PART II //

HISTORICAL LANDSCAPE CONDITIONS AT THE WATERSHED SCALE

In Part II we develop a landscape framework for the Coyote Creek watershed. In the first section, we summarize the drainage patterns and habitats that characterized the Coyote Creek watershed prior to Euro-American modification, with particular attention to the valley floor. In the second section, we divide the watershed into five major landscape types that help explain landscape history and organize thinking about environmental restoration and management. The third section defines the major habitat types of the Santa Clara Valley and describes how we map them.

U.S. District Court 1870 [Land Case Map D-494]. Courtesy The Bancroft Library, UC Berkeley

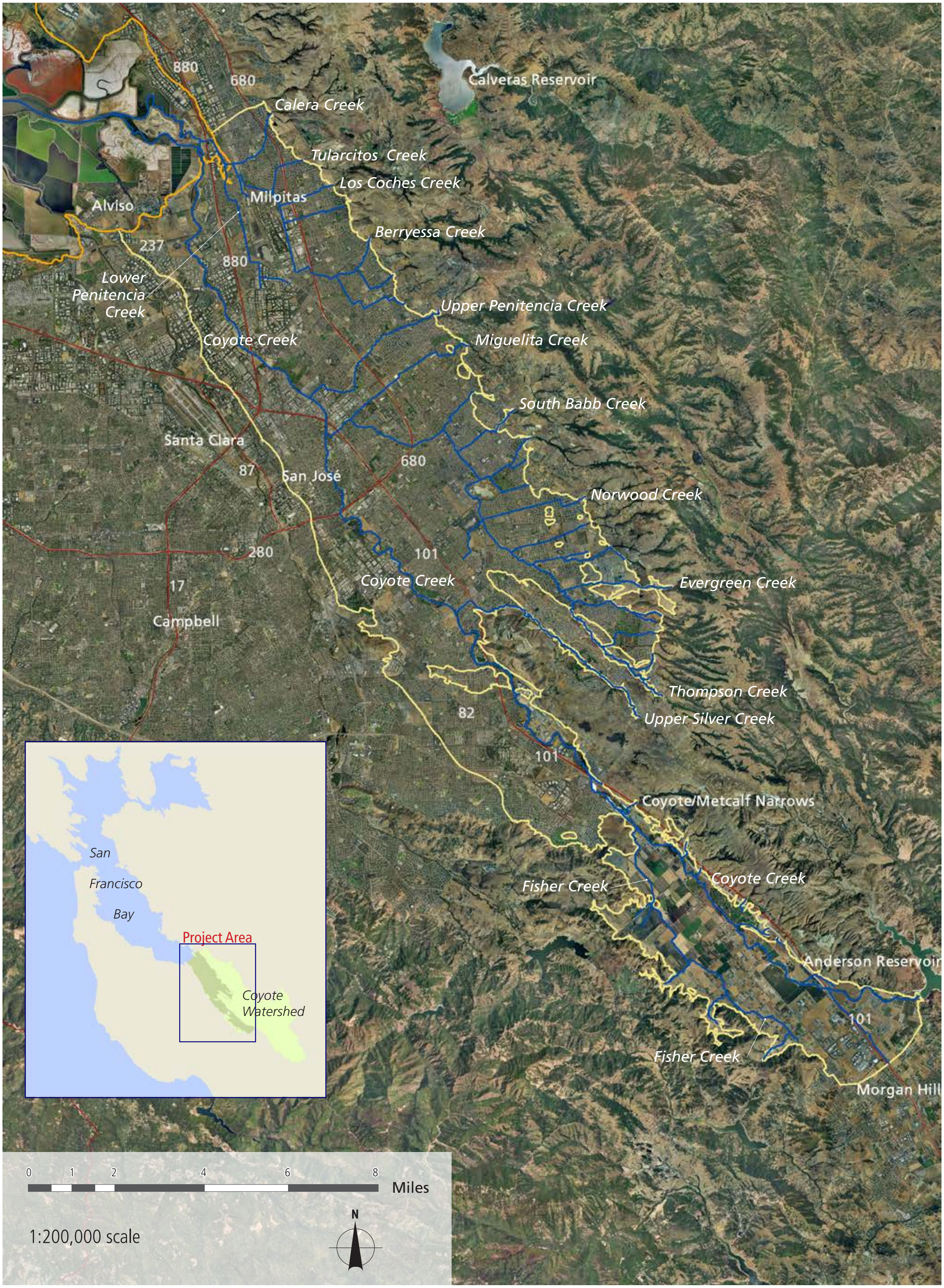


FIGURE II-1. THE PROJECT STUDY AREA follows the eastern side of the Santa Clara Valley, from Morgan Hill to Milpitas. It includes the valley floor draining to Coyote Creek and the receiving tidal marshlands (Imagery Copyright 2005 AirPhotoUSA, LLC, All Rights Reserved).

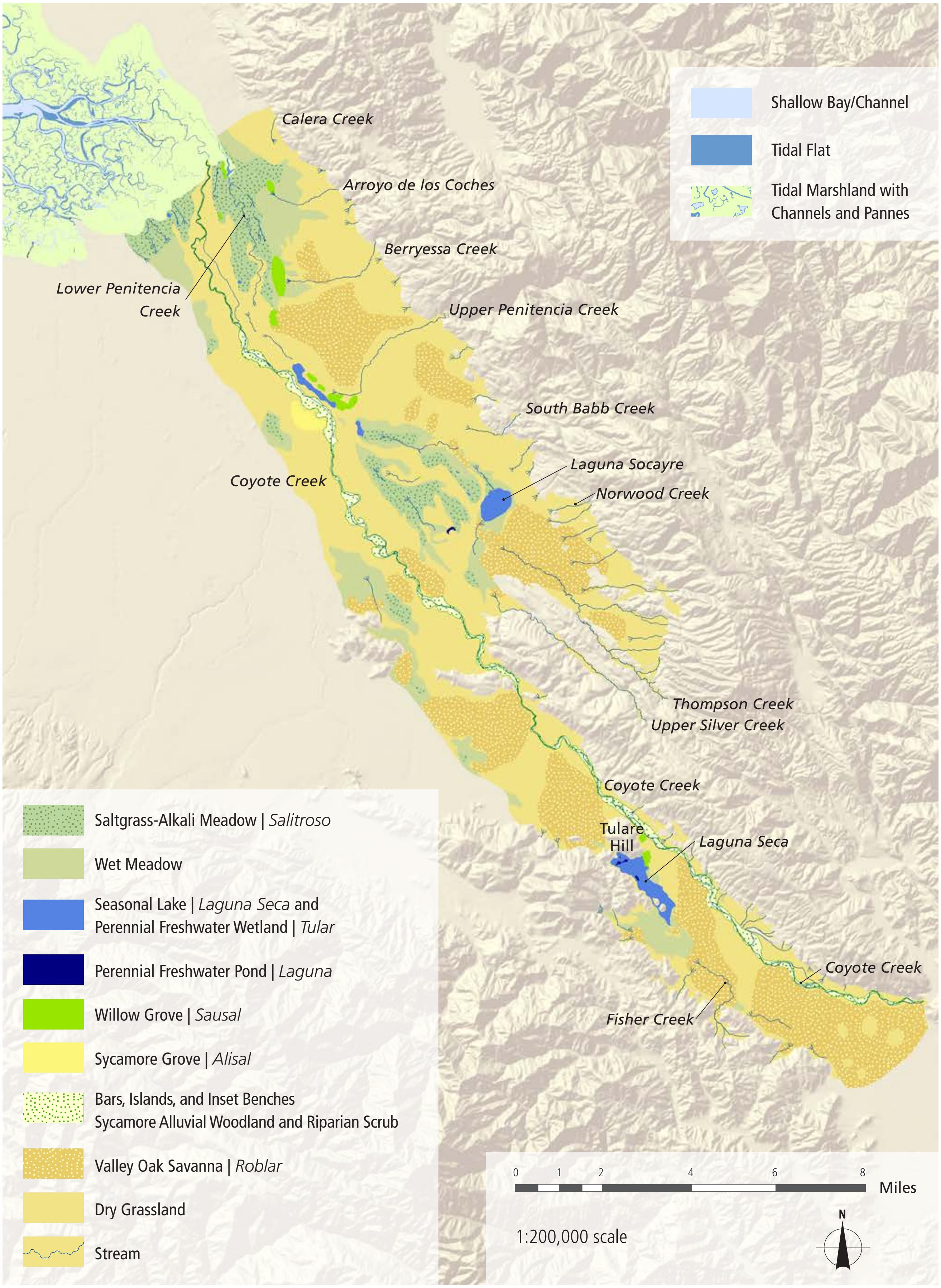


FIGURE II-2. HISTORICAL LANDSCAPE PATTERNS ALONG COYOTE CREEK. This composite map based on numerous historical data sources illustrates prevailing habitat conditions during initial Euro-American settlement, circa 1769-1850. The certainty level varies among features; valley oak savanna is a preliminary estimate. More information is available in the project GIS.

HISTORICAL CONDITIONS SUMMARY

The eastern side of the Santa Clara Valley, where the Coyote Creek watershed originates, is bounded by the deceptively stark hills of California's Coast Range, regionally known as the Diablo Range. Its dry, grassy slopes (both before European contact and since) conceal small but fertile intermontane valleys scattered historically with *lagunas* and *tularcitos* (little tule marshes). Almost three hundred square miles of the Range drains to the Valley, creating at least 30 identifiable streams. From Babb to Quimby, Calera to Coyote, the streams of the Diablo Range (plus a few small ones from the Santa Cruz Mountains to the west) together established the complex landscape pattern of the eastern Santa Clara Valley — a diverse array of habitats organized on the stream deposits between the hills and the Bay (**FIGURES II-1** and **II-2**).

Coyote Creek, the largest of these streams, is the dominant physical feature along the eastern Valley edge, maintaining a wide zone of influence along its 26 mile course across the plain, from the canyon mouth near Morgan Hill to the tides near Milpitas. Coyote's natural attributes were spatially heterogeneous, sometimes counterintuitive, and largely unique for the Valley. As a result, the creek has often been misunderstood, particularly in relationship to neighboring Guadalupe River.

COYOTE CREEK MORPHOLOGY

While Guadalupe's perennial waters gave birth to a mission, pueblo, town, and prominent mills, much of Coyote Creek was dry at the surface most of the year. Coyote was bordered by broad benches or terraces for most of its middle reaches, typically inset 10 to 15 feet below the adjacent valley surface. This imposing channel morphology, often 500 to 1500 feet wide, dictated transportation corridors and urban growth patterns, creating a barrier rather than a center **(FIGURE II-3).** The "deep, very wide, and irregular channel" (Foote 1888: 160) was also a barrier to high flows; there are indications that flooding was not a problem from Coyote Creek for San Jose until the city expanded in the 20th century. Reaches farther upstream, especially in Coyote Valley, were shallower and had a strong braided, multithread channel character. Wide reaches predominated along the stream but were interspersed with shorter, narrow reaches.

COYOTE CREEK RIPARIAN HABITAT

This physical template supported a complex riparian habitat pattern. Along Coyote Creek, dense, closed-canopy riparian forest was relatively limited. Instead, the dominant riparian habitat was an open riparian woodland or savanna. Widely spaced trees occupied the dry, gravelly bed and adjacent stream benches, with broad areas of scattered riparian scrub and unvegetated gravel bars. Grand sycamore trees in "splendid groves" (Day 1854) were the prevalent tree, forming the now-rare Sycamore Alluvial Woodland vegetation type and an associated community of native fish and wildlife species.

LOWER COYOTE

Near its downstream end, in the vicinity of present-day Trimble Road, Coyote's morphology shifted to a relatively shallow, sinuous, meandering channel, presumably in response to the base level set by tidal processes. This reach intercepted near surface groundwater and had the character of a slow-moving, perennial lowland stream. Dense but narrow riparian forest dominated by willows followed the low, frequently overflowed banks downstream, until precluded by the salinity of the tidal influence (near the present-day downstream limit alongside the San Jose-Santa Clara Water Pollution Control Plant). In this lower reach, Coyote flooding had its widest influence as high flows regularly jumped the main channel to form an extremely broad, occasionally-used system of overflow channels extending all the way from Guadalupe River to Lower Penitencia Creek.

THE MARSHLANDS

Coyote Creek also had a broad impact on the tidal marshlands, especially their landward margin. Unlike most Santa Clara Valley streams, this creek directly joined a major tidal slough, creating fresh and brackish tidal marsh habitats within a larger mosaic of salt marsh. Because of the highly branched and interconnected network of tidal channels prior to artificial levees, the twice-daily rising tide could push Coyote Creek's freshwater onto the marshland along Coyote's tidal channel. At flood stage, Coyote waters also entered the marsh through the lateral overflow channels across the lower alluvial plain, creating additional points of brackish influence. Tidal influence extended inland along these high flow channels scoured by Coyote Creek (some are still visible today) while artesian flow created brackish and fresh conditions year-round (e.g. Artesian Slough). Towards the open bay, Coyote Creek's tidal channel was broad enough to support hundreds of acres of tidal flat, used by shorebirds when exposed at low tide.

DISCONTINUOUS CREEKS

In contrast to the tidal marshlands, where channel connectivity was high and has been reduced by subsequent management, creeks on the valley floor were mostly discontinuous. Coyote Creek was the only creek in the watershed with a continuously connected channel from hills to Bay. Many of the creeks that are today considered tributary to Coyote Creek were in fact distributary, spreading out on the valley floor before reaching a mainstem channel. In fact, Coyote Creek did not have a single tributary downstream from Coyote Narrows.

GROUNDWATER RE-EMERGENCE

Of these distributary or terminal creeks, only a few (such as Berryessa and Upper Penitencia) maintained a channel more than a couple miles beyond their canyon mouth; most lost a defined channel within a mile and sank into the coarse soils of their alluvial fan. As a result, shallow groundwater was efficiently charged by stream flow, and would reemerge downslope to form the freshwater wetlands of the Valley: wet meadows, saltgrass-alkali meadows, willow groves, seasonal lakes, perennial ponds, and freshwater marshes. Like Coyote, whose commonly dry

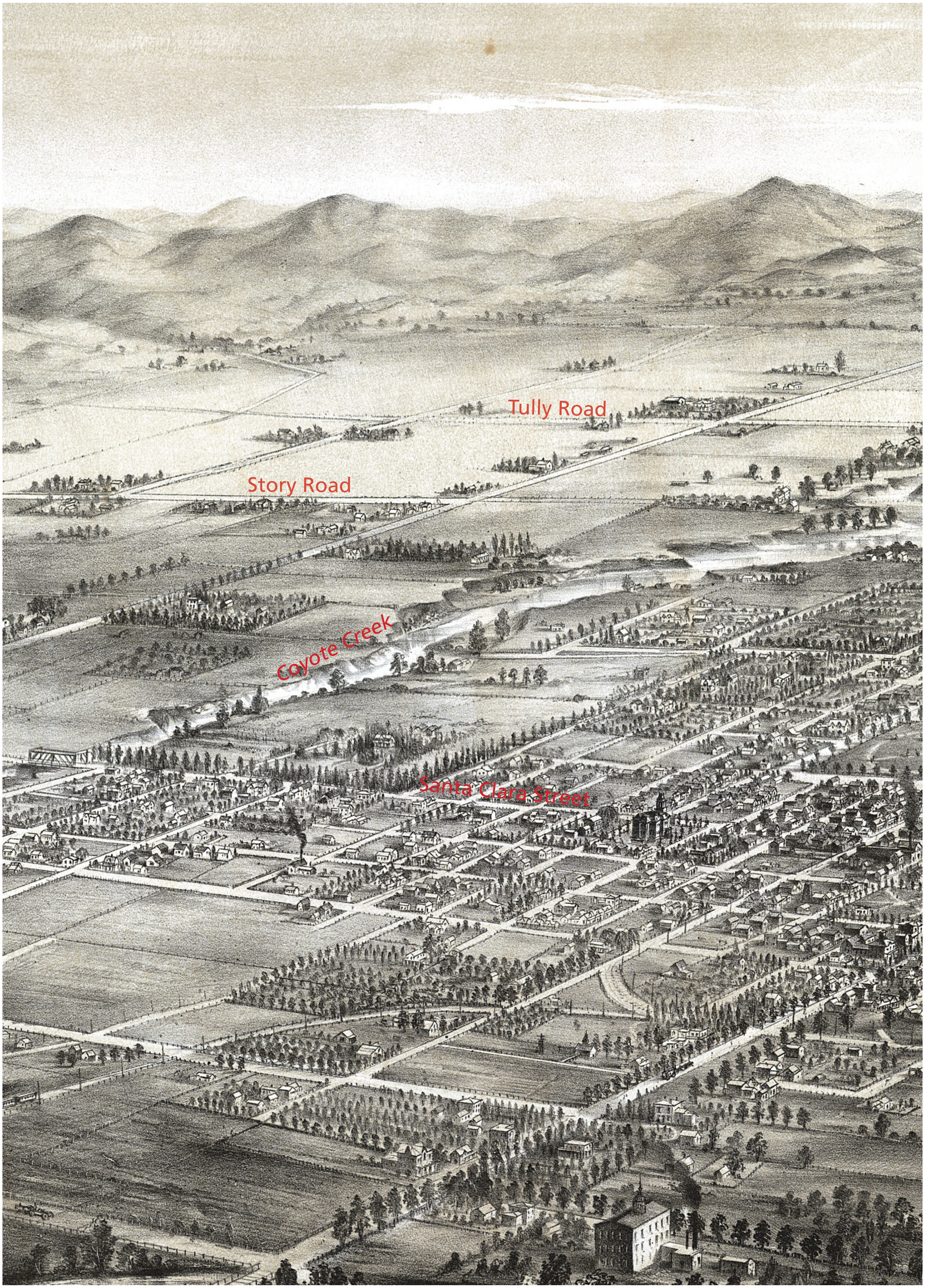


FIGURE II-3. BIRDSEYE VIEW OF COYOTE CREEK IN 1869. This highly detailed lithograph provides an unusual three dimensional perspective of Coyote Creek during the mid-19th century. The portion shown here follows the creek from Santa Clara St. south to Coyote Narrows. At this time, the creek lies on the outskirts of town, with the Santa Clara St. Bridge the only crossing. Abrupt banks can be seen as the creek area widens upstream of

Santa Clara St. A few groves of trees — likely sycamores — occupy inset benches. Upstream of Tully Road, occasional groups of riparian trees line the outer channel banks, but further downstream there are few or no riparian trees on the valley floor terrace (Gray and Gifford ca. 1869, courtesy Library of Congress).

channel nevertheless supported sycamore groves and mixed riparian forest with subsurface flow, the markedly dry appearance of the small creeks was somewhat deceptive. Their waters supported lush perennial habitats farther downslope.

