

# Science Foundation Chapter 4

## Appendix 4.2

### Profiles of the Transition Zone Types

#### BACKGROUND

This appendix is designed to serve as a quick reference to the basic characteristics of each of the seven types of the T-zone.

#### Type Hillslope or Alluvial Fan and Valley or Plain

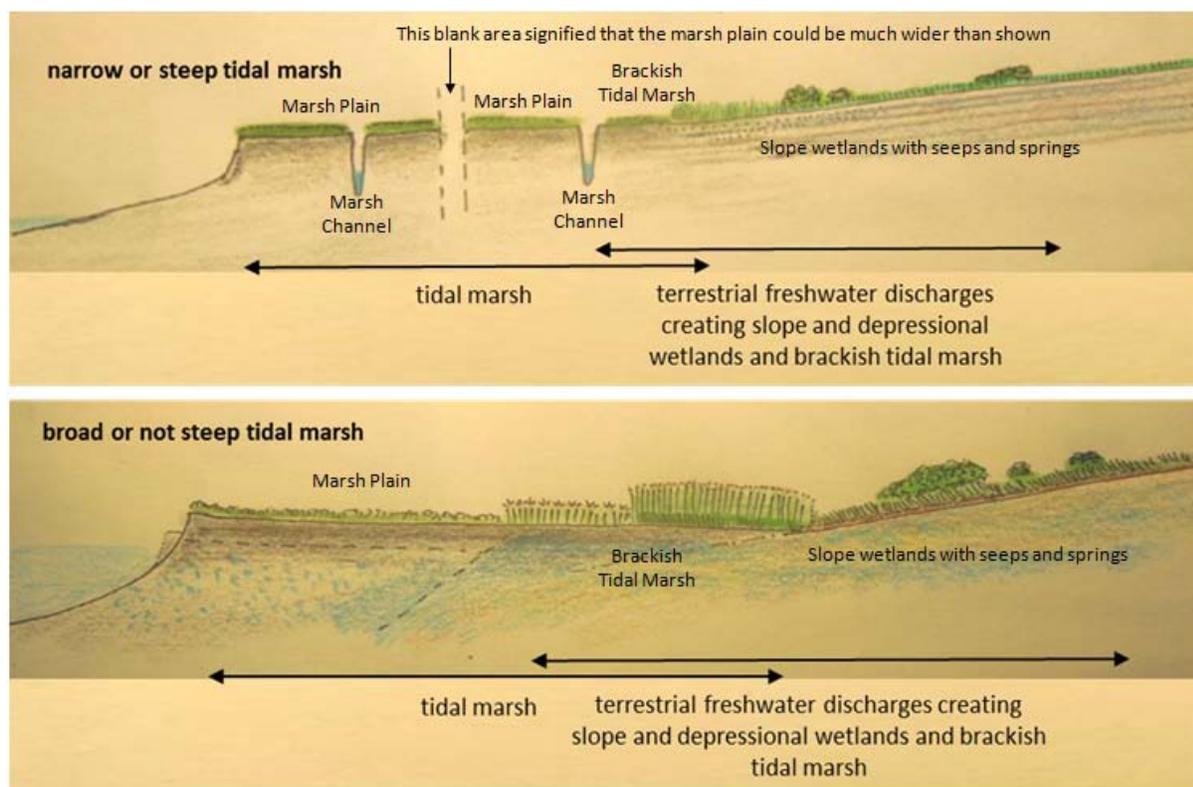


Figure 4.2.1. T-zone associated with hillslope, alluvial fan, valley or plain

#### *Narrative Description of Natural Physical Condition and Setting*

**Landscape Position:** bayward margin of hillslope, alluvial fan, valley or plain.

**General Description.** This type of T-zone exists where tidal marsh borders gently sloping terrestrial lands away from a river or stream. The lands might be the bayward margin of a hillside, alluvial fan, valley or plain. Areas more than 0.25 miles wide corresponding to Sub-zone 1 are described by Cooper (1926) for the historical bayward reach of Santa Clara Valley. The landward part of this type (Sub-zone 4) is often characterized by slope wetlands and depressional wetlands, with seeps and springs in some places, due to

near-surface or emergent groundwater. The backshore portion of this T-zone type is characterized by brackish or freshwater tidal marsh. Where alkali grasslands (grasslands dominated by salt tolerant species) border tidal marsh (e.g. Suisun Marsh; the historical T-zone area near present-day Milpitas), landward and bayward boundaries of the t-zone may be poorly defined by vegetation. If the tidal marsh portion is mature, it can include elongate pans along the backshore.

