assistance and coordination with the appropriate regulatory and planning agencies.



Freshwater marsh for urban runoff treatment

Coastal Processes Analysis and Management

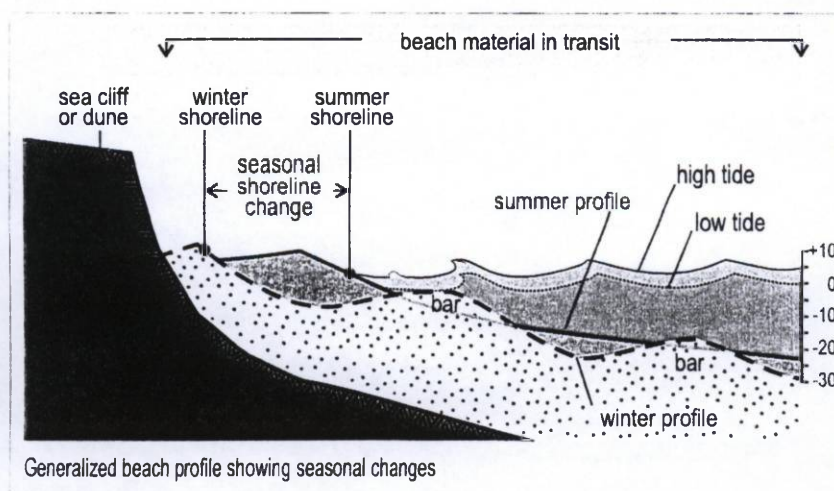
As a resource the coast is subject to increasing pressure as the population grows, leading to increased development potential as well as a rising need for public recreation and conservation. It is therefore critical that sound technical guidance is made available to the decision makers charged with managing our coast.

PWA's expertise with coastal processes is augmented by our expertise in riverine and estuarine regimes which often overlap in considering sediment transport, flood potential and water quality.

For example, most of the California coast was developed in the 1940's to 1970's, during a relatively benign storm period. During this same time frame, some of man's activities such as dam and flood control projects, harbor construction and sand mining inadvertently led to increased erosion potential which, in many cases, is still being felt. Since the 1980's large storm events have become more frequent, resulting in erosion and damage to property. Furthermore, the effects of sea level rise and the recurring El Nino - Southern Oscillation (ENSO) are sources of concern. Regulators now require more detailed evaluation of these factors as part of the project approval process.

Some of the services offered by PWA are:

- Mapping of historic shoreline positions and rates of change;
- Sediment transport and sediment budget analysis;
- Development set-back recommendations;
- Evaluation of coastal flooding potential and federal flood limits;
- Development of wave and current design loads;
- Numerical modeling of wave diffraction, refraction and shoaling;
- Circulation and water quality modeling;
- Wind and boat generation of waves;
- Erosion control and coastal drainage design;
- Coastal morphology, including river and estuary mouths;
- Dredging and sand bypassing requirements.



Applied Geomorphology

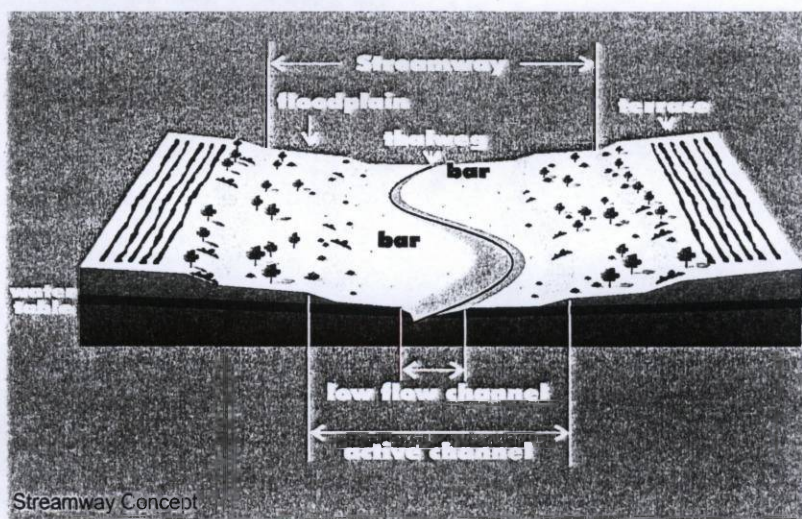
Understanding the physical evolution and response of different landscapes through applied geomorphology is the first step in the development of innovative, environmentally sensitive and self-sustaining solutions to complex river and wetland management projects. Investigations of the relationship between water flow, sediment transport and the physical characteristics of rivers and wetlands fall within the science of fluvial and coastal geomorphology. Applying concepts in geomorphology to river and wetland management and restoration projects bridges the gap between hydraulic engineering and ecosystem management by considering the physical processes that naturally

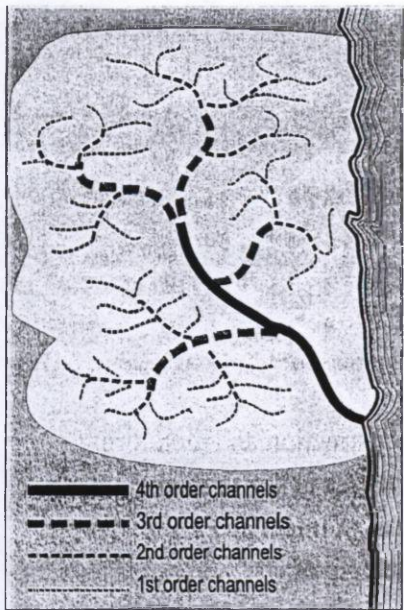


The Miller Creek two-stage channel design

**Geomorphology is
the science of
landforms and the
processes that
create them.**

shape river channels and wetlands in both tidal and non-tidal environments. Land alterations, construction and development activities can adversely affect rivers, wetlands and the ecosystems that depend on them through direct manipulation or indirect adjustments in the supply of water and sediment from contributing watersheds. Problems that can occur include excessive bank erosion, channel enlargement, unusually high sediment loadings and adverse changes to physical habitat. Answers to these problems require a multi-objective planning and design approach that includes consideration of the processes that





An idealized channel network for a 40-acre created tidal marsh

An understanding of fluvial processes can help determine how streams are changing and how they will respond to different management scenarios.

influence the shape, dimension and stability of riverine and wetland systems. Single objective approaches that consider only structural engineering or biological issues can limit project benefits and result in high maintenance costs or even project failure.

Approach

PWA integrates geomorphic analysis and applied techniques with accepted engineering principles in all of our planning and design projects. For example, geomorphic analyses are used in stream management restoration projects to properly size and configure channels, to identify problems caused by long-term watershed changes and to develop or maintain specific physical characteristics, including bank stability regimes, habitat elements and desired sediment transport capabilities.



San Francisquito Creek Bank Stabilization Master Plan



Sediment Evaluation at Route 4 in Concord

Professional Services

- Channel bank stability assessments
- Channel stabilization, flood protection and habitat enhancement designs
- Hydraulic geometry assessments
- Geomorphic conditions and trends analyses
- Channel migration analyses
- River channel impact assessments (flood protection, reservoirs, road crossings, urban infrastructure, gravel mining and urban storm water drainage)
- Scour analyses
- Sediment characterization and transport analyses
- Watershed process evaluations (sediment transport and hydrology)
- Gravel mining impact assessments