WETLANDS AND DRY LANDS

The mosaic of wetland and dry land habitats on the valley floor was mostly controlled by patterns of alluvial deposition, and their effect on the movement of water through the Valley. Dry land habitats — expansive, fertile grasslands often accompanied by "scattering" oak trees — occupied the slightly higher, well-drained soils along current and geologically recent stream courses. Between the alluvial fan deposits, low-lying bottomlands received flood overflows and the fine-grained clay soils deposited at the terminus of floodwater energy.

ROBLARS

The well-drained grasslands, consisting mostly of perennial grasses with numerous wildflower species, comprised two thirds of Coyote Creek's valley floor. These habitats occupied the rich soils that enabled the great success of Valley ranching and agriculture, and the celebrated oak "parklands" that awed visitors. The elegant *roblars*, groves of widely spaced, large valley and live oaks (mostly valley in the Coyote area) were perhaps the signature habitat of the Valley; against all odds, a surprising number remain today.

BOTTOMLANDS

Roughly alternating with the broad dry land areas, smaller bottomlands presented contrasting hydrological, ecological, and cultural characteristics. These basin areas were formed by simple and persistent topographic conditions associated with poor drainage. In each case, Coyote Creek again exerted broad influence over the valley floor, its natural levee (a stream-built ridge of sediment deposited along the creek) creating a barrier to surface runoff. In combination with a bedrock wall (at the north end of Coyote Valley), a broad fan built by adjacent creeks (Penitencia and Berryessa), and extremely flat topography (at the Baylands margin), Coyote Creek's former and present course shaped drainage and resulting ecological patterns. Similarly, on the west side of the creek, the point where the former and present stream levees diverge created conditions supporting a large sycamore grove.

FRESHWATER WETLANDS

On the "black adobe" soils of the bottomlands, occasionally flooded wet meadows surrounded smaller perennial wetland complexes of freshwater marshes and *lagunas*. Along the landward edge of the tidal marshlands, the accumulation of minerals from high-tide overflow and the evaporation of seasonal ponds created a subtype of wet meadows with distinctive salt-tolerant flora, including saltgrass plains and a mix of now-rare species often referred to as an alkali meadow. Seasonal evaporation created similar salt-affected *salitroso* lands scattered throughout the Valley's wet meadows, often with vernal pool characteristics. Poor drainage and mineral salts shaped a different historical course for the wet meadows, mostly precluding agriculture, slowing development, and leaving significant present-day restoration opportunities. By attenuating both flood flows and stream-borne sediment from the upper watersheds, these basin areas performed important watershed storage functions that modern-day watershed management efforts are increasingly seeking to emulate.

SAUSALS

In the bottomlands, willow groves, or *sausals* — dense thickets often 50 to 100 acres in size — provided the only wooded areas outside of a few isolated riparian stream reaches. Like the tidal marsh ecotone, willow groves were one of the important habitats associated with the edge between major landscape types, often located at the intersection of alluvial fan and bottomlands soils where the clay seal of the latter forced groundwater to the surface as springs and seeps.

LAGUNAS

Two of the Santa Clara Valley's three large freshwater wetland complexes, or *lagunas,* were found in the Coyote watershed. The first was located east of downtown San Jose, where an old levee of Coyote Creek created Laguna Socayre, which intercepted flood flows from the surrounding distributary creeks and probably received emergent groundwater. Groundwater emergence and surface runoff formed the second wetland, Laguna Seca, a renowned wetland complex in a natural hollow that retains significant hydrological function and ecological potential today. (The third, the *Tulares de las Canoas*, was tributary to Guadalupe River.)

HABITAT CONTROLS

Since these habitat patterns emerged from the most fundamental physical characteristics of the Santa Clara Valley — geologic structure, alluvial topography, groundwater movement — their basic controls remain surprisingly intact in many places. Restoration and maintenance of the Valley's natural heritage will depend upon identifying the persistent and recoverable elements of these patterns and processes in the context of the contemporary landscape.

The rest of this report documents the characteristics and geographic distribution of these historical conditions in more local detail and discusses landscape changes affecting present-day watershed management and restoration. The report provides a set of information resources and initial interpretation to support the establishment of quantitative and geographically specific resource goals, as well as a foundation for more detailed studies as part of project implementation.

LANDSCAPE TYPES

This section provides an overview of the basic landforms comprising the Santa Clara Valley and establishes a landscape perspective for understanding habitat distribution, stream processes, and local history.

Like all valleys, the Santa Clara represents the physical expression of the unrelenting movement of sediment, water, and rock. During winter rains, small creeks pick up sediment from the hills, carry rocks, sand, and silt through the canyons, and deposit the materials in elaborate patterns creating the valley floor. Moving back and forth across the surface, the creeks direct the deposition of soil into a rippling surface of alluvial (stream-built) topography.

Unlike many valleys, Santa Clara Valley runs, in a very short distance, the full length of potential watershed character — from the initiating geology of the Santa Cruz Mountains and Diablo Range to the receiving salt-water geology of the sea. Most unusual among valleys, it meets the tides in a highly enclosed setting, the lower South San Francisco Bay, resulting in a broad extension of the Valley in the form of Baylands. As a result, at its low end the Valley is being submerged by the rising seas. Stretching between the hills and the Bay, the Valley exists in perpetual motion, continually re-shaped by the fluxes of land and water at either end.

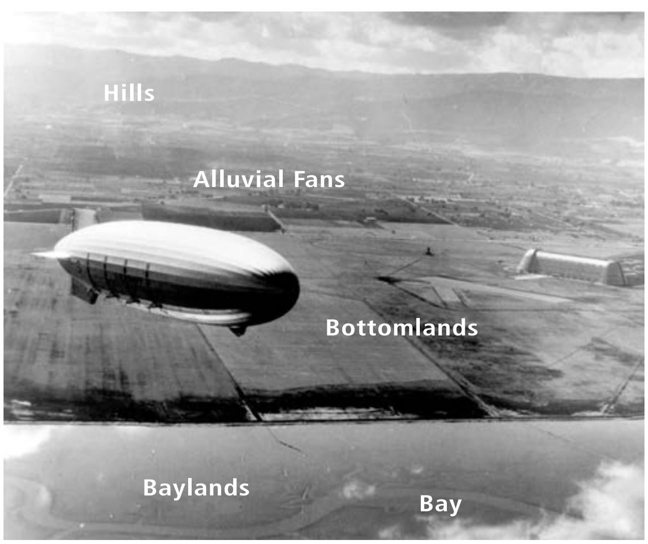


FIGURE II-4. LAND USE PATTERNS. By 1934, this portion of the Baylands has been diked for salt production, and the Alluvial Fans intensively developed for agriculture and housing. Large military/industrial/technological industries have begun to recognize the available space of the un-developed Bottomlands (View of the rigid dirigible USS Macon over Moffett Field; U.S. Navy 1933-34, courtesy The Moffett Field Historical Society and Museum).

Despite this continual activity — flooding streams, buried land, rising tides — people and plants and animals have managed to find ways to live coherently in the Valley in patterns that have persisted for hundreds, and sometimes thousands, of years. Not all of this activity happens in the same place at the same time. In fact, the landscape is highly organized, focusing the forces of water and sediment into distinctive patterns — patterns that are reliable for centuries at a time. The distribution of forests, grasslands, and wetlands is guided by these patterns. Human activity, when most sustainable, is well calibrated to this dynamic, but organized landscape.

Looking across the Santa Clara Valley from a good vantage point, we can recognize five distinct landscape types that together form the highest level of this pattern (**FIGURE II-4**). Moving from low elevation to high, these include: the open waters of the Bay, the intertidal Baylands, the adjacent low-lying Bottomlands, the gently sloping alluvial fans and natural levees, and the steeper, bedrock Hills (**FIGURE II-5**). These landscapes join seamlessly, yet are clearly evident as separate kinds of places. Each landscape is created by different formative processes and supports a different suite of habitats.

These five landscapes can still be identified from above, but are largely hidden from view by human structures. They are perhaps the most basic patterns of the land. Thus they explain a significant amount about the past, present, and future of the Valley, including development trends, engineering challenges, species distribution, and restoration opportunities. They provide a framework for

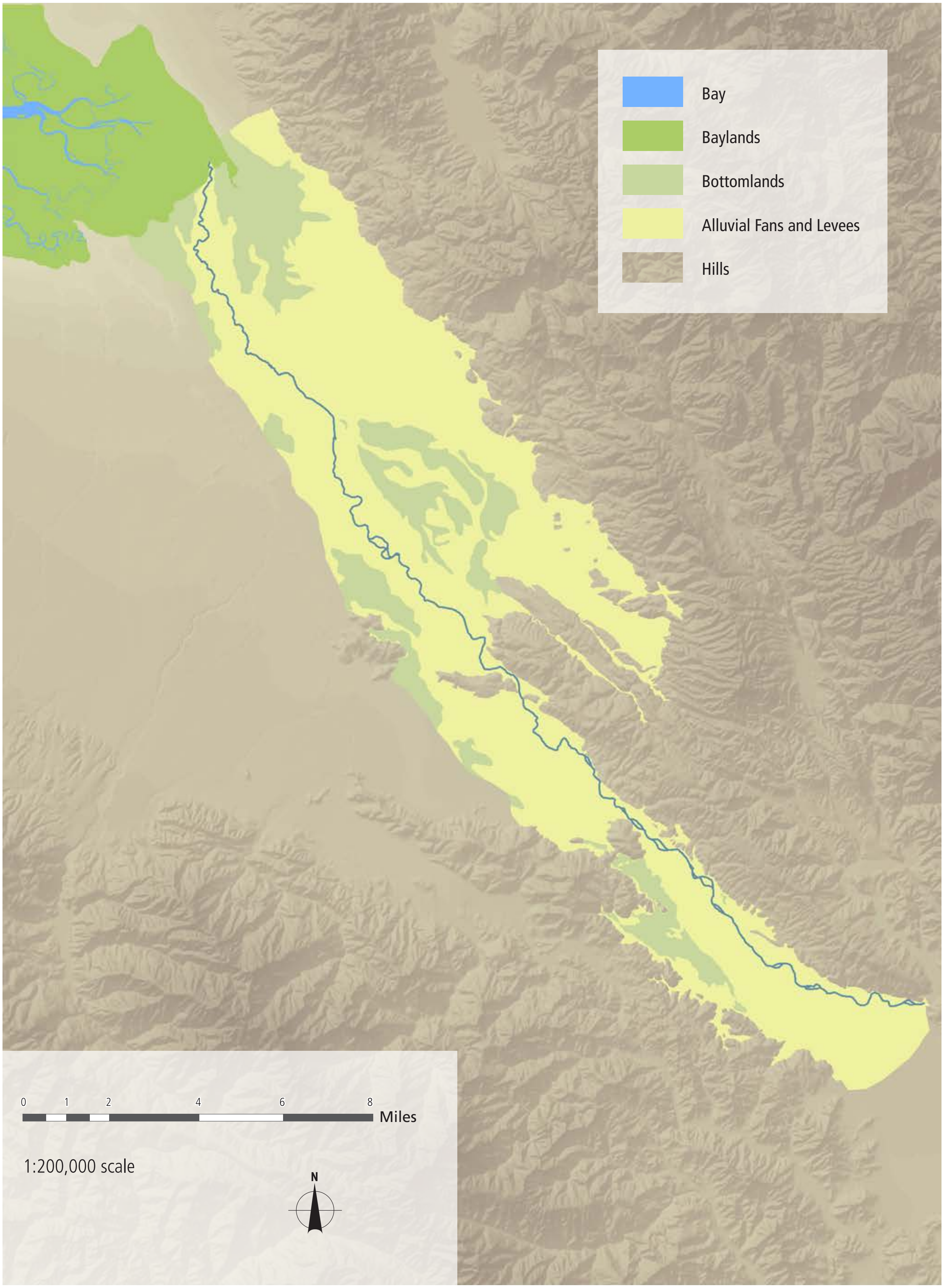


FIGURE II-5. LANDSCAPE TYPES characterizing the valley floor along Coyote Creek. Hills are bordered by alluvial fans (except where runoff is insignificant off small hills and no alluvial fan exists). The fans and levees form higher ground around the bottomlands. Bottomlands merge into the Baylands at the northernmost part of the Valley, while the Bay extends toward land through tidal sloughs.

understanding the interwoven patterns of native habitats and cultural constructions.

Detailing the distinct characteristics and spatial distribution of the five landscapes is particularly useful because of what takes place at their edges. Important processes tend to happen at the transition between two or more landscape types. As a result, many present-day problems are the unintended consequence of changes in how the five landscapes connect to each other (either by increasing or decreasing their connectivity). The following few pages give thumbnail descriptions of each landscape type; their component habitats are discussed in the next section.

THE BAY

The bottom end of the Santa Clara Valley is shaped by the southern arm of the San Francisco Estuary — an inland extremity of the Pacific Ocean. Rising gradually since the last ice age, and more quickly in recent years, the South Bay is slowly inundating the surrounding valleys and plains. This submerged landscape is the driving force for many characteristics of the Valley, providing tidal energy, a modulated climate, limitless salt, and a giant perennial water body. In a region without large navigable rivers, the Bay represents the reliable water surface for transportation, enabling Santa Clara Valley to boom economically decades before the railroad, providing transport for Mexican-era cattle hides, American grain, and a myriad of other products of the land. Where the open waters of the Bay approach the adjacent alluvial land surface, they create a broad transitional environment with an array of distinct characteristics — the Baylands landscape.

THE BAYLANDS

While the Bay is a perpetual tidal water surface, the Baylands lie at the edge of the ocean's influence and are submerged by the tides only part of the time. This intertidal landscape is made of both earth and water. Birds can walk on it and a few specialized plants can grow, but humans inevitably will get their feet wet or even sink waist deep.

The protected nature of the South Bay and the gentle underlying slope of the already-submerged portion of the Santa Clara Valley make for unusually wide baylands. In fact, a band of intertidal habitats more than a mile (and as much as 3 miles) wide runs east-west between the Bay and land, forming a mostly impenetrable barrier to navigation and shipping, as well as high tides and storm surges. But the edge between Bay and Baylands is intricate: the Baylands are split by large tidal sloughs which extend the Bay's waters through the Baylands and inland, creating conduits for human commerce and for the distribution of tidal energy, nutrients, and sediment-carrying water.

The Baylands have shaped land use in particular ways. Despite rich organic soils with access to transportation, agricultural efforts in the Baylands have failed. Despite centrally located, flat surface, the hazards of unstable land and flood risk (which slowed development long enough for environmental protection to take hold) have mostly precluded urban and commercial development.

Their natural characteristics led to a single dominant industry — commercial salt production. The peculiar development history places them both at the center and at the hinterlands, creating the potential for large-scale urban ecological restoration, as is currently taking place through the South Bay Salt Pond Restoration Project.

The dominant natural habitat of the Baylands is tidal marshland. Other important habitats occur at the Bay edge — such as tidal mudflats — and at the inland edge where the Baylands merge with the Bottomlands, and, in a few places, merge with Alluvial Fans to produce transitional habitats — fresh/brackish tidal marsh, *salinas,* and the saltgrass-alkali meadows of the tidal marsh ecotone.