**Substrate.** Either entisols (recent sediment, no soil profile development) or soil profiles well-developed (including organic-rich sediments created by non-tidal wetlands) contiguous with the landward edge of tidal marsh. Fine textured soils and sediments (mostly fine sand, silt, clay, local coarse channel deposits).

**Slope.** Gently to very gently sloped, near 0% (alluvial flats, valley floors) to 5% (some hillslopes and uplifted alluvial fans).

**Hydrology.** Naturally shallow fluctuating seasonal groundwater (historically drained for agriculture and urban/industrial development), seasonal flooding or overland flow; historical channel avulsion of braided alluvial fan distributaries; extensive groundwater emergence near sea level. Freshwater discharge and terrigenous (flood discharge) sediment transport extends terrestrial influence into tidal marsh bayward of MHHW boundary (visible as contrasting brackish marsh vegetation zone in salt marsh, or fresh-brackish marsh vegetation zone in brackish marsh).

#### Terrestrial vegetation of Sub-zones 3 and 4.

- wet meadow (lowland grassland, valley grassland, sedge meadow, sedge-rush meadow, seasonal marsh).
- alkali meadow (lowland alkali grassland).
- vernal pool grassland phase (depressional wetland pool and swale, annual/spring ephemeral forbs).
- riparian scrub (willow grove or sausal; mixed riparian scrub).
- freshwater slope wetland and depressional wetland (rushes, sedges, willows).

**Regional distribution and abundance.** Historically widespread as the dominant T-zone type of East Bay, South Bay, and much of Suisun and northern San Pablo Bay (Petaluma, Napa, Schellville, Fairfield vicinity). Low slopes and fertile soils favored rapid early agricultural conversion and subsequent urban development. Remnants occur in small valleys of North Bay (often fragmented by diked baylands). ranch lands, open space preserves, and wildlife refuges.

**Type Localities.** Public access lands: (1) Rush Ranch (Suisun Marsh), (2) Sears Point (Sonoma Marshes), (3) China Camp (Marin).

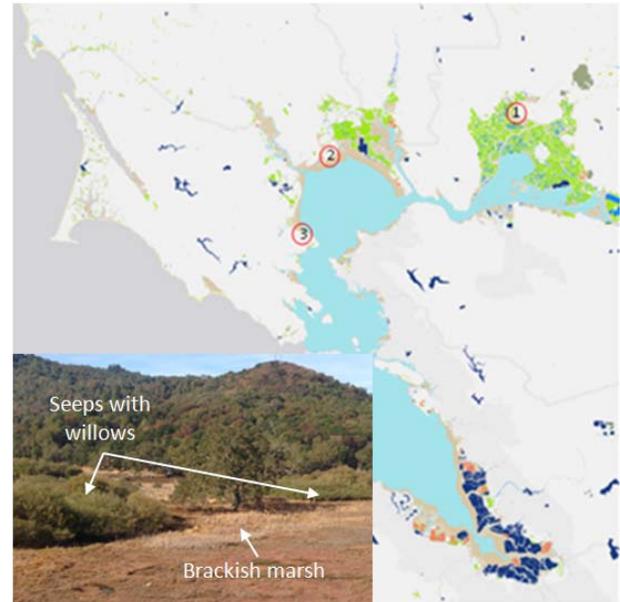


Figure 4.2.2. Type localities for hillside T-zone.

Type: Bluff or Cliff

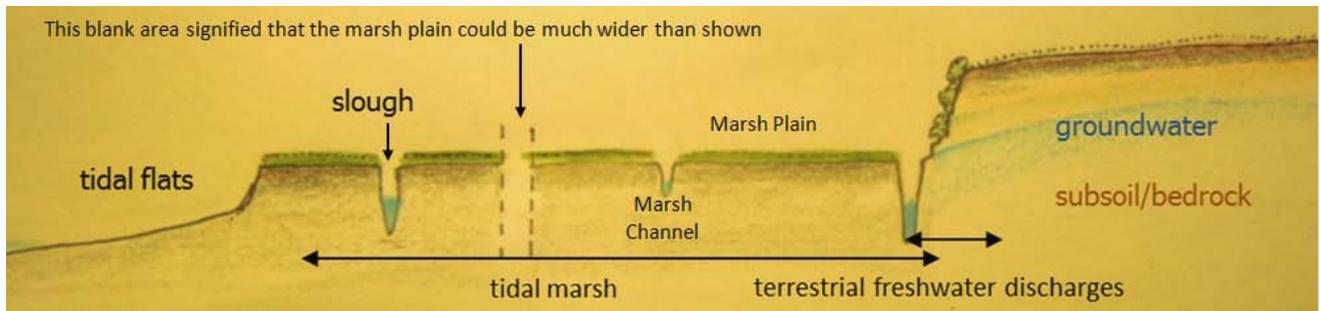


Figure 4.2.3. T-zone associated with bluff or cliff.

*Narrative Description of Natural Physical Condition and Setting*

**Landscape position.** Bayward margin of cliff or steep bluff subject to erosion, sometimes involving a relic slough.

**General description.** This is a relatively rare type of T-zone except on islands and along the hilly Marin County bayshore. It is extremely narrow with an abrupt landward discontinuity in vegetation type due to near-vertical terrestrial slopes of sub-zones 3 and 4. Bluffs and cliffs are generated by erosional processes (including wave-cut bench and channel bank erosion) that are usually constrained by tidal marsh, which can include relict features of channel migration co-existing with prograding tidal marsh.

**Substrate.** Exposure of subsoil, weakly consolidated or cohesive sediments (bluffs), or moderately to strongly resistant bedrock (cliff profiles), or slope debris (talus, slump) to tidal marsh edge.

**Slopes.** Depending on shear strength of substratum, slopes can be steeper than angle of repose of dry sand. Bedrock may be exposed to form near-vertical slopes.

**Hydrology.** Seeps or springs localized in contacts between impermeable and permeable substrates; mostly xeric to mesic, depending on estuary position (fog gradient of Central Bay to Carquinez Strait– most mesic; arid inland)

Terrestrial vegetation of Sub-zones 3 and 4.

- coastal bluff scrub (Central and South Bay, south-aspect slopes);
- riparian scrub (North Bay and Suisun, north-aspect slopes)

**Type Localities.** Public access lands: (1) China camp Islands; (2) Carquinez Strait; (3) south Sausalito.



Figure 4.2.4. Type localities for bluff T-zone.