THE BOTTOMLANDS

Like the Baylands, the Bottomlands are naturally quite flat and wet. But, at least presently, they lie above the reach of the tides. Where they are positioned adjacent to the Baylands, they will be the next parts of the Valley to be submerged if the seas continue to rise and no actions are taken. The term Bottomlands has been used locally (e.g. by Broek 1932) to describe the poorly drained interfluvial basins (Helley & Lajoie 1979:35) that lie between adjacent, slightly higher alluvial fan and levee deposits. While the Baylands form where tidal energy dissipates and drops sediment, the Bottomlands are formed by the waning energy of stream overflows over the fans and levees. The lightest, finest stream sediment is deposited in these low areas, forming heavy clay soils. These areas have almost no creeks, except rare sinuous low-gradient streams at the Bay edge and occasional distributary creeks terminating in the Bottomlands. These clay-sealed basins with little drainage capture freshwater in the winter and gradually evaporate it through the year.

The Bottomlands are also largely the "artesian lands," famous for their natural supply of pressurized groundwater sealed by the clay soils. They are characterized by springs, ponds, and wet meadows — the vast "fens" described in early waterfowl accounts. The Santa Clara Valley's few large freshwater ponds or *lagunas* were found in the Bottomlands, often persisting as modern drainage challenges. Special habitats at the edge of this landscape include the *salinas* and *salitroso* lands along the extremely flat gradient to the Baylands, and *sausals*, or willow groves, which were often found where the Bottomlands met Alluvial Fans. Most of the present-day water courses of the Bottomlands are artificial drainage channels.

As in the Baylands, the heavy clay soils of the Bottomlands slowed and redirected the common trajectory of American development. Most agriculture, including orchards, was precluded by poor drainage and seasonal flooding. Roads and towns avoided the areas. As higher lying lands were subdivided into lucrative orchards and town sites, the Bottomlands continued to produce relatively low value crops, such as hay, grain, and pasture land, in comparatively large tracts. As a result, these lands contain some of the few significant areas with substantial potential for restoration and preservation on the valley floor.

At the same time, however, this open land has been one of the engines of Silicon Valley growth, providing a standing supply of open land for the development of large industrial/technological centers since the first decade of the 20th century, from Hendy Iron Works and Moffett Field to Westinghouse, Lockheed, Cisco, and Google.

THE ALLUVIAL FANS AND NATURAL LEVEES

While all five landscapes are clearly integral to the Valley as we know it, the alluvial fans and levees have received most of the glory. These alluvial deposits form gently sloping, well-drained surfaces between the steeper Hills and nearly flat Bottomlands. The alluvial fans and levees comprise the famous Santa Clara Valley agricultural lands that supported a century of prune and apricot orchards. Earlier, they supported the great valley oak parklands described by almost every early European visitor. Many stream reaches, particularly towards the top of the alluvial fans, were naturally incised and less prone to flooding than the bottomlands. The best places for year-round settlement, the alluvial fans were the location for nearly all of the significant Spanish and American towns and have been rapidly and sequentially subdivided, from large farms to smaller "fruit ranches," to modern developments.

The alluvial fan and levee deposits contain the natural, historical streams and are now often important sites of significant bank erosion, sediment transport, bed incision, and groundwater recharge.

THE HILLS

There are two major sets of hills defining the Santa Clara Valley, providing the parent bedrock geology to the downstream landscapes. On the east, the relatively dry, mostly unwooded Diablo Range is locally called the Mt. Hamilton range. On the south and west, the Santa Cruz Mountains receive more rainfall and are substantially forested with pockets of redwoods. The hills have been sites of sawmills and woodcutting, reservoirs and mines, parks and hunting, grazing and foothill crops. The canyon mouths are particularly dynamic sites — serving as the transition between the hills and the alluvial fans. Here, reservoirs benefit from the water resources and the steep topography on the hill side of the transition. On the west side of the Valley, early homesteads and towns were often centered immediately downstream of the canyon mouth (e.g. Los Gatos, Saratoga, Stevens' creekside location) for the access to perennial water, low flooding risk along incised streams, and proximity to the resources of both the hills and Valley.

PRECEDENTS FOR LANDSCAPE TYPES

The landscape patterns described above have been recognized in practical ways by the people who have inhabited the Santa Clara Valley for thousands of years. They have also been described by researchers over the past century as part of significant regional studies. In fact, these strongly evident landscape patterns of the Valley, combined with proximity to the academic research centers at Stanford and UC Berkeley, have inspired several important earlier studies that inform this landscape classification.

Ecologist William S. Cooper used the dramatic Santa Clara Valley landscape pattern as the basis for his 1926 paper in the journal *Ecology,* "Vegetational development upon the alluvial fans in the vicinity of Palo Alto, California." The geographer Jan Otto Marius Broek built upon this work in an impressive dissertation, *The Santa Clara Valley, California: a Study in Landscape Changes*, describing, for example, the transition between Bay, Baylands, and Bottomlands: "Behind the amphibious saltmarsh bordering the San Francisco Bay lay an open meadowlike belt" (1932: 29). Broek also uses the terms "compound fan" and "bottomlands" (26). Another geographer, Edward Torbert (**FIGURE II-6**), focused on agricultural patterns, noting, for example, that "a broad zone of fine-textured, low-lying soils landward from the tidal marshes of the Bay has not been occupied by prune and apricot growers" (Torbert 1936). These distinctions were reflected in the soil surveys carried out by the US Department of Agriculture by Lapham (1903), Holmes and Nelson (1917), and Gardner et al. (1958), typically separating upland, basin, and alluvial fan/levee soils.

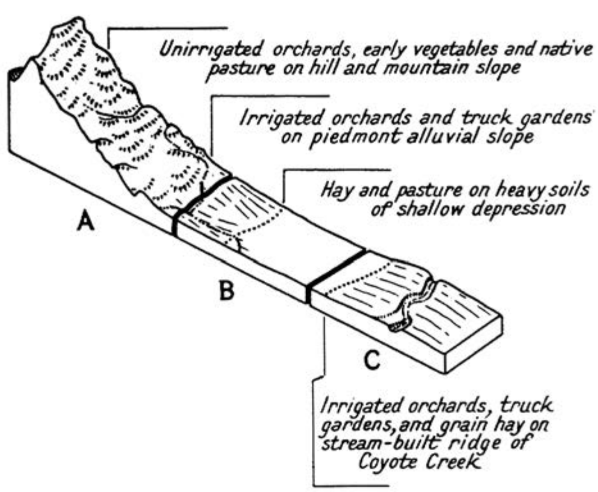


FIGURE II-6. TORBERT'S 1936 DIAGRAM SHOWING LANDSCAPE TYPES: hillslopes, alluvial slope and natural levee, and depressional bottomlands (Torbert 1936, courtesy American Geographical Society).

HABITAT TYPES

This section describes the fluvial, riparian and wetland features that comprise the pre-modification Santa Clara Valley as well as our approach to mapping them. We focus on the components of the three central landscape types — Baylands, Bottomlands, and Alluvial Fans and Levees — because of their extensive historical modification in comparison to the Bay and Hills. Each habitat is mostly or completely associated with a landscape type or the interface between two types. To set the context for assessing landscape change, each habitat is described with regard to its historical depiction and ecological/physical characteristics. **TABLE II-1** illustrates the linkage between habitats recognized historically, through maps and written descriptions, and current wetland and vegetation classifications.

HABITATS OF THE BAYLANDS

TIDAL FLAT

As a boat approaches the southern end of San Francisco Bay, tidal flats mark the transition from the open water of the Bay to the intertidal Baylands. Tidal flats are the first semi-solid surface to be encountered, emerging from the Bay at low tide to present temporary obstructions to waterborne traffic. For this reason, the habitat was mapped in detail by early navigational charts (**FIGURE II-7**), as well as described in travelers' accounts of accidental stranding by ill-timed tides. Tidal flats are also recorded as a substrate desirable for oysters and other shellfish. Prior to development of the Baylands, there were hundreds of acres of tidal flat along the intertidal portion of Coyote Creek and the many tidal sloughs branching from the creek into the surrounding tidal marshland.

Tidal flats are conventionally defined as the areas of bare clay and silt, sand, or shell hash between local Mean Lower Low Water (MLLW) and the foreshore of tidal marshland (or, if no marsh is present, local Mean Tide Level (MTL); Goals Project 1999). We map the historical tidal flats along Coyote Creek based primarily upon the hydrographic and topographic surveys of the United States Coast Survey (USCS), carried out in 1857-58 to facilitate waterborne commerce between the Santa Clara Valley and commercial centers in the Central Bay. The USCS data are being compiled in a concurrent SFEI project to digitize and georeference historical tidal marsh maps of the South Bay, supported by Santa Clara Valley Water District and Santa Clara Valley Urban Runoff Pollution Prevention Program (see http://maps.sfei.org/tSheets/viewer.htm). Through coordination with this project, we obtained the most current versions of the USCS data.

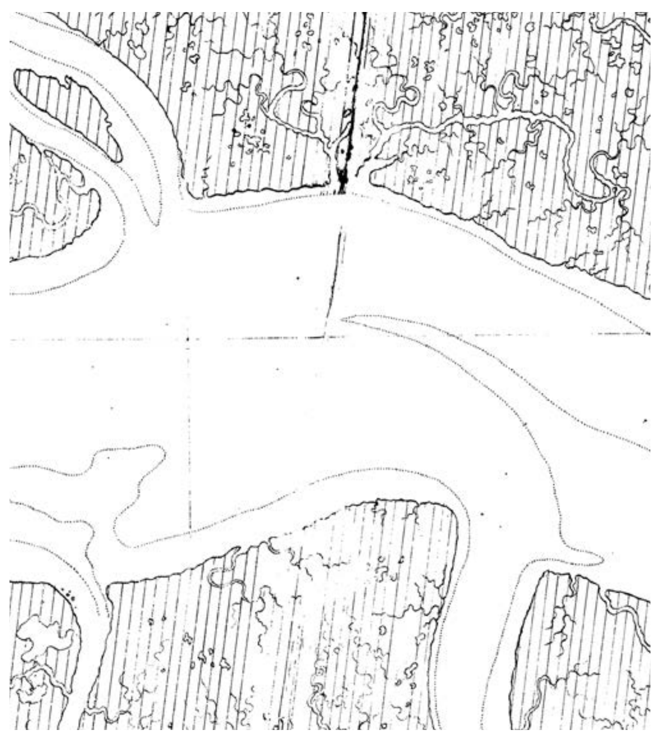


FIGURE II-7. DOTTED LINES representing low tide separate tidally-exposed flats from Bay waters in an early U.S. Coast Survey map (Rodgers and Kerr 1857, courtesy National Ocean Service).

		WETLAND CLASSIFICATION AND WATER REGIME (Cowardin1979)	**VEGETATION CLASSIFICATION** (NDDB: Holland 1986, MCV: Sawyer and Keeler-Wolf 1995)
BAYLANDS	Tidal Flat	Estuarine intertidal unconsolidated shore. Regularly flooded.	-
	Tidal Marshland	Estuarine intertidal persistent emergent wetland. Regularly flooded, permanently saturated.	Pickleweed alliance, Cordgrass alliance, Saltgrass alliance, Bulrush alliance (MCV); Northern coastal salt marsh (NDDB)
BOTTOMLANDS	Saltgrass-Alkali Meadow *(Salitroso)*	Palustrine emergent saline wetland. Temporarily flooded, seasonally to permanently saturated.	Saltgrass alliance, Alkali sacaton alliance, Ashy ryegrass alliance, Creeping ryegrass alliance (MCV); Alkali Meadow (NDDB)
	Wet Meadow	Palustrine emergent wetland. Temporarily flooded, seasonally to permanently saturated.	Ashy ryegrass alliance, Creeping ryegrass alliance (MCV); Valley wild rye grassland (NDDB)
	Perennial Freshwater Wetland *(Tular)*	Palustrine persistent emergent freshwater/ saline wetland. Temporarily to seasonally flooded, permanently saturated.	Bulrush series (MCV)
	Seasonal Lake *(Laguna seca)*	Palustrine persistent emergent freshwater/saline wetland. Seasonally flooded, permanently saturated.	Bulrush series (MCV)
	Perennial Freshwater Pond *(Laguna)*	Permanently flooded.	Bulrush series (MCV)
ALLUVIAL FANS AND LEVEES	Willow Grove *(Sausal)*	Palustrine forested wetland. Temporarily flooded, permanently saturated.	Arroyo willow alliance (MCV)
	Riparian Forest	Riparian, lotic, forested, mixed species (NWI 1997). Temporarily flooded.	Coast live oak series, Mixed willow series (MCV) Central coast live oak riparian forest, Central Coast arroyo willow riparian forest, Central Coast cottonwood-sycamore riparian forest (NDDB)
	Sycamore Alluvial Woodland and Other Riparian Habitat	Temporarily flooded, permanently saturated at depth.	Sycamore alliance, Mulefat alliance (MCV); Sycamore Alluvial Woodland, Central Coast Riparian Scrub (NDDB)
	Valley Oak Savanna	Intermittently flooded, saturated at depth.	Valley oak alliance (MCV); Valley Oak Woodland (NDDB); Valley oak/grass association (Allen et al. 1991)
	Dry Grassland	-	Ashy ryegrass series (MCV)

TABLE II-1. HABITAT "CROSSWALK" TO WETLAND AND VEGETATION CLASSIFICATIONS. NDDB refers to the California Natural Diversity Database (2005); MCV refers to the Manual of California Vegetation (Sawyer & Keeler-Wolf 1995).

TIDAL MARSHLAND

In the South Bay, tidal marshlands are the dominant habitat of the Baylands — vast vegetated plains representing a significant percentage of the West Coast's tidal wetlands (Atwater and Hedel 1976).

Tidal marshes are defined as intertidal areas that support at least 10% cover of vascular vegetation adapted to intertidal conditions. The lower marsh edge is called the foreshore, and the high edge along the uplands is called the backshore. Tidal marshes are composed of several characteristic habitat elements: marsh plains, marsh pannes, *salinas*, and drainage networks (SFEI 2005).

The tidal marshlands adjoining Santa Clara Valley had extensive drainage networks of repeatedly branching tidal channels, or sloughs. The larger sloughs, such as the tidal portion of Coyote Creek, were particularly important as transitional environments where the Bay extended inland through the Baylands and close to land. Thousands of shallow enclosed ponds, or pannes, dotted the surface of the marshlands. Distinctive elongated pannes along the backshore, called *salinas*, evaporated water naturally to produce salt (Grossinger and Askevold 2005).

Spanish explorers were impressed by the extent and complexity of the South Bay marshes: "To the south, the sea-arm or estuary turns into great numbers of other inlets, and I suppose lakes as well. I had a clear view of it, and it looks like a maze" (Crespi 1769 in Stanger and Brown 1969: 105-106). Spanish *diseños* illustrated the general concept of complex patterns of sinuous channels and pannes, but it was not until the USCS that this environment was mapped with precision (**FIGURE II-8** and **II-9**).

The accuracy of the historical USCS maps of tidal marshland in the San Francisco Bay Area has been well-documented (Grossinger 1995, Grossinger et al. 2005, Askevold 2005). We digitized most of the tidal marshland information for the Santa Clara Valley from these "T-sheets," through the Historical Tidal Marsh Map project. The mapping of the tidal reaches of the Coyote Creek channel is described in the Streams section below.

The landward boundary of tidal marshland has been mapped previously at a regional scale by Nichols and Wright (1971) and SFEI (1998). With additional local information, we slightly modified the SFEI version through the Historical Tidal Marsh Map project and this study. This interpretation is described in the Lower Coyote Creek section.