Type: Barrier Beach

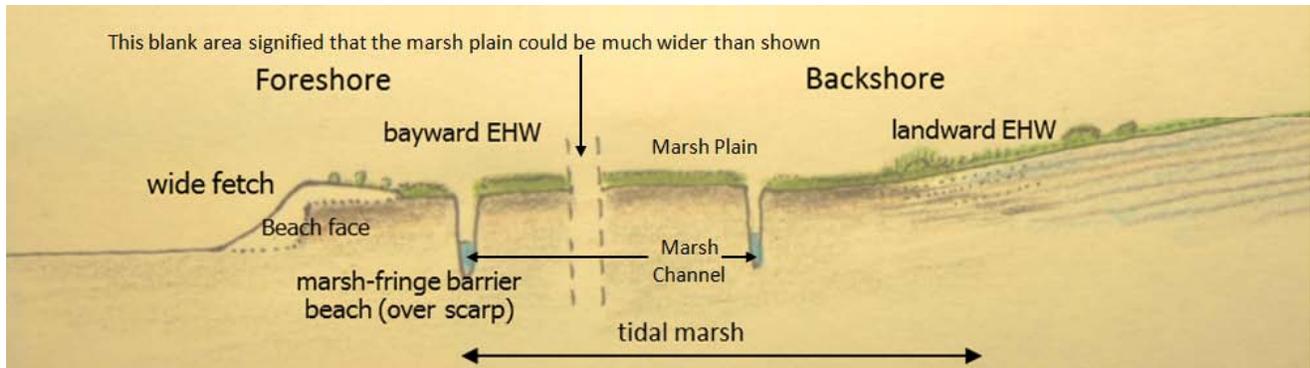


Figure 4.2.4. Barrier Beach

*Narrative Description of Natural Physical Condition and Setting*

**Landscape position:** High wave energy bayward edge of existing tidal marsh at end of long fetches bordering tidal flats; extending as barrier spits across tidal flats or deltas.

**General Description:** Historically prevalent West Berkeley to Alameda (sand), Richmond and Point Pinole vicinity (sand), northern SF Peninsula bayshore (sand, shell) to Palo Alto; Richardson Bay; minor elsewhere. Atwater (1979) attributed natural (San Lorenzo) historic natural salt ponds to marsh berms (barrier beaches).

**Substrate:** Mostly coarse clastic sediments: sands (originating from fluvial, headland bluff, bay sand shoals, Pleio-Pleistocene marine, dune and lagoon or beach deposits of Colma, Merritt formation sources), gravels (headland bluff and cliff erosion); and native fossil oyster shell hash (erosion of shell-rich muds, oyster shell hash bar migration onshore). Grades landward into higher elevation berms composed of mixed fine and coarse sediment and organic debris as coarse sediment supply declines, but subject to material deposition by wind-driven waves. Variations in barrier beaches are largely due to difference in substrate as affected by its sources and wave-energy regimes.

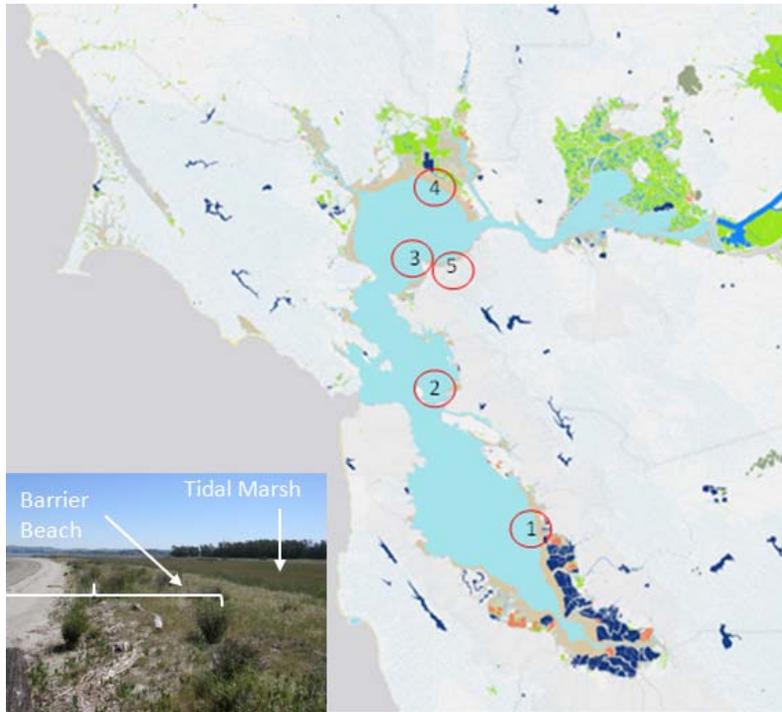
**Slopes:** Steep beachface slopes, especially shell and gravel; gentle slopes of berms, wash-over fans, low aeolian dunes. Elevations range from wave run-up approximately 2 ft above still-water extreme high tides, or more than 2 m where sand dunes form.

**Hydrology:** Shallow freshwater lens perched just below marsh plain. Naturally shallow fluctuating seasonal groundwater. Marsh groundwater discharge through permeable lower beachface. Beaches are deposited by wind-driven waves where coarse sediment supply occurs; limited cross-shore landward transport of coarse sediment (low backwash energy at lower tide) or alongshore (oblique wave approach).