HABITATS OF THE BOTTOMLANDS

Prior to reclamation efforts, the low-lying bottomlands

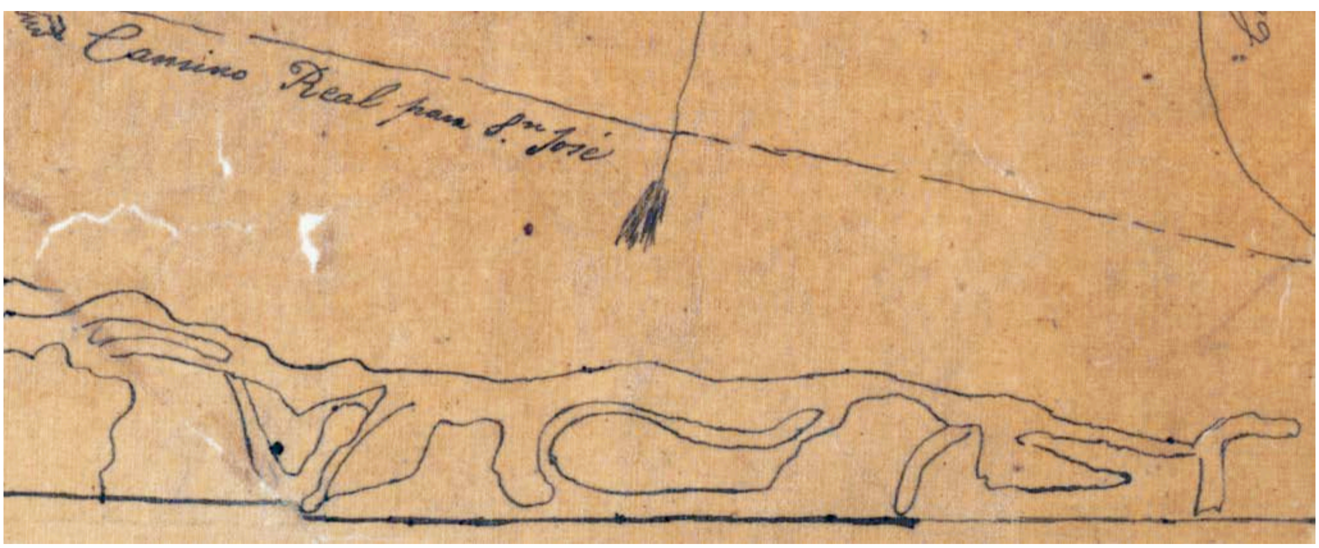


FIGURE II-8. CONCEPTUAL REPRESENTATION OF TIDAL MARSHLAND on the *diseño* for Rancho Los Tularcitos, circa 1840 (U.S. Dist. Court 1841, courtesy The Bancroft Library, UC Berkeley).

of the Valley supported a diverse range of wetland habitats with varying hydrology and associated ecological support functions. Temporarily flooded, seasonally saturated wet meadows covered the largest area, while perennial freshwater ponds, or *lagunas*, had highly restricted distribution. More subtle variation distinguished the wetland habitats with intermediate characteristics between the wet meadows and the *lagunas*.

The historical record presents several types of information useful for distinguishing these habitat types. Occasionally, written accounts describe water depth and/or duration. Vegetation types can sometimes be distinguished from landscape photography. Descriptive terminology used by local residents or travelers can also be useful. One of the most useful sources is Spanish terminology, as applied and recorded in the Mexican land grant *diseños*, which distinguishes several palustrine wetland types. Because of the similarity of many western U.S. landscapes to those in Spain, many Spanish geographical terms described the features of the American West particularly effectively and were often adopted by subsequent English-speaking immigrants (Austin 1933). When available, we use the concise Spanish terms as well as the longer American versions.

While usage varies somewhat, the term *laguna* was used by both Mexican and American residents to describe areas with more perennial surface water. *Laguna* refers to open water ponds; presumably the local features are too small to be called *lago*, lake (correspondingly, they are also too small (less than 20 acres) to be called lacustrine in modern terminology; Cowardin 1979). *Tular*, or *tulare*, translates as "place of tules" (Gudde 1998: 402), indicating freshwater emergent wetland. *Laguna seca*, literally translated as "dry lagoon,"or small lake, appears to be used to distinguish

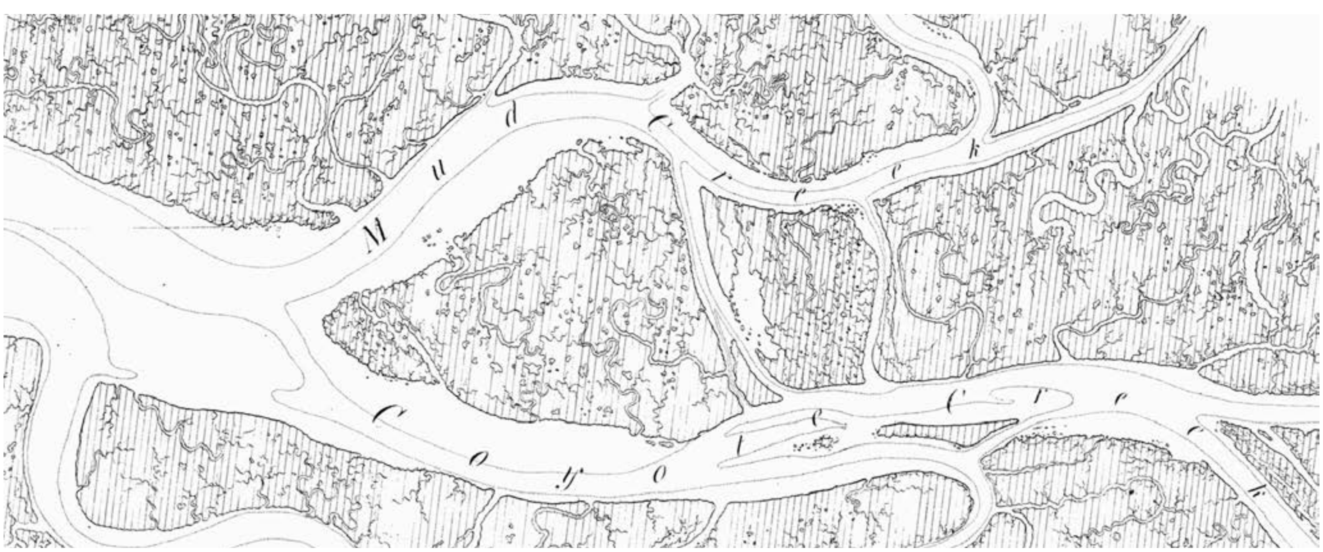


FIGURE II-9. PLANE TABLE SURVEY OF TIDAL MARSHLAND by David Kerr (Rodgers and Kerr 1857, courtesy National Ocean Service).

areas of freshwater marsh vegetation with notably persistent standing water — places where "the water has stood for some time before drying" (Austin 1933). Both *tular* and *laguna seca* thus describe emergent palustrine wetlands that would typically flood in the winter, but *laguna seca* would have standing water much or most of the year.

These habitats generally existed in mosaics with subtle gradations between the different components. Their relative extent would vary substantially with seasonal, interannual, and longer-term climatic variation. The mapped boundaries indicate an approximate average condition, providing a flexible template for understanding and designing freshwater habitat mosaics, rather than precise designations.

WET MEADOW

Wet meadows, which covered broad areas of the Santa Clara Valley prior to hydromodification, are characterized by poorly drained, moist to saturated soils with standing water present for brief or moderate duration. The dominant plant species were probably rhyzomatous ryegrasses *(Leymus* spp.; Holstein 1999) with a significant component of obligate or facultative wetland plant species (U.S. EPA 2005, Illinois Department of Natural Resources 2005, Ratliff 1988). They were well-documented in the Santa Clara Valley because they hindered agriculture.

Nationally, wet meadows are reported at a range of elevations, often including "low-lying farmland" (e.g. U.S. EPA 2005, Illinois Department of Natural Resources 2005). In California, wet meadows are conventionally associated with alpine or subalpine environments. However, Ratliff (1988) notes that California valley and foothill grasslands can potentially include wet meadow conditions, but that these sites "dry rapidly" and are dominated by annual grasses and forbs. Prior to Euro-American modification, we find that significant parts of the Santa Clara Valley exhibited conditions consistent with the basic hydrological and botanical attributes of wet meadow.

To create a map of wet meadows in the Santa Clara Valley prior to Euro-American modification, we used the mid-20th-century U.S. Department of Agriculture (USDA) Soil Surveys of the region, with refinements and calibration from a number of other data sources. The major portion of the area mapped as wet meadow is based on the identification of heavy textured, poorly drained basin soils by Gardner et al. (1958). This survey covers the entire western portion of Santa Clara Valley and extends southward along Coyote Creek to The Narrows. The fieldwork was carried out during 1940-1941, prior to most suburban expansion, and with the benefit of 1939 aerial photography. In the Coyote Valley area, our mapping is based upon the 1967 USDA Soil Survey of Eastern Santa Clara Area (Lindsey 1974; fieldwork carried out 1960-65), which describes equivalent soil types. We also used a variety of earlier historical sources. The wet meadow soil type boundary transmits strongly through time and land use patterns, providing additional confirmation (see **FIGURE III-7**).

Gardner et al. (1958: 47-48) combined 13 soil types into the general category Soils of the Basins. They describe

On boundary between sections 13 and 18.

Cross boggy land, wet in winter--baked in summer.

Day 1854: 511, courtesy Bureau of Land Management

this group of soils as "developed under various degrees of slow or very slow runoff and high groundwater levels", typically having "smooth and nearly level relief (<0 .5% in slope)", and mostly "heavily textured." They report that these soils had, either at the time of survey or in recent historical times prior to modification, poor drainage and herbaceous vegetation (as opposed to woodland or brushland).

Largely because of the poor drainage, some of these areas were alkaline. The general category "Soils of the Basins" included eight basin soil types "commonly free of salts and alkali" and five additional soil types that were mapped as basin soils "commonly containing salts and alkali." We combined these 13 categories of Soils of the Basins into wet meadow, and defined a secondary category of salt-affected areas called Saltgrass-Alkali Meadow (described in the next section).

Hydrological and Ecological Characteristics

The Santa Clara Valley's low-lying bottomlands were dominated by open, treeless wet meadows, except for isolated willow swamps and a few stream reaches at the Baylands edge. In his reconstruction of pre-modification vegetation patterns in the vicinity of Palo Alto, Cooper (1926: 15) described the habitat as an "open meadow-like belt" around the edge of the Bay. Broek (1932: 14) described the same areas in the 1930s as an "open landscape" contrasting with the surrounding "forest of orchards" (fruit trees being almost completely excluded from the "Basin Soils" by the saturated clays). Preliminary data collected by SFEI show that oak savanna, a widespread historical habitat of the Santa Clara Valley, is strongly non-coincident with wet meadow. Of the 1,098 historical valley oaks we identified through aerial photography, only 15% occur in the areas mapped by soil type as wet meadow. Of the coincident 15%, more than half are found close to (within 500 feet of) the outer edge of wet meadow areas, suggesting fine scale error or gradation in the soil boundary. It is likely that the few trees lying well within the wet meadow area represent finer scale topographic variation, occupying slightly higher, more well-drained topography such as old stream ridges not mapped by the soil survey (Cooper 1926: 20, 23). While Santa Clara Valley's wet meadows do not precisely fill the classic image of openings in dense forest, they represent the equivalent unwooded component in the semiarid, savanna-dominated local landscape.

Historical evidence provides additional descriptions of wet meadow characteristics. These "waterlogged areas" became "impassible swamp lands" in the rainy season (Broek 1932:29). Crossing the lower Santa Clara Valley in March 1776, Font reported that "All this road is through very level and low land and therefore miry, so that when it rains heavily it becomes impassible" (Font in Bolton 1933: 353-355). Federal surveyor Westdahl (1897c: 5) notes the exclusion of orchards by seasonal flooding: "Orchards are being planted everywhere owing to the greater profit derived from horticulture, and it is safe to predict that this entire region will be devoted to it as soon as the low country can be protected from overflows." Because of these conditions, wet meadows remained almost devoid of roads and urban development through much of the 20th century, being used instead to yield hay and grain, or were simply left unused. Cooper's 1926 reconstruction indicates that substantial changes had taken place in the plant community, but notes remnants of native composites, describing what he calls a "Willow-Composite Community."

Baye (1999) identifies several plant species that fit Cooper's narrative, including common spike weed (*Hemizonia pungens*) and Aster species. These soil types sometimes include "hogwallow" topography and vernal pool systems. Contra Costa goldfields (*Lasthenia conjugens*) was recorded on wet meadow soils east of Coyote Creek in 1958 (CNDDB 2005). Two historical records of *Plagiobothrys glaber* (hairless popcorn-flower; 1892 and 1955) appear to be associated with the wet meadow areas (CNDDB 2005). Congdon's tar plant (*Centromadia parryi* var. *congdonii*) was identified in 1928 in the wet soil areas just east of the Coyote Creek at Milpitas, and Hoover's button-celery (*Eryngium aristulatum* var. *hooveri*) was recorded (1902) in wet meadows just east of Guadalupe River. Alkali milk-vetch (*Astragalus tener* var. *tener*) occurred at both of these areas in 1905 (CNDDB 2005). The latter species was recorded generally in "saline areas along San Francisco Bay" including the Santa Clara Valley (Thomas 1961 *in* Baye et al. 1999).

In the lower Santa Clara Valley, wet meadows often border tidal marshland. Because of the nearly flat topographic gradient, the transition between these two habitats was unusually gradual, forming a broad area distinguished by intermediate characteristics such as occasional tidal influence and alkali effects. Since this ecotone has substantial ecological significance and has been identified distinctly throughout the local history, we describe it in more detail in the Saltgrass-Alkali Meadow section.

The wet meadows occupy nearly flat or depressional lowlands. Torbert (1936) describes how surface drainage of the shallow basins south and east of San Jose "has been cut off by stream-built ridges." Bedrock hills preventing drainage of the lower Coyote Valley created wet meadows with perennial marshes and ponds (Clark 1924).

Most of the wet meadows appear to have received seasonal surface runoff or stream overflow, plus emergent groundwater. Substantial floods on larger streams such as Coyote Creek and Guadalupe River would spread water beyond the coarse alluvium immediately adjacent to the channel into the lower lying basins. In many places the greater water source was flood flows from the many terminal or distributary streams that would send sheet flow across the lower ends of alluvial fans into the wet meadows. In 1776 Font observed this pattern:

> "On the way we found some lagoons of water formed by the arroyos which run from the sides of the sierras and, flowing toward the estuary of the port, become lost in those plains and flats" (Font in Bolton 1933: 323).

Stanford zoologist John Snyder (1905: 329-330) also described the formation of seasonal ponds from terminal creeks in the lowlands, and the potential importance for lateral fish migration:

> "Most of the streams of this basin converge toward the southern end of the bay... Before reaching the sloughs, however, this water often spreads out, forming large ponds. The union of two or more of these temporary ponds, the shifting of a creek channel caused by some obstruction, the change in the direction of a slough, or a combination of these conditions may form between two streams a continuous passage well adapted for the migration of fresh-water fishes".

The wet meadows were also supplied by springs in some places, resulting in persistent moisture and perennially wet willow swamps and freshwater ponds. These were reliable places for late-summer cattle grazing, as Taylor (2000: 50) noted in September 1849, describing "the fertile and sheltered plains of Santa Clara": "Large herds of cattle are pastured in this neighborhood, the grass in the damp flats and wild oats on the mountains affording them sufficient food during the dry season."

The clay soil layer precluded widespread groundwater emergence, but produced artesian conditions that probably created a wide sphere of influence around natural seeps and springs. Despite a high water table and "good grass cover most of the year," the adobe soils exhibited shrink/swell characteristics: "in dry weather shrinking into hard blocks separated by wide cracks, and in wet seasons becoming exceedingly sticky, the water standing on its flat surfaces for days" (Broek 1932: 77). Gardner et al. (1958: Sheet No. One) described the sponge-like wet meadow soils characteristics: very slow surface runoff, occasional high water table, and moderate to high water-holding capacity.

Interpretation of Gardner et al. (1958)

Gardner et al. (1958) can be considered the first mature soil survey of the region, partly because it was able to build upon two significant earlier efforts (William Reed, personal communication). "Soil Survey of the San Jose Area, California" carried out by pioneering soil scientist Macy Lapham (1904) was one of the first-ever USDA soil surveys. The Valley was revisited in 1917 as part of a reconnaissance survey for the entire San Francisco Bay region (Holmes and Nelson 1917). Upon later reflection, Lapham himself admitted that the turn-of-the-century surveys were relatively coarse and experimental (Lapham 1949), but after nearly four decades of experience, Lapham again participated in the 1940-41 survey, as Senior Soil Scientist. So there is reason to expect that the 1940-41 survey reflects well-developed mapping techniques and empirical understanding of the region.

While soil boundaries generally cannot be mapped with extreme precision, recent assessments have found the 1940-41 soil mapping to be very accurate. The new mapping of Santa Clara Valley soils by the USDA Natural Resource Conservation Service (NRCS) has confirmed the general accuracy of boundaries, particularly the contact between gently sloping alluvial fans with loamy soils and clay-rich, nearly level basin soils, which is relatively easy to identify in the field (Reed, personal communication).

Adjustment at Santa Clara

In the vicinity of Santa Clara, the Orestimba loams occupying the final site of the Santa Clara Mission were excluded from the Wet Meadow soil type because of substantial historical evidence that the Mission occupied significantly higher and drier ground. For example, Lewis (1861) emphasizes the shift from "dark alluvial soil" to "soil of more gravelly description" and a corresponding step up in elevation of about 2 feet. Lapham (1904) also distinguishes this area from the surrounding adobe soils.

Recent Burial of Basin Soils

Gardner et al. (1958: 95-96) identify a large area of shallow, recent deposits that have buried former basin clay soils during historical times, labeled "Mocho loam/sandy loam/fine sandy loam, over basin clays." They ascribe this to large-scale erosion since 1850 due to agricultural practices, which, ironically, have improved downstream clay soils by burying them with a layer of lighter, well-drained material. They describe the effect as follows: "[I]n the Santa Clara Area suspended material from eroded areas has been deposited over rather large areas of the Valley floor. This recently deposited material makes up the soils of the Mocho series. In many places along the larger creeks the deposits are more than 6 feet deep, but the largest areas have an overwash of less than 6 feet over basin clays. Differences in depth of Mocho soil material on either side of old levees or road embankments and statements made by people who have directly inherited land taken up at the beginning of the intensive settlement of the Valley indicate that nearly all of the material that has become the Mocho soils has been deposited since about 1850" (Gardner et al. 1958: 177). Land case testimony from farmers along Coyote Creek indicates that some increased deposition goes back as far as the 1830s or 1840s (see discussion in Lower Coyote Creek section).