*Terrestrial vegetation types at tidal marsh edge:*

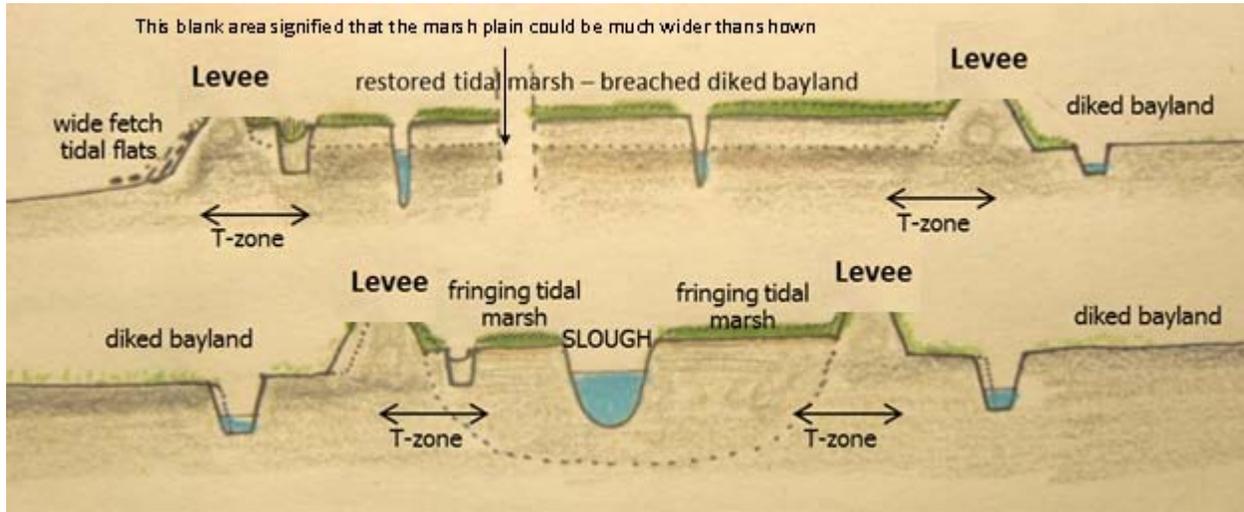
- modern low-energy beach and foreshore pioneers: *Ambrosia chamissonis*, *A. psilostachya*, *Distichlis spicata*, *Cakile maritima*, *Iva axillaris*, *Lepidium latifolium*, *Carpobrotus spp.*
- historical native beach and foreshore vegetation (SF, Alameda, Berkeley, Oakland).
- stabilized beach ridge - high salt marsh succession (*Grindelia*, *Salicornia*, *Frankenia*).

*Type Localities.* Public access lands: (1) San Leandro (Long Beach, Roberts Landing), (2) Radio Beach (Emeryville/Oakland), (3) Point Pinole (Whittell Marsh; sole historic marsh-fringing barrier beach, (4) Highway 37 fringing marsh, (5) Pinole Creek pocket marsh.



**Figure 4.2.5.** Type localities of Barrier Beach

### Artificial Levee



**Figure 4.2.6.** Artificial Levee

#### *Narrative Description of Natural Physical Condition and Setting*

**Landscape position.** Multiple. Bayward edge of tidal marsh (bayfront dike/levee) borders of tidal slough and diked baylands, landward edge of tidal marsh (flood control dike).

**General description.** Extremely narrow zone on outboard levee slope: disturbed by levee capping (maintenance cycle 3+ yr), 1-2 m wide typical. Non-native annual forbs and grasses are frequently dominant over extensive areas. Pervasive throughout estuary: dominant terrestrial transition zone type by linear extent, exceeding natural length of tidal marsh/terrestrial edge due to perimeter dike alignment along historic bay and slough edges of tidal marsh.

**Substrate.** Bay mud dredged from borrow ditches; less commonly composed of imported fill. In Suisun Marsh, peat or muck soils are used to maintain old non-engineered dikes. Bayfront dikes directly exposed to high wave energy of open tidal are often armored with boulder (rip-rap) or concrete rubble.