To represent pre-modification conditions, we added these areas of previously basin soils to the other basin soils. Comparison of the reconstructed extent of Wet Meadow with the 1904 soil survey clearly shows the expansion of loams over basin clays during the first decades of the 20th century.

Comparison to Modern Quaternary Geology

The wet meadow soil types correspond substantially with Quaternary Holocene Basins as mapped by Knudsen et al. (2000), but covers more area. We found that several areas of known historical seasonal/perennial freshwater wetlands corresponded more closely to Gardner et al. (1958). For example, Lewis (1851) shows a broad area of wetlands surrounding the higher ground of the early town of Santa Clara. These features correspond closely to basin clay soils that are shown by the soil survey, but not the more recent quaternary geology map.

Wet meadows also coincide generally with the location of "Fine-grained Alluvium," as identified in the regional USGS map of surficial geology (Helley and Lajoie 1979). Fine-grained Alluvium displays characteristics typical of seasonally wet areas:

> "Distribution and Stratigraphy: Found in poorly drained, nearly horizontal basins between active and abandoned stream levees at the outer margins of alluvial fans adjacent to San Francisco Bay. Origin of deposit: Deposited from standing floodwaters that periodically inundate low interfluvial basin areas and locally form seasonal fresh-water marshes. Presently being formed but depositional processes severely disrupted by modern cultural activity" (Helley and Lajoie 1979).

Interpretation of Lindsey (1974)

Wet meadow soils were derived from the Soil Survey of Eastern Santa Clara Area, California (Lindsey 1974) based upon the same rationale as described above for Gardner et al. (1958). Lindsey describes the drainage of the Santa Clara Valley as "generally well developed" (1974: 85), identifying only a single association of poorly drained soils: the Clear Lake-Pacheco-Sunnyvale association. This association is mapped in only two areas, "near Soap Lake and Tulare Hill," (1974: 4); both are well-confirmed areas of historical freshwater wetlands.

The soils in this association that we used in the Coyote watershed are: Clear Lake clay (Cg); Clear Lake clay, drained (Ch) ; Clear Lake clay, saline (Ck); Pacheco clay loam (Pd); and Sunnyvale silty clay, drained (Sv). These soils are "poorly drained" clays or clay loams and, in the Coyote Valley area, they each coincide in full or in part with the historical extent of Laguna Seca, confirming their wetland character.

Topographic Adjustment

Differences in scale and/or registration caused the wet meadows layer to slightly overlap with steep bedrock topography in several places. We adjusted the wet meadow boundary in our GIS to conform to these topographic controls at Laguna Seca in Coyote Valley.

SALTGRASS-ALKALI MEADOW (TIDAL MARSH-WET MEADOW ECOTONE; *SALITROSO*)

The Saltgrass-Alkali Meadows represent a subset of the wet meadow habitat type. Their largest representatives in the watershed were found at the northern end: a complex zone of transition poised at the upper limit of tidal influence and the lower limit of the terrestrial land. The width of this "ecotone" between Bayland and Bottomland varies depending upon the slope of the underlying topography. In the Guadalupe-Coyote-Penitencia area, the nearly flat topographic gradient created a broad and distinctive habitat described explicitly by a range of historical sources.

Mexican and early American residents referred to this area at the edge of the Bay, and other salt-affected areas with limited or no tidal influence, as *salitroso* lands (literally "salt petrous"). We use this convenient term interchangeably with Saltgrass-Alkali Meadow. The habitat is similar or equivalent to "alkali meadow" (Holland 1986) and the "Saltgrass series" (Sawyer and

Keeler-Wolf 1996). These alkaline grasslands are recognized as a scarce native grassland type (Faber 2005, Holstein 1999).

Unusually high concentrations of salt in alluvial soils (not Bay mud) created a distinctive flora as well as limitations to agricultural use. Typical salts include sodium chloride, sodium sulfate, sodium bicarbonate, and sodium carbonate (Gardner et al. 1958: 178). There are multiple mechanisms for salt accumulation in these low gradient areas. Evaporative processes of seasonally flooded depressional areas are the typical mechanism for forming alkali deposits, and at the edge of the Bay, additional processes contributed salts of marine origin. Land case testimonies describe occasional tidal inundation over much of the saltgrass-alkali meadow area, which would result in saltwater effects. Gardner et al. (1958: 60, 178) note the importance of saltwater seepage into the groundwater along the Bay's edge. The strength and prevailing direction of local winds suggests that aeolian deposits may also have contributed to the inland extension of salt influence.

There were a number of other alkali areas in the Santa Clara Valley that were not tidally influenced, as Antonio Maria Pico described in the Rincon de los Esteros land case:

> **Question 25:** Are there not spars of this alkali or *salitroso* land that you have spoken of scattered all over the land in various ranchos and plains in the Valley of San Jose?
>
> **Answer:** Yes sir, in some parts. (Pico 1860: 121)

The most noteworthy nontidal *salitroso* lands occupied parts of the Soap Lake area at the very southern end of the Santa Clara Valley (Broek 1932). While this area had no tidal effects and lies outside our study area, it shared similar ecological characteristics to the edge of the South Bay, including broad, white, evaporative, salt-crusted flats.

Early conditions in Rincon de los Esteros area are discussed in detail as part of the Berryessa land case, with particular attention to the extent of tidal influence several decades earlier, because of the traditional designation of tidelands as state property: "I shall not extend the grant beyond... the line of division between the marsh and the dry land" (Parker 1863: 201-202). The litigators use the same indicators used by present-day historical ecologists: extent of tides, vegetation, soil characteristics, and agricultural use.

Local residents' testimony provides explicit evidence for the saltgrass-wet meadow habitat. Parker (1863: 221-224) stated that one third of his grain crop was "eaten out by alkali" and that the next year he kept hogs on it rather than farming. Pico (1860: 119-120) reported that "the character of the land is '*salitroso*' or alkali lands" which are "not as good for grazing as the other," but used nevertheless. And the predominant vegetation is described repeatedly as saltgrass.

In the 20th century, local botanists took interest in the area. As part of his reconstruction of historical vegetation in the Palo Alto area conducted in 1915-16, Cooper (1926) interviewed local resident G.F. Beardsley about conditions circa 1870. Beardsley described a strip of "wiry hard grass," interpreted as *Distichlis* by Cooper, "several hundred yards to one-quarter mile wide" at the upland edge of the "line of natural salt pan" (Cooper 1926). Gardner et al. (1958: 60) affirmed the transitional salt marsh character of the zone, describing the vegetation on Alviso clays along the marsh margin as consisting "largely of grasses, saltgrass predominating, and pickleweed and brass buttons."

The saltgrass-wet meadows represent an important ecological habitat supporting a number of regionally rare, threatened, endangered, or now extinct species. Botanical evidence for these transitional areas around San Francisco Bay describes a unique plant community with characteristics of high tidal marsh, alkali flats, and vernal pools (Baye personal communication, Baye et al. 1999). The presence of the rare annual milk vetch, hairless popcorn flower, and Contra Costa goldfields in the saltgrass-alkali meadows along Coyote Creek and Guadalupe River near the tidal marsh margin (described in the Wet Meadows section) suggests the presence of vernal pool-like habitat (Baye et al. 1999).

To define the extent of saltgrass-alkali meadow, we use the descriptions of high tide extent and saltgrass in the Berryessa land case and the mapping of alkali-affected areas by Gardner et al. (1958) as the primary sources. These largely confirm each other, but the land case testimony explicitly described saltgrass beyond the Alviso-Milpitas Road (approximately present-day Highway 237), so we follow that source.

Located at the edge of two major landscape types, the saltgrass-alkali meadows in the lower Valley represent the interplay of both alluvial and tidal processes, with processes operating at different time scales overlaying each other to create a complex pattern of vegetation and hydrology. With ongoing sea level rise, tidal marsh and *salitroso* lands are gradually moving inland. Therefore, preserving the existing saltgrass-alkali meadows is critical to the future of tidal marshlands; with natural or heightened estuarine transgression, the *salitroso* will become fully tidal.

Over a longer time period, as the tides gradually intersect steeper topography, the *salitroso* zone will narrow. Superimposed upon this longer-term process of inundation, fluvial deposits during major floods create slightly lower and higher places, sometimes temporarily reclaiming newly tidal areas to the land side. While the fluvial deposition observed by early Mexican and American farmers in the mid-19th century may have been exacerbated by recent land use, the habitat pattern described is illustrative (Bloomfield 1863).

> **Court:** "Describe the character of the land lying North of the Milpitas road as you first knew it in 1852, and state how much has since been reclaimed?"
>
> **Stephen Bloomfield:** "...The land as I first knew it was Salt Marsh beyond the Milpitas road except some few knolls which were made by freshets."

Reed (1862) captures some of the complexity of the ecotone:

> "In running this line it was impossible to follow the exact line between the Marsh and the upland, for the reason that the line would have been very crooked as narrow strips of Marsh land extended up into the uplands and corresponding strips of the upland extended into the Marsh lands. I ran that line as to leave as much Marsh land on the side of upland as there was upland left outside of the Rancho, running down into the swamp land."

Intermediate vegetation patterns at the interface between tidal marshland and saltgrass-alkali meadow undoubtedly reflected gradual adjustment to increased saline tidal influences, colonization of younger flood deposits, relict populations, and persistent alkali areas. As Reed (1862) notes, "it was a medium between the two, it was neither like the upland nor like the Salt marsh, but it partook of the character of both."

Gardner et al. (1958) suggest that salt effects extended farther inland during the first decades of the 20th century due to land subsidence. Given the close correspondence between Gardner et al. 1940-41 mapping of alkali-influenced areas and the land case testimonies about the extent of alkali, saltgrass, and *salitroso* land, we think it is unlikely that the saltgrass-wet meadow area represents a substantial expansion during historical times. In fact the observation of large alkali-affected areas after a century of active and passive reclamation efforts including soil deposition, plowing, and drainage indicates strongly persistent conditions. These soil characteristics, and potentially suitable habitat for several listed species, may still be recognizable in some places, and are likely to increase over time with saltwater intrusion along the Bay edge.

PERENNIAL FRESHWATER POND: *LAGUNA*

Persistent fresh surface waters were relatively rare in the Santa Clara Valley's semiarid climate. As a result, historical documents reliably record the few, important perennial water bodies that persisted outside the tidal lands. Spanish, Mexican, and early American accounts and maps use the term *laguna* for these permanently flooded, unvegetated wetlands. Twentieth century American descriptions often refer to these places in regard to their use by dabbling waterfowl, indicating standing water several feet deep (e.g. "duck ponds" (Cooper 1926), "Mallard Pond" (SCVWD Vault 1916: 146)). These features are too small to be considered lakes (greater than 20 acres) within National Wetlands Inventory (NWI) classification, and *laguna* translates to lagoon; so we use the term pond. However, while the open water area is generally relatively small, the historical usage of the term *laguna* generally applies also to the full wetland complex, including seasonally-flooded areas as well as the perennial portions.

On the valley floor around Coyote Creek, we were able to distinguish small *lagunas* as part of the Laguna Seca wetland complex using the reclamation photographs (SCVWD Vault 1916-1917) and associated caption descriptions of water depth and avian use. Healy (1861; "water") and Thompson and West ([1876]1973) show perennial waters of the Laguna Socayre complex.

PERENNIAL FRESHWATER WETLAND/ SEASONAL LAKE (*TULAR, LAGUNA SECA*)

While the wet meadows flooded temporarily, for days or weeks at a time, and *lagunas* were permanently flooded, there were at least two additional habitat types with intermediate hydrology. *Tular* and *Laguna Seca* each refer to perennial emergent freshwater wetlands that have groundwater at or near the surface through most, if not all of the year. *Laguna Seca*, or seasonal lake, has expansive and prominent surface water for much of the year, which disappears at the height of the dry season, at least during some years. The traditional Spanish-American term for these features where "the water has stood for some time before drying" is *laguna seca* (Austin 1933). In the wet season these features covered relatively large areas, greater than 20 acres, and looked like open water. Thus, although they were vegetated, we refer to them as seasonal lakes. *Tular* has similar freshwater tule vegetation, but less expansive, deep, or persistent seasonal flooding. We mapped these as distinct feature types, based upon historical evidence for hydrology, but combine them into the single perennial freshwater wetland category in most map graphics.

FIGURE II-10. "WATER STOOD FIVE FEET ABOVE GROUND SURFACE BEFORE RECLAMATION" [text from original photo caption]. Photograph taken immediately following the construction of drainage ditches through Laguna Seca (SCVWD Vault 1917).

Mexican *diseños* describe two major freshwater wetlands as *laguna seca* adjacent to Coyote, including the eponymous *Laguna Seca* in Coyote Valley and the Laguna Socayre. While it is difficult to define the exact spatial extent of these seasonally and inter-annually variable habitats, historical data give some guidance. The latter feature is labeled *Laguna Seca* by Yerba Buena land case map B-465 (US District Court 1859). Lyman (1847) and USGS Los Gatos (1919) each depict Coyote Valley's Laguna Seca as a large area of wetland vegetation with a smaller open water area. Also, the Laguna Sega reclamation photographs report that the water level was 4-5 feet above the ground before reclamation (**FIGURE II-10**), describing the open water area mapped earlier. They also indicate a visible discoloration line on the tall tule vegetation at a similar height indicating the "height of water before drainage" (**FIGURE II-11**). These data suggest a water level several feet deep for much or most of the year, yet with emergent vegetation. Hence we defined the wetter, northern end of the complex as *laguna seca*, with an adjacent area of freshwater marsh or *tular*.

It is also possible that drainage efforts prior to 1916 had already reduced the persistence and depth of flooding, permitting vegetation encroachment, and that the open water area shown by Lyman and USGS was truly perennial. In this case, the surrounding area that we have mapped as temporarily flooded *tular* would have been a more persis-

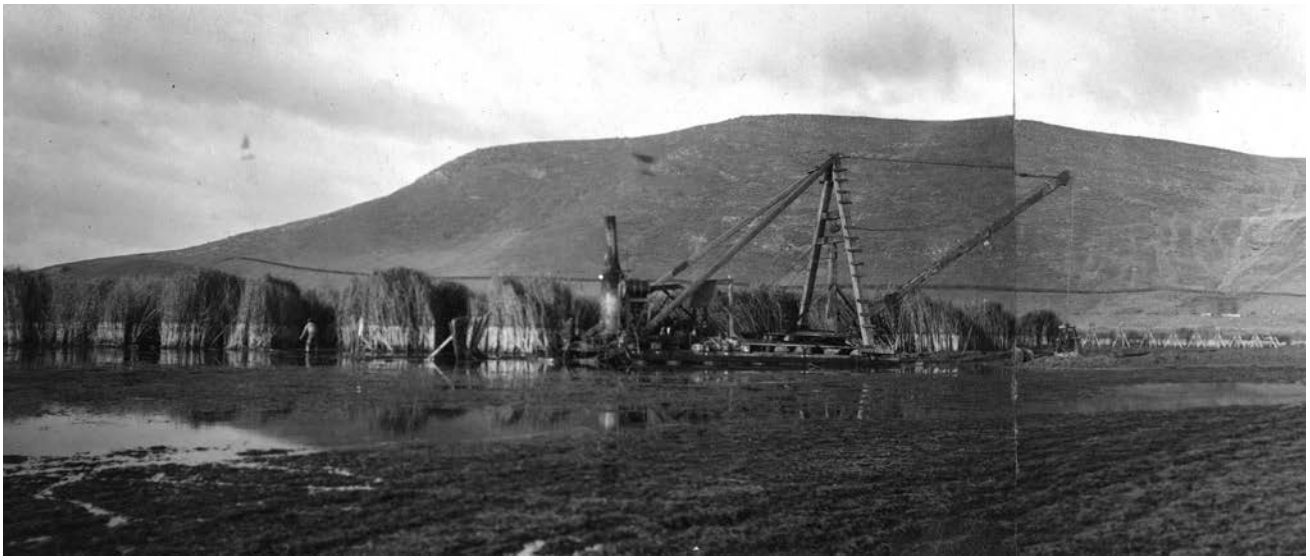


FIGURE II-11. "LAGUNA SECA RECLAMATION", 1916. "Bottom of Lagoon on December 28, 1916, showing Clam-shell machine at end of Ditch. Discoloration on tulles [sic] shows height of water before drainage. Small shallow pools are from drainage water still coming from tulles and flowing to Ditch" [text from original photo caption] (SCVWD Vault 1916: 66-67).

tently flooded *laguna seca*.

We defined "*tular*" as the peripheral, less flooded area of the Laguna Seca and Laguna Socayre complexes and other, smaller freshwater wetlands. Evidence for additional freshwater marshes in the Rincon de los Esteros area is available in the form of small features mapped by the United States Coast and Geodetic survey (Westdahl and Morse 1896-97) using traditional freshwater marsh symbols, and even by Gardner et al. (1958). Efforts to drain many of these features are evident at the time of the survey, providing additional confirmation. Several of these areas are also clearly evident as dark, mottled patterns in the 1939 aerial photography; in these cases, we used the imagery to define a more precise feature boundary (see **FIGURE III-7**). These features likely had similar vegetation and seasonal flooding to the *laguna secas* but, because of size or water depth, would not be considered seasonal lakes.

HABITATS OF THE ALLUVIAL FANS AND LEVEES

WILLOW GROVE: *SAUSAL*

A grove of willows at a sink along a creek, at the downstream end of distributary creeks, or on the bottom lands near a seep or spring is a "*sausal*." *Sausals* (*sauce* = willow) are forested, nontidal wetlands; the dominant tree is arroyo willow (*Salix lasiolepis*; Cooper 1926). Surface water is usually present temporarily to seasonally and the water table is consistently close to the land surface, but the woody vegetation does not tolerate prolonged inundation. *Sausals* are not strictly riparian nor lacustrine in nature.

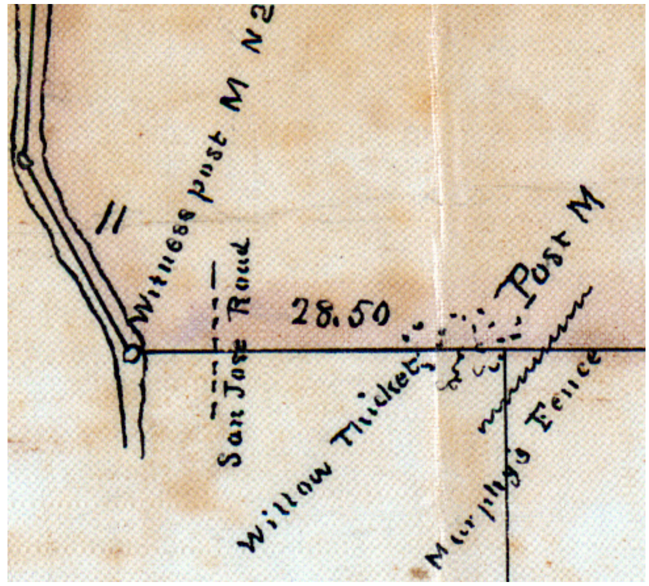
Sausals are and were strongly associated with areas of emergent groundwater along the boundary between the bottomlands and alluvial fans, but also occur near sites of groundwater emergence not immediately along the edge. Within the open vistas of the lower alluvial plain, *sausals* constituted important landmarks in the native landscape. Pictographs illustrating clumps of trees, often with green watercolor, appear commonly in Mexican land grant *diseños*, usually labeled as "*sausals*," "*sausales*," "*sauzal*," or the diminutives "*sausalito*" and "*montecito*" (little thicket). American maps use similar variations of the term as well as "willow grove," "willow marsh," or "willow thicket" (**FIGURE II-12**).

Written accounts also describe willow groves. Cooper (1926) describes "dense thickets sometimes 30 feet in height" with blackberry and wild rose. A visitor approaching San Jose in 1850 reinforces the size and density of a mature willow grove:

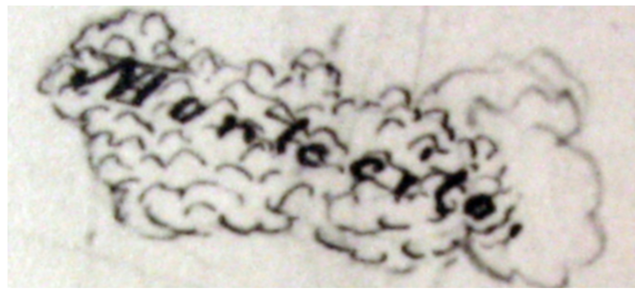
> "I came, within two or three miles of San Jose, to a large extent of willows, so thickly woven together with wild blackberry vines, wild roses, and other thorny plants, that it appeared as if I could never get through it. But I found a winding trail made by the cattle…the willows were in places 50 feet high and a foot in diameter. The willows where I came from were mere bushes and these astonished me (Manly 1850 in James and McMurry 1933).

Perhaps contrary to expectation, *sausals* were popular cultural sites. Their common association with shellmounds indicates long-term occupation by indigenous peoples (Striplen et al. 2005) and, during the American era, the edges of willow groves were often selected as homesites for leading citizens, with the trees molded into elegant gardens. At least one Bay Area *sausal* became a significant local destination, the San Lorenzo Grove, a willow grove near Hayward that was advertised as "The Picnic Paradise of California" (Grossinger and Brewster 2004).

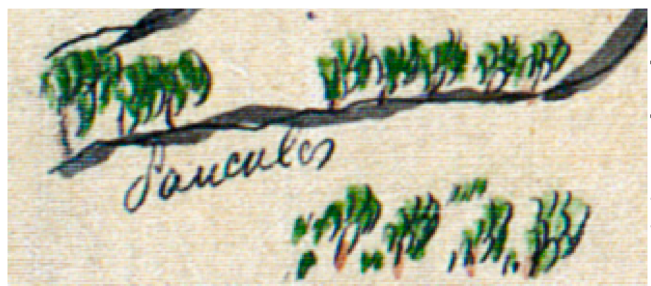
Willow groves provided valuable avian habitat. Evens (1993: 129) describes one of the few significant regional remnants, the Olema Marsh, a large alder-willow thicket that provides some of the most important habitat for breeding, wintering, and migrating birds in the Point Reyes area. Early naturalists' accounts and more recent intensive studies have documented a remarkable concentration of bird species (over 80) within the small



Thompson 1857a.



Day 1851


U.S. District Court [184-?]a.


U.S. District Court 1870.

FIGURE II-12. DEPICTIONS OF WILLOW GROVES DOWNSTREAM OF UPPER PENITENCIA CREEK (top three images) and **BERRYESSA CREEK** (lower image) in early Spanish and American maps (courtesy Santa Clara County Surveyors Office (top two maps), and The Bancroft Library, UC Berkeley).

area, including a number of now relatively rare wetland bird species. Interestingly, the willow marsh was managed for hunting during the early part of the 20th century using fire, presumably to reduce willow and cattail vegetation, increase open water for waterfowl, or to foster fresh browse for larger game (Anderson 2005).

Since willows can rapidly colonize large areas in response to favorable changes in environmental conditions (e.g. new alluvium at Elkhorn Slough, Monterey County (Byrd et al. 2004); former overflow channel area at Wildcat Creek, Contra Costa County (SFEI 2001)), it should be considered whether *sausals* reported in the mid-19th century might be the result of recent expansion due to landscape changes such as erosion and sedimentation. However, it is unlikely that willow groves would have expanded during this period given their use for firewood, and the effects of cattle browsing. Descriptions of the *sausal* along Penitencia Creek during the 1840s and 1850s attest to the restrictive effect of intensive cattle grazing on willows:

> "There was a considerable extent of land around it on which long straight willows were growing. They are not very high but there are a great many of them. The cattle cut off the tops in the winter. They would spring up thickly every year" (Houghton 1860).

Pico (1860) describes similar effects — "the cattle have eaten off the tops of the trees leaving the stumps"— indicating that the *sausals* recorded during this era are likely a conservative estimate of the original extent.

The Rincon de los Esteros land case testimony describes in some detail an additional related habitat type between Coyote Creek and Lower Penitencia Creek near the edge of the Baylands — "scattering willows." Healy (1860b) testifies that these are persistent but not dense enough to be considered a *sausal*. For the sake of simplicity, we mapped the individual clumps as *sausals* (based upon their distribution as shown by Westdahl (1897).

STREAMS (CREEKS, DISTRIBUTARIES, "SPRING RUNS"; *ARROYO, RIO, SANJON*)

Santa Clara Valley's streams are among its longest standing cultural resources. They are some of the oldest named features in the region; their courses have dictated human settlement patterns, both providing perennial water and precluding development by flooding. Before the expansion of the road network, streams were the most important landmarks defining Valley geography. As a result, their locations are extensively recorded in the historical record.

Despite similar climate and general geology, streams in the Coyote Creek watershed exhibited a wide range of morphology. To represent the important and consistently-identifiable distinctions of the historical streams, we defined and mapped several different fluvial feature types.

Except for Coyote Creek itself, streams in the watershed were narrow. They were less than 100 feet wide (usually much less) — much thinner than the corridor of mature riparian trees along their channels. We mapped these features as linear (polyline) features. While we mapped the Coyote Creek channel as a polygon because of its substantial width, we also created a line to represent its main channel. This synonymy permits measurements of stream length and allows all fluvial features to be maintained within the same GIS data set. Where multi-thread reaches were evident, they were represented as branches with additional lines, creating islands.

Features mapped as streams therefore include mainstem channels of large creeks, such as Coyote Creek, overflow channels (e.g. along lower Coyote Creek), spring runs or *sanjons* that received artesian water and overland flow (e.g. between Coyote Creek and Guadalupe River), and distributary creeks, which had discontinuous channels along the Valley floor (most of the watershed's streams). We only mapped streams with well-defined channels and banks (i.e. not swales or wetlands) as recorded by historical maps, aerial photography, or field notes. Within the tidal marshland extent, we classified channels as tidal, rather than fluvial.

At the downstream end of discontinuous creeks, where fluvial flow spread out or sank underground, we followed early map convention by depicting a trifurcation or "crowfoot." These features were coded separately in the GIS as "distributaries." The point of distribution — the termination of a defined channel — was often well documented by historical maps. The location at which a channel loses definition can also be seen quite clearly where unmodified by the time of early aerial photography (**FIGURE II-13**). Where channels were extended by ditching by this time, the sudden shift from sinuous to straight-line plan form generally matches historical sources and, in places with no earlier sources, was used to infer the historical point of distribution. Because of the high resolution of the orthorectified photomosaic, we were able to clearly identify the downstream extent of distinct, defined, unstraightened channel on most creeks, and avoid potential errors in interpretation associated with using small-scale prints. For this reason, as well as additional historical sources, our mapping of historical channel position differs in places from previous efforts.

The extension of discontinuous channels by the construction of ditches took place surprisingly early on many Santa Clara Valley streams. Creeks such as Upper Penitencia, Stevens, and Permanente were extended to the Bay (through extension to Coyote Creek in the case of Upper Penitencia) by 1876. Since many hydrological alterations appear in late-19th-century maps, it is important to consult mid-19th-century maps to construct an accurate picture of pre-modification drainage patterns.

Other descriptive sources can also provide important corroborating data. For example, Westdahl (1897a: T2312) labels the straight lower reaches of Adobe, Barron, and Matadero Creeks with "ditch," confirming their anthropogenic origin. In the Descriptive Report for the neighboring map, he notes that "The small creeks on the East side, between Warm Springs and Milpitas, have been

FIGURE II-13. THE LOWEST NATURAL REACHES OF NORWOOD CREEK, 1939 (LEFT) AND 2002 (RIGHT). The creeks flow right to left; Norwood Creek is above, an unnamed smaller creek is below. Spiderlike cow path patterns can be seen in the grazed area at lower right. Norwood and Ruby Avenues intersect at upper middle (AAA 1939; 2002 imagery copyright 2005 AirPhotoUSA, LLC, All Rights Reserved).

confined to ditches dug for them from the point where they issue on the flat lands (Westdahl & Morse 1896-1897: T2313). Accordingly, the general extension of distributary streams in straight channels across the seasonally flooded bottomlands is celebrated in an 1885 newspaper article:

> "Over immense stretches of swampland…once useless as veritable quagmires, may be seen the deep furrows of the plow, and the long even drains and ditches that in sections run to the bay and appear like so many streaks of glass in the morning light." (San Francisco Monitor January 10, 1885 in Gullard and Lund 1989: 79).

Early surveys confirm the absence of a channel in many places where they cross the routes of present-day creeks, often noting a "hollow" or nothing at all. Occasionally, they even specifically comment on the absence of a creek: "42.00 Lowest point in valley, no creek." (Day 1854: 503).

For streams with a relatively wide channel area, however, a single line representation does not effectively convey the spatial extent of fluvial process and riparian habitat. For Coyote Creek, we were able to find detailed historical data showing bars, islands, and inset benches and terraces that defined a broad channel area (as wide as 500-1500 feet). These features were well documented by multiple sources (and are still visible today in places). Since precise flood return intervals could not be defined from available data sources, we classified the area generally as "Riparian," and refer to it as the riparian or channel area, with detailed descriptive information where available. Characteristics of the riparian habitat, which include Sycamore alluvial woodland, riparian scrub, and open unvegetated gravelly areas, are described in more detail in that section.

Coyote Creek General Approach

For the nearly 26-mile valley floor length of Coyote Creek, we mapped both a low flow channel and the outer banks defining the riparian/active channel area (**FIGURE II-15**). Where significant secondary channels could be identified, we mapped these along with the main channel.

The sources of historical channel information vary substantially along the valley floor length of Coyote Creek, from tidal waters to Anderson Dam. For the Lower and Mid-Coy-

FIGURE II-14. THOMPSON CREEK IN 1939 (LEFT) AND 2002 (RIGHT). Thompson Creek flows to the northwest here, immediately downstream of Aborn Road. Note expansion of riparian vegetation (AAA 1939; 2002 imagery copyright 2005 AirPhotoUSA, LLC, All Rights Reserved).

ote reaches, we were able to create nearly continuous coverage using 19th-century map sources with remarkable detail and accuracy. This was fortunate because channel modifications were extensive by the time of aerial photography. A key source for assessing the accuracy of the historical cartography, and our interpretation of it, was the field notes of the General Land Office (GLO), which describe crossing the creek in several places with explicit width measurements. Early soil survey data also confirmed historical channel area in most places, although with less detail.

In general, for the upper reaches channel modifications were more limited prior to 1939, so aerial photography often gives more direct evidence of unmodified channel banks. Nevertheless, gravel extraction and agricultural activity occupied a few substantial areas by 1939, so additional sources had to be used in concert with the aerial photography. In addition, 1850s GLO field notes reveal substantial, apparently natural, channel changes in comparison to aerial photography. We used GLO notes, soil survey data, and several detailed 19th-century maps to identify pre-1939 channel pattern and to calibrate our interpretation of the aerial imagery.

Coyote Creek Main Channel

The main active channel is the dominant low flow channel occupied by all flow events (e.g. Graf 2000, Kondolf et al. 2001). Historical maps of Coyote Creek consistently show a relatively narrow main channel with parallel banks and more widely spaced lines indicating a set of outer banks encompassing adjacent bars, inset benches and/or terraces (**FIGURE II-15**). As would be expected, the position of the main channel has been more dynamic than these channel banks; its movement can be traced over time in a number of places (see **PART IV**). Where detailed early maps were unavailable, we mapped the main channel from early aerial photography. The unvegetated, main channel is generally readily apparent as a white (if dry) or a black (if water is present) sinuous feature.

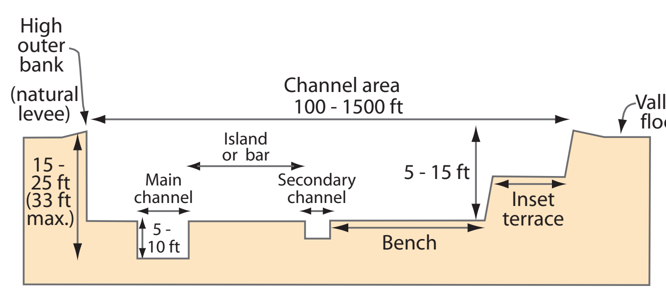


FIGURE II-15. CONCEPTUAL DIAGRAM OF TYPICAL HISTORICAL CHANNEL CROSS- SECTION FOR BROAD PORTIONS OF THE MID-COYOTE REACH. Diagram is based on an array of historical data discussed in Part IV.

Coyote Creek Benches

The deep chasm along Coyote Creek was a defining feature of the eastern side of the Valley and noted by a wide range of source materials.

Maps such as Herrmann (1905, along the entire stream length) and Thompson and West ([1876]1973, in the middle reaches) use the conventional symbology of hatch marks to indicate steep banks bounding broad inset surfaces along the active channel (**FIGURE II-16**). A number of other, independent sources indicate that these outer banks were distinct, particularly in the Mid-Coyote reach. These sources, discussed in **PART IV**, include Day (1850), Herrmann's (1874a) survey notes (referring to, for example, "top line of bank"), Foote's description of the steep banks in the vicinity of Santa Clara Avenue (1888), and the Gray (1869) birdseye view of the channel (see **FIGURE II-3**). Historical cross-sections (**FIGURE II-17**) and residual present-day topography confirm these wide, inset flood-prone areas along the creek.