**Slopes.** Steep 2:1 slopes typical; rarely 3:1 – 5:1 or 7: Dike crests subside and erode, maintained for 1-2 ft freeboard above EHW, but are overtopped by extreme high tides or wave runup as they subside.

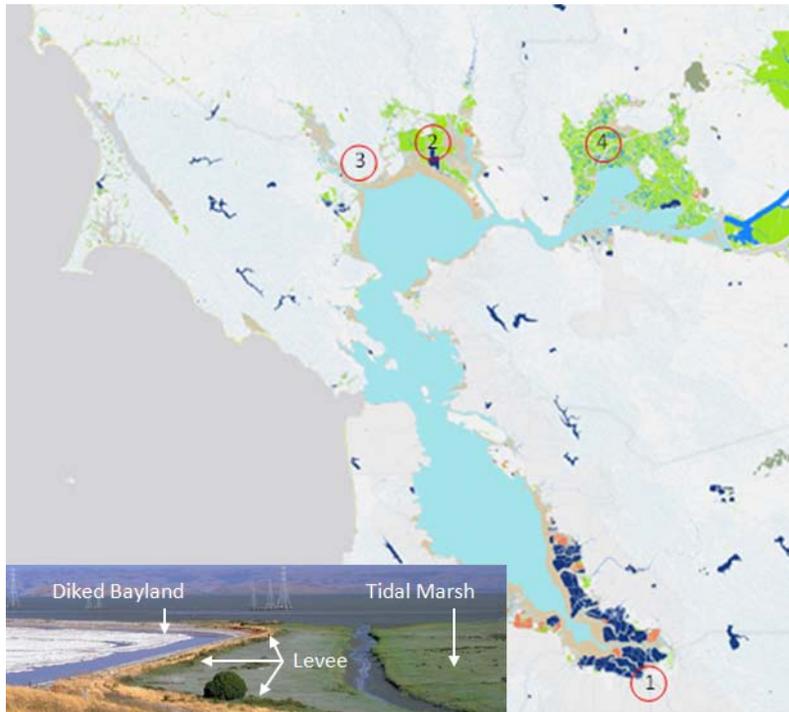
**Hydrology.** Shallow freshwater lens may support salt-intolerant plants: coast live oaks grow on 30+ yr old stable dikes surrounded by salt water in Marin (Richardson Bay and Bahia). Dredged bay mud capping raises soil salinity temporarily, as does overtopping. No significant freshwater seepage occurs through clay dikes detached from supratidal uplands separated by subsided diked baylands.

#### Terrestrial vegetation types at tidal marsh edge.

- high salt and brackish marsh (lower outboard levee slope)
- ruderal forbs and annual grassland (upper outboard levee slope).
- artificial plantings (ornamental, amenity plantings, stabilization plantings, habitat plantings, mixed purpose plantings).

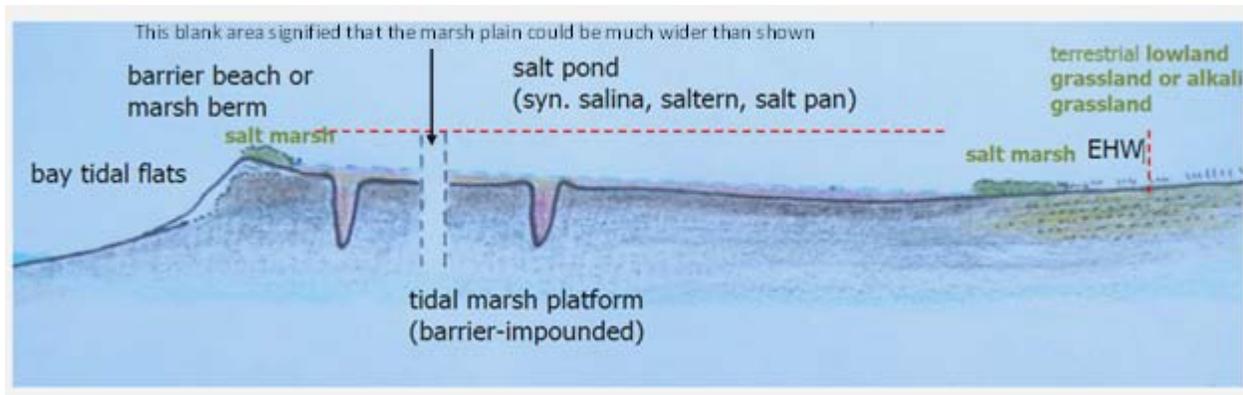
- interior slopes: atypical salt marsh assemblages (high frequency ruderal halophytes).