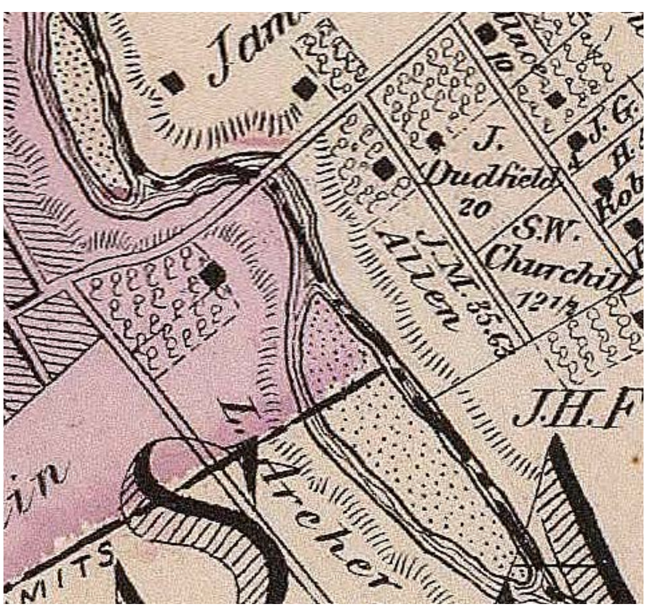


FIGURE II-16. COYOTE CREEK AT STORY ROAD, 1876. While this County Atlas depiction of channel plan form is not spatially precise, it provides strong qualitative evidence for steep, widely spaced channel banks and large unvegetated mid-channel islands (Thompson and West [1876]1973, courtesy David Rumsey, Cartography Associates).

The documentation of the broad, inset benches along Coyote Creek is both historically and spatially consistent, suggesting that it was a natural condition. Despite extensive descriptions of the creek in land case testimonies, and descriptions of it as the San Jose boundary, as well as notations by GLO surveys, we have found no mention of the extremely dramatic changes on the creek that would have had to occur in the first half of the 19th century if the observed channel form was the result of rapid changes in response to Spanish or early American land use.

Additionally, the outer banks have subsequently been quite stable, which would be unlikely to be consistent with rapid downcutting. For example, multiple independent maps closely agree about the outer boundaries of Coyote Creek for the two mile reach between Berryessa Road and Reed St. during 1850 and 1904 (**FIGURE II-18**), indicating both that these banks were a distinct feature in the field and that it was relatively stable over this half-century period.

There is evidence that the wide benches mapped along Coyote Creek were not surfaces completely abandoned by recent geological downcutting. Early historical evidence shows that this fairly incised condition precedes the era of general gully erosion in the western United States, 1880-1920, described by Leopold (1994).

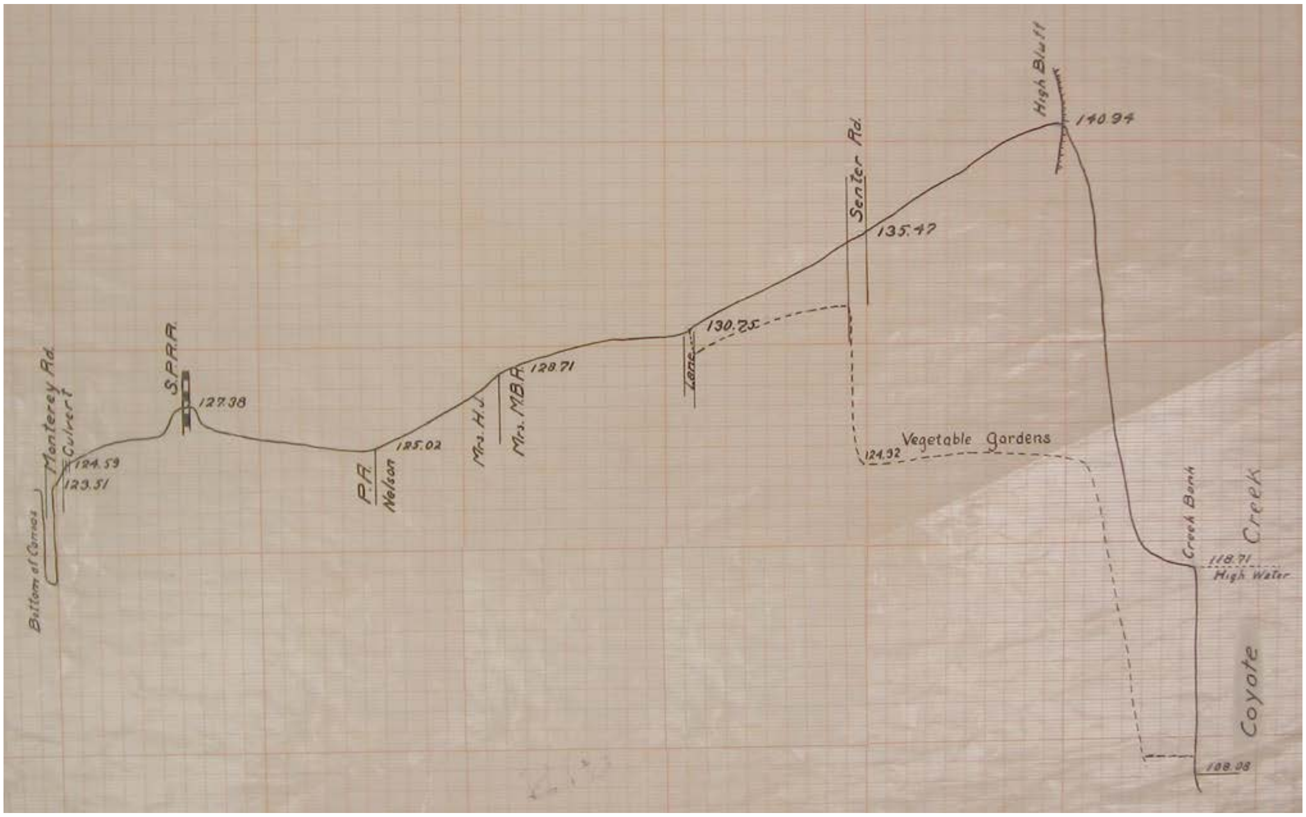


FIGURE II-17. "PROFILE [OF] PHELAN AVENUE FROM MONTEREY RD. TO COYOTE CREEK. MARCH 29, 1907." This county survey illustrates the natural levee along Coyote Creek ("High Bluff") and an inset bench with "Vegetable Gardens." The creek curves abruptly here, so the surveyor depicted two, adjacent sections of the stream bank (Hermann (?) 1907, courtesy Santa Clara County Surveyors Office).

A number of sources indicate fairly frequent overflow onto the benches. Aerial photography shows channel scour patterns and riparian trees. Several sources specify "gravel bars" or "gravel beds," indicating active depositional process (e.g. Herrmann 1874b,c). A number of maps, including Thompson and West ([1876]1973) and McMillan (1902), employ a stiple pattern to show the broad areas along the creek, a symbol conventionally indicating an unvegetated surface composed of sand or gravel (see **FIGURE II-16**). We expect that most of these areas received flow on a decadal time scale if not more frequently. Some of the lower benches were likely the active floodplain, while higher inset terraces were above the floodplain. These elevational differences might be distinguished and mapped through further fieldwork.

The outer channel area boundary, as indicated by early maps is also well-corroborated by the soil survey of 1940-41 downstream of the Narrows (Gardner et al. 1958). Almost all of these broad channel areas revealed by historical maps occupy the soil classification "Mocho soils, undifferentiated, one to three percent slopes," albeit at a coarser scale. The soil description, like other historical sources, puts these areas between five and 10 feet above the main channel, which we would expect to be within the range of occasional flooding:

> "The soils occupy small, recently formed "benches" that are generally five to ten feet higher than the channel of Coyote Creek and five to ten feet lower than adjacent soils of the Sorrento series. The "benches" are the result of cutting and filling by the creek and are subject to overflow during exceptional floods" (Gardner et al. 1958: 99).

This survey and associated land use follow a decade of drought, so these areas may well have appeared less prone to flooding than normal.

The less intensive agricultural development of these areas (open space, gardens, younger or less vigorous orchards in early aerial photography) — when adjacent land was already intensively farmed — suggests significant practical limitation to their use, presumably soil characteristics and/or flood potential. Most of these surfaces are still preserved below adjacent valley surfaces today and prone to flooding.

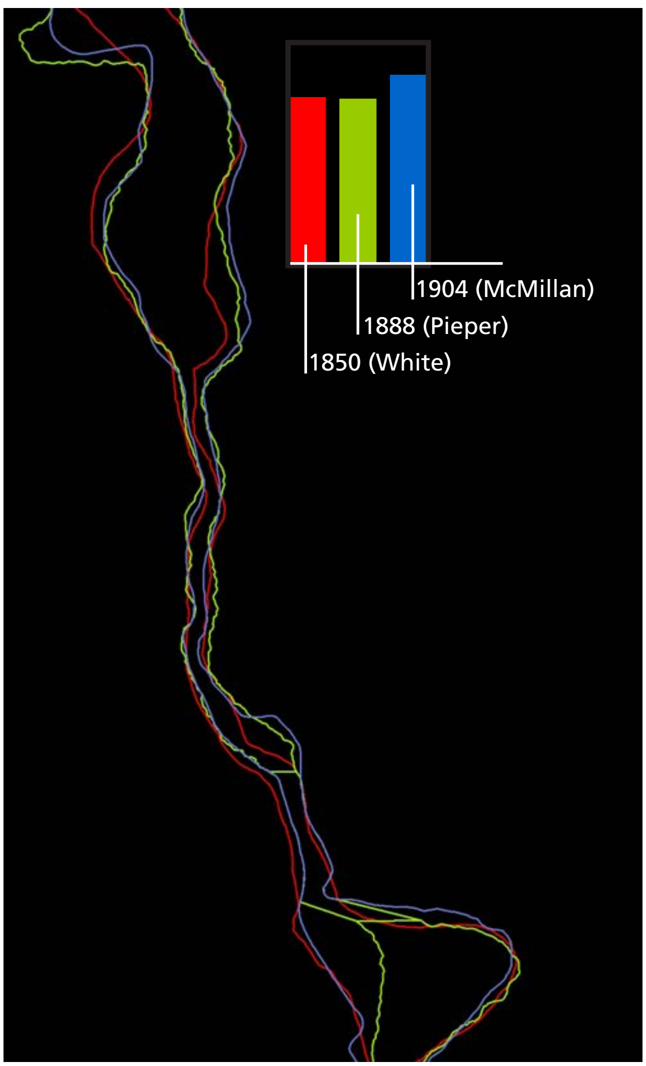


FIGURE II-18. INDEPENDENT MAPS OF COYOTE CREEK, 1850-1904. Each map has been geo-referenced and the outer boundary shown for this reach of Coyote Creek (Mabury Rd. to William St.) digitized. The amount of the area mapped as channel by each surveyor is within 10% (bars at upper right). The close correspondence (and lack of directional change where different) suggests both channel stability and competent surveyors.

Upstream of approximately Tully Road, the creek exhibited a strong braided channel pattern, with multiple diffuse channels, wide reflective scoured areas, and sparse riparian vegetation. Broad areas with adjacent benches were still interspersed with relatively narrow reaches, presumably the result of previous geologic/climatic events. Not coincidentally, the braided reaches became sites for gravel quarrying and managed stream percolation.

RIPARIAN HABITAT

Riparian vegetation consists of trees or shrubs associated with rivers, streams, lakes or artificial water bodies (SFEI 2005). For the purposes of historical analysis, we focused on identifying patterns of streamside vegetation that could be consistently revealed by historical documents. Willow groves can be considered a riparian habitat type but are not directly associated with surface waters; we mapped them separately and describe them in a separate section.

The natural diversity of riparian habitat along Santa Clara Valley streams reflected the variety in channel morphology and hydrology. Some fluvial channels supported dense, but narrow, corridors of riparian forest, creating classically shaded woody stream settings. Other stream reaches had few or no trees, even on the valley floor (see **FIGURE II-14**). Where channels were wide and gravelly, especially on Coyote Creek, a broad, open riparian woodland with scattered large sycamore trees and riparian scrub dominated. We identified these different kinds of habitats based on a variety of sources.

Because of its narrow shape, especially along smaller streams, riparian habitat can be challenging to map. Riparian features are also not always as precisely recorded by historical maps as creeks and other types of wetlands. For these practical reasons, we qualitatively assessed riparian habitats for all valley floor streams, but limited GIS mapping to the well-documented riparian habitat along Coyote Creek.

Riparian habitat on distributary creeks

Nearly all creeks that flowed from the hills onto the valley floor appear to have supported at least occasional riparian trees in their canyon reaches. The distance that riparian canopy continued downstream from the canyon mouth was highly variable, however. Riparian trees typically stopped some distance before the point at which channel definition was lost and the stream sank into its alluvial fan, often leaving 1000-3000 feet of channel completely without tree cover.

Streams that initiated from groundwater sources on the valley floor, with relatively small watersheds (i.e. not including Lower Penitencia Creek), show little or no evidence of riparian trees. These are often referred to *"sanjon"* in Mexican and early American documents, which literally translates as "ditch," likely reflecting the lack of normal streamside trees. However, streams without dense riparian tree cover undoubtedly maintained distinctive channel-side flora and associated ecological values, albeit not including shaded pool habitat.

The primary source of information about the riparian vegetation on smaller creeks is early aerial photography, which reflects substantial landscape modification. It is likely that riparian vegetation had been significantly altered on some streams by this time. However, the downstream extent of riparian trees is generally similar on adjacent streams of similar size, across multiple properties and land uses, (**FIGURE II-20**), suggesting that the overall pattern has not been modified. On many of the distributary creeks, riparian trees, where present, are widely spaced rather than continuous. This pattern would not result from widespread clearing, but could possibly be the result of gradual riparian tree loss due to grazing and agriculture (and has often filled in during recent decades, see **PART IV**). Riparian canopy width, where continuous, is generally one tree wide, roughly 40-80 feet across.

Riparian habitat on Coyote Creek

Historical evidence and comparison to modern field conditions revealed several distinct forms of natural riparian habitat along Coyote Creek, associated with hydrogeomorphic variation. Prior to modern modifications, Coyote Creek displayed an alternating pattern of broad and narrow channel morphology along its length. Reaches with broad inset benches or terraces, often 500-1000 feet wide, were separated by narrower reaches several thousand feet in length. Superimposed upon this morphology were limited perennial influences at either end of the Valley, for a couple miles downstream from the canyon mouth and upstream from the tidal interface.

Narrow stream reaches consistently supported a continuous band of narrow, dense riparian forest. Linear strands

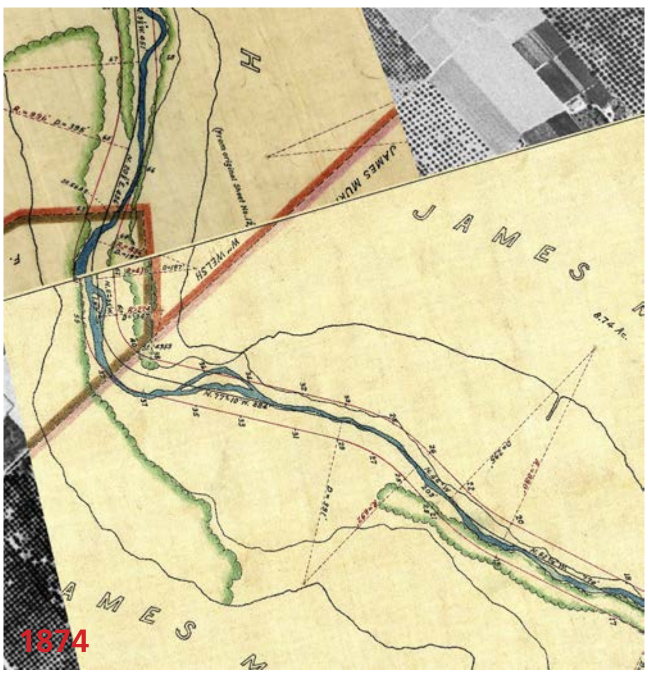


FIGURE II-19. COYOTE CREEK AT HIGHWAY 880: 1874 (LOWER LEFT), 1939 (UPPER LEFT), AND 2002 (RIGHT). Change in this reaches been extensive. In 1874, Hermann's Coyote River Survey documented a narrow main channel with some linear riparian habitat and broad adjacent benches partly occupied by willow thickets (his field notes indicate the tree species). By 1939, much of the former active channel area is occupied by agriculture, although the location of the willows and parts of the adjacent bars or benches can still be identified. The 1972 flood control project removed the channel's sharp turn; the banks have since been colonized by riparian vegetation (AAA 1939; 2002 imagery copyright 2005 AirPhotoUSA, LLC, All Rights Reserved; Herrmann 1874c).

of riparian forest were also found occasionally along one of the outer banks of the braided channel areas. There is some indication that riparian forest also followed the main channel in the broad, entrenched reaches downstream of Tully Road to approximately Trimble Road, but this is less certain (**FIGURE II-19**).