*Type Localities.* (1) South Bay salt ponds; (2) Napa salt ponds; (3) farmed North Bay diked baylands; (4) Suisun Marsh duck clubs.



**Figure 4.2.7.** Type Localities – Artificial Levee

## Natural Salt Pond



**Figure 4.2.8.** Natural salt pond.

### *Narrative Description of Natural Physical Condition and Setting*

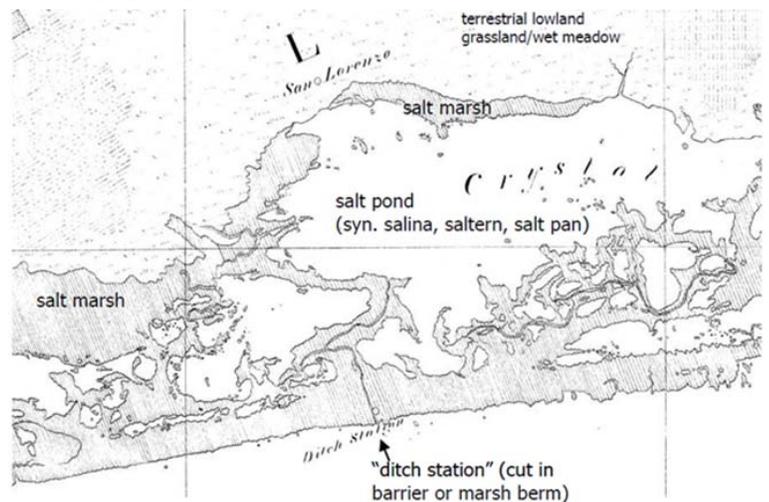
**Landscape position.** Across landward edge of tidal marsh and contiguous alluvial fan below brine flooding elevation range and beach-impounded tidal marsh platform with channel outlets choked or obstructed. (Atwater et al. 1979). Natural salt ponds create gaps (discontinuities) between terrestrial and estuarine emergent vascular vegetation types.

**General description.** Distinctively large and shallow (maximum depth <1m) intertidal ponds of tidal waters trapped behind barrier beaches or marsh berms. Subject to desiccation by evaporation entirely or in part during late summer or fall, causing marine salts to precipitate at edges and sometimes across the pond bottom.

**Substrate.** Halite or gypsum over pre-existing tidal flat or tidal marsh plain (marsh peat or bay mud underlie pond substrates) and extending over drowned (hypersaline flooded) portions of terrestrial alluvial fans.

**Hydrology.** Tidally flooded by over-marsh flows during spring tides, storm-elevated tides, wave overtopping of marsh-fringing barrier beach or berms. Evidence of dry season evaporative concentration of brine, evaporation-driven drawdown, emergence of hypersaline flats and brine pools in relict channels and depressions of pre-existing marsh. Subject to intermittent infrequent freshwater inputs from rainfall, overland flow, small stream, or groundwater discharge at landward edge. Moderately shallow and persistent flooding for months; No extant examples; historic only, but recommended for reconstruction of naturalistic facsimiles in 1999 Goals Report.

**Slopes.** Very low, near zero.



**Figure 4.2.8.** Natural salt pond. Excerpt from U.S. Coast and Geodetic Survey sheet T-635 (early to mid-1850's field mapping).

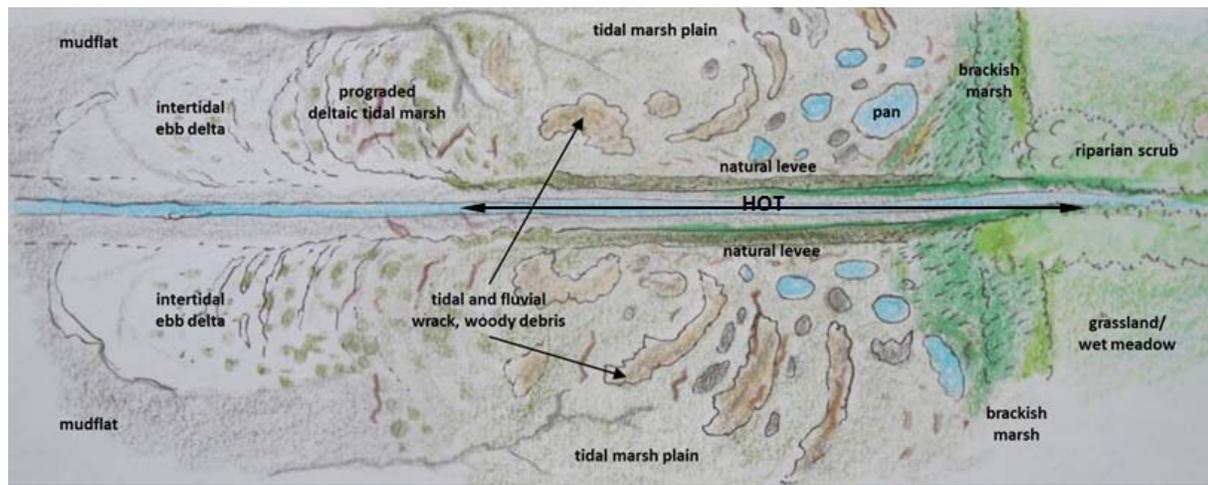
Vegetation. No vascular plants; hypersaline microflora: ubiquitous *Dunaliella salina*, cyanobacteria, halobacteria; high tidal marsh vegetation at pond margins; Terrestrial vegetation types at backshore: alkali grassland, vernal pool grassland, lowland grassland; local sedge-rush meadow.

Type Localities. None in present-day Estuary; partial modern analogs of derelict industrial salt concentrator ponds or managed salt ponds with summer drawdown and shallow brine.

## River or Stream



**Figure 4.2.9.** River or stream T-zone in profile



**Figure 4.2.10.** River or stream T-zone in plan view.

### *Narrative Description of Natural Physical Condition and Setting*

**Landscape position.** Associated with the discharge of a river, stream, or major outfall entering the Bay, extending from the bayward limit of the freshwater effects of the discharge to the upstream effects of the tides.

**General description.** Riverine T-zone length varies inversely with channel slope and varies directly with annual mean flow; width varies directly with frequency of out-of-channel flooding; can involve fluvial levees and associated riverine riparian vegetation that extend bayward as terrestrial peninsulas into tidal marshland.

**Substrate.** Channel bed consists of bay mud interspersed with fluvial deposits, which sometimes occur as annual strata. Terrigenous bedload ranges from clays and silts to gravels, although many urban channels are armored with boulder (rip-rap) or concrete rubble.

**Slopes.** Bed within T-zone mostly not steep (<1%) steepness often increasing near upstream limit of the Head-of-Tide (HOT); stream banks generally steep (>30) due to channel incision or because banks are revetments, riprap, or artificial levee faces (natural fluvial levees much less steep).

**Hydrology.** Mixed tidal and fluvial, with fluvial regime being perennial, ephemeral, or episodic. Perennial regimes are strongly seasonal unless influenced by POTW discharge.

Terrestrial vegetation types at tidal marsh edge.

- high salt and brackish marsh
- riparian can include native and ornamental trees and shrubs.

Type Localities. (1) San Antonio Creek (Sonoma/Marin Counties); (2) Sonoma Creek; (3) Coyote Creek



**Figure 4.2.11.** Type localities of riverine T-zone. Inset photo shows floating debris accumulating at Head-of-Tide.