The wide benches and gravel bars along the creek were mostly dominated by a more open riparian pattern. The most common trees of these broad gravelly channels were large, well-spaced California sycamores (*Platanus racemosa*), suggesting that many reaches would be classified today as Sycamore Alluvial Woodland (Holland 1986) California Sycamore series, or Central California Sycamore Alluvial Woodland (Sawyer and Keeler-Wolf 1996). California's Sycamore Alluvial Woodland is recognized as "Very Threatened" by The Nature Conservancy's Heritage Program (Sawyer and Keeler-Wolf 1996).

There were also large, frequently flooded areas with few or no trees, scattered riparian scrub, and unvegetated gravel bars (characteristics of Central Coast Riparian Scrub, Holland 1986; Mulefat series, Sawyer and Keeler-Wolf 1996). Some elevated, less frequently flooded benches/terraces appear to have been mostly grass covered (**FIGURE II-21**). These patterns were well evi-

FIGURE II-20. **QUIMBY CREEK AT THE BASE OF THE FOOTHILLS IN 1939 (LEFT) AND 2002 (RIGHT).** Downstream extent of visible riparian vegetation in 1939 is similar on Quimby Creek (image lower right), the unnamed creek to the north, and other nearby systems. By 2002, the creek to the north is no longer aboveground and riparian vegetation has expanded on the remaining portion of Quimby Creek. Chaboya Road runs through the middle of both images (AAA 1939; 2002 imagery copyright 2005 AirPhotoUSA, LLC, All Rights Reserved).

denced in many places along the creek less than 75 years ago in aerial photography and written description. For example, Gardner et al. (1958: 99) described vegetation of the "benches" along Coyote Creek in 1940-41: "Where not cultivated, the soils support a growth of grass and brush."

At the upstream end of the Valley, the channel was more densely wooded. Palou (1926) describes this mixed riparian forest in 1774 as "thickly grown with cottonwoods, sycamores, and willows." There appears to be a general upstream increase in riparian tree cover (but still not a closed canopy), as visible in the early aerials, from approximately the present-day Ogier Ponds area to the site of Anderson Dam. This makes sense given historical documentation of perennial water extending a few miles downstream of the canyon mouth and corresponds with the shift from California sycamore to coast live oak-dominated woodland present currently in the vicinity of the Highway 101 crossing (Sawyer and Keeler-Wolf 1996).

At the downstream end, presumably where near-surface groundwater was intercepted, the broad channel area had large willow thickets on bars. Downstream of approximately Trimble Road, both Penitencia Creek and Coyote Creek had thick riparian forest along a narrow single thread channel. Hermann's Coyote River surveys (1873 field notes) document mostly willow trees along Lower Coyote Creek.

As described in the Streams section, we mapped a "riparian" area occupied by the bars, islands, and occasionally flooded benches or terraces along Coyote Creek. This area falls within clearly defined outer channel banks and includes the riparian patterns described above. In addition, we noted the presence of linear segments of continuous Riparian Forest as a qualitative assessment.

FIGURE II-21. **CATTLE GRAZING** on stream bench along Coyote Creek (Gardner et al. 1958).

Evidence for Sycamore Alluvial Woodland and Open Riparian Character

Given that most of Coyote Creek currently exhibits a dense, closed canopy riparian forest, the identification of historically open woodland and savanna conditions is nontrivial. Evidence for the prior condition, however, is robust and diverse. Notably, while extensive illustration of open riparian habitats is available from the early aerial photomosaic, substantial corroborating data also come from both earlier eras and present-day remnants. In fact, the reach between Ogier Ponds and Highway 101 has been recognized as one of 17 significant existing occurrences of Central California Sycamore Alluvial Woodland in the state (Sawyer and Keeler-Wolf 1996).

Sycamore alluvial woodland and related riparian scrub habitats are typical of highly episodic, intermittent gravel-dominated Central California stream beds. Within the Santa Clara Valley, a similar pattern (broad braided channel reaches supporting sycamore alluvial woodland alternating with narrow, naturally confined reaches of dense, linear riparian forest) was described on lower Guadalupe Creek (Jones and Stokes 2001: 33-40) which, despite smaller size, had similar morphology to Coyote Creek. Jepson, in his classic description of California trees (1910: 247), closely ties the sycamore to "[I]ts favorite habitat in the beds or on benches of flood streams." He adds:

> "[T]he Sycamore reaches its greatest development as a tenant of river beds in the low valleys of 10 to 800 feet altitude, so that the stream-bed habitat and the very irregular crown with divided, leaning, or trailing trunks are associated characteristics."

A range of 19th-century historical sources indicate that California sycamore was the predominant tree along the broad areas of historical Coyote Creek. For example, several mid-19th-century General Land Office surveys follow the creek south of Tully Road, consistently reporting sycamores. The trees occur in recognizable groups or groves of well spaced trees. Live oaks are mentioned occasionally and appear to be associated with the linear stretches of riparian forest. None of these surveys mention cottonwoods, which appear to be the dominant tree today.

Day (1854: 524-525) described this pattern as he summarized timber resources for a one square mile section, characterizing Coyote from Tennant Road downstream to approximately the Highway 101 crossing: "splendid groves of oak and sycamores along the Coyote which flows from ¼ to ¾ mile E. of the line."

Following Coyote Creek — the western boundary of Rancho Yerba Buena — on consecutive GLO surveys, Wallace (1858: 429) and Tracy & Healy (1860-1863: 432) both recorded "[T]hree large sycamores in middle of creek," and Healy also notes a six-foot diameter sycamore bearing tree (a witness tree that was "notched" or "blazed" by the surveyor to facilitate relocation of the survey). These observations can be mapped precisely to the areas alongside present-day Cottonwood Lake, just downstream of the Highway 101 crossing, which show scattered trees in a wide, scoured, mostly unvegetated channel in 1939 (see **FIGURE III-20**). Along the long Yerba Buena border, following the creek from Tully Road to Coyote Narrows, the only other trees recorded are another sycamore and two live oaks. Of the oaks, one is located at The

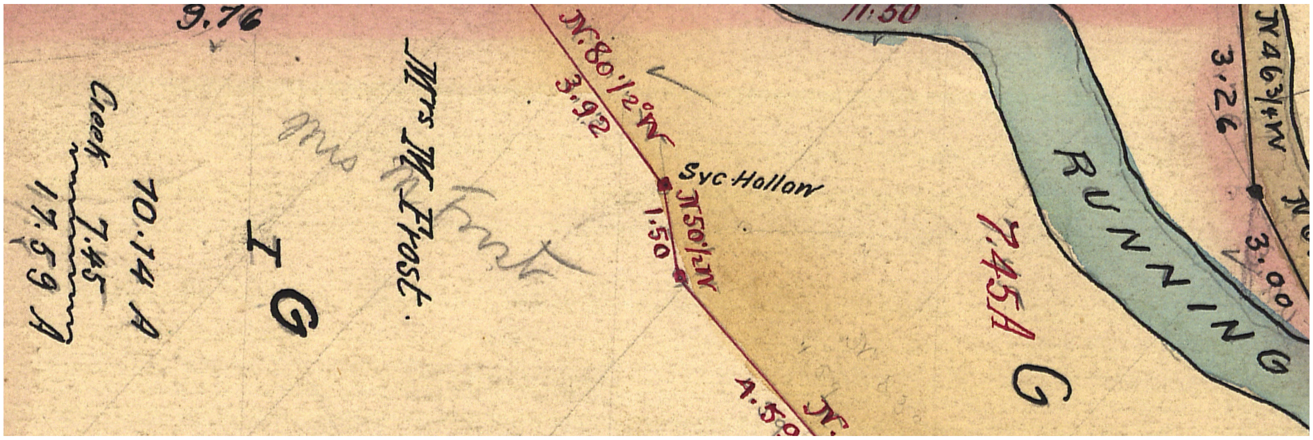


FIGURE II-22. **SYCAMORE BEARING TREE ON A HERRMANN SURVEY** ("Syc Hollow"; Herrmann 1874a, courtesy Santa Clara County Surveyors Office).

Narrows, and the other at the present-day Silver Creek Valley Road crossing (corresponding with a short segment of dense west-bank riparian forest identifiable in early aerial photography).

Similarly, the six bearing trees used by Howe (1851: 89-90) in the Coyote channel (at two sites about 1000 feet apart) in the present-day Ogier Ponds area include five sycamore trees (18 to 30 inches in diameter) and one white oak (valley oak). The sycamores range 36 to 105 feet from the quarter section posts. He recognizes the open spacing, referring to this area as having "some little scattering timber."

A subdivision map by County Surveyor Herrmann (January 26, 1874, Herrmann 1874a.) shows the reach just downstream of Malech (which was highly modified prior to 1939) as a gravel bed. Three sycamore trees are used to survey the boundary between gravel bed and "good soil" (**FIGURE II-22**).

An additional source provides cryptic information in support of sycamore trees along Coyote Creek from approximately the present-day Upper Penitencia Creek confluence to Anderson Dam (U.S. District Court [184-?]b). This *diseño,* created to define lands of the Pueblo of San Jose, quite accurately depicts a variety of other landscape features, such as the location of *sausals*, the discontinuous channels of Penitencia and Berryessa Creeks, and Valley topography. The map annotates Coyote Creek with the letter "A" at four widely spaced intervals.

The interpretation of this clue is complicated, as the map legend is poorly executed. Part of the legend reads "M = *Montey*," an obvious misspelling of "*monte*," which means thicket. The legend entry for the letter "A" is "*Misal*," which has no known translation. However, existing *diseños* in California are generally copies of the originals (Askevold 2005) and given the similarity of the letters "Al" and "M" in the map's calligraphy, the annotation likely refers to "*alisal*," or sycamore grove (Brown, personal communication, September 2005). (*Aliso* literally means alder, but in Spanish California referred to sycamores (Gudde 1998: 8, SFEI unpublished data)). Thus, this map provides additional confirmation of sycamore woodland along most of the stream's length from the canyon mouth into downtown San Jose.

Early aerial photography provides the most extensive illustration of open riparian habitat. Most of the broad reaches on Coyote Creek upstream of Hellyer Road not directly impacted by land use show scattered, widely-spaced large trees in the circa 1939 aerial photomosaic. Field visits to several of the sites with residual large trees (as identified by comparative aerial photo overlays) show that they are primarily California sycamore (**FIGURE II-23**).

Additional Evidence for Riparian Scrub

While sycamore groves were the most prominent vegetation in broad channel reaches, there were also large areas of mostly unvegetated gravel bars with scattered shrubs that likely received more frequent flooding.

These conditions are often indicated by the descriptors "gravel bar" or "gravel bed" (e.g. Herrmann 1874b,c), showing recent sediment transport/deposition, and are generally noted by Gardner et al. (1958) as "a growth of grass and brush" on the Coyote Creek "benches." Amateur naturalist Mary Carroll (1903) notes the presence of *Mentzelia laevicaulis* in "sandy beds of the dry creeks" generally within Santa Clara Valley.

A field study on Coyote Creek during 1929-1936 gives more detail about the riparian scrub community occupying gravel beds in between, and as understory to, sycamore groves. Pickwell and Smith (1938) carefully documented the vegetation of the "gravel beds" just downstream of Coyote Narrows, emphasizing the presence of mulefat *(Baccharis salicifolia)* along with a variety of other shrubs and herbs characteristic of seasonally dry gravel stream beds (**TABLE II-2**). In their accompanying map they also indicate sycamore trees.

FIGURE II-23. SYCAMORE on occasionally flooded terrace of Coyote Creek, near Coyote Creek Golf Club.

Consideration of early impacts

It should be considered whether or not the sparse riparian tree cover consistently observed along the broad channel reaches of Coyote Creek in early aerial photography could be the result of prior land use impacts. Local historians have noted the extent of woodcutting during the Spanish, Mexican, and early American eras, and some have emphasized the effect on riparian habitat. However, some of these interpretations are based upon the assumption of a densely wooded valley floor and generalization of specific impacts.

For example, when the settler Bernard Reid noted, in Santa Clara in 1851 (Friedly 2000: 312), that "wood for fuel already had to be hauled from 3 miles away, indicating a dearth of lumber within that radius," he was describing an area largely surrounded by clay-rich bottomlands that precluded most trees. The complaint was about natural condition rather than deforestation. Similarly, Schick (1994: 24-25) suggests that the Santa Clara Mission deforested extensive riparian forests to make space for agriculture. That nearby riparian forests were not clear-cut is confirmed by the presence of riparian tree corridors in early mapping of, for example, lower Coyote Creek, Guadalupe River, and Penitencia Creek (e.g. Day 1852, Herrmann 1873, Westdahl 1897b; **FIGURE II-19**).

SCIENTIFIC NAME (NATIVE SPECIES IN BOLD)	COMMON NAME
ABUNDANT PLANTS	
Baccharis viminea ***[B. salicifolia]***	Mulefat
Chrysopsis oregano ***[Heterotheca oregona]***	Goldenaster
Senecio douglasii ***[S. flaccidus var. douglasii]***	Douglas' Groundsel, Shrubby Butterweed,
Mentzelia laevicaulis	Blazing Star, Smooth-stem Blazing Star
Brickellia californica	California Brickellbush
Brassica adpressa	Mediterranean Mustard
SCATTERED PLANTS	
Lepidospartum squamatum	Scale-Broom, California Broomshrub
Heliotropium curassavicum	Heliotrope, Seaside Heliotrope
Verbascum thapsus	Woody Mullein
Xanthium canadense ***[Xanthium strumarium]***	Cocklebur
Amaranthus blitoides	Mat Amaranth, Prostrate Pigweed
Chenopodium botrys	Jerusalem Oak Goosefoot
Centaurea melitensis	Tocalote, Napa Star Thistle
Artemisia vulgaris var. heterophylla	Mugwort
Eremocarpus setigerus	Turkey Mullein, Dove Weed
Antirrhinum glandulosum ***[A. multiflorum]***	Sticky Snapdragon, Chaparral Snapdragon
Antirrhinum vagans	
Salix melanopsis	Dusky Willow
Salix laevigata	Red Willow

TABLE II-2. "FLORA OF GRAVELLY FLOOD BEDS." Plant list for a half-mile reach of Coyote Creek immediately downstream from Coyote Narrows based upon field studies 1929-1936. From Pickwell and Smith 1938.

These historical interpretations did not have the benefit of historical cartographic and photographic evidence, and a spatial compilation, and therefore appear to be somewhat overstated. Dramatic, explicit descriptions of deforestation appear limited to the Santa Cruz Mountain redwood groves and *sausals* (e.g. Foote 1888: 21). There is also no evidence that most natural local riparian corridors (excepting Coyote Creek) were ever broader than the narrow "ribbons" typically shown by maps and reported by written descriptions.

Part of the reason that riparian forest substantially persisted, while the redwood groves were rapidly clear-cut, is that local riparian trees were fortuitously useless for most purposes other than firewood. For example, in a thorough description of County resources, County Surveyor Healy (1857) describes the trees of the Valley — the "white oak" (valley oak), "Evergreen, or Live oak," sycamore, "cotton-wood," and willow — and reports that "None of these trees furnish timber of a good quality; all that is used in the manufacture of wagons, plows, etc., is necessarily brought from abroad." Grossinger et al. (2004: 38) found similar limitations to the extractive use of riparian trees, including for fuel, in the Napa Valley.

Also, despite many evident examples, we should not assume complete exploitation of all possible resources at all times, particularly where they were managed for personal use. Alfred Doten's 1861 journal entry "Cut the lower limbs of the big live oak over the hen house, for firewood," cited by Friedly as evidence for widespread clearing, seems actually quite restrained (Doten 1973: 606, Friedly 2000: 312). Jepson, describing the Fremont cottonwood (1910: 185), states that "Mexicans never cut down the tree but pollard it by cutting off the main branches and thus insure a continuous crop."

With regard to Coyote Creek riparian habitat, then, it is unlikely that extensive modification would have taken place prior to the GLO surveys of the 1850s and 1860s. This is particularly true given that most of the valley floor length of Coyote Creek was some distance from the center of Spanish and early American activity. Most important, mid-19th-century descriptions closely corroborate riparian patterns visible in early aerial photography. It is still possible that these patterns exhibit some more minor effects of woodcutting, grazing, and other earlier impacts, such as reduced tree density and understory vegetation.

Fortunately, the 1939 aerial photography closely follows the construction of Coyote Dam (1936) and precedes Anderson Dam, so it provides a good illustration of conditions prior to flow regulation. Except for localized areas of direct impact from gravel quarrying, Coyote Creek riparian characteristics south of San Jose (roughly Tully Road) circa 1939 appear to well-represent patterns of the prior century.

In summary, numerous sources of evidence from throughout the historical record confirm an open riparian habitat along the broad, intermittent reaches characterizing much of Coyote Creek. The prominent writer Bayard Taylor, who visited Santa Clara Valley in the 1850s, succinctly summarized habitat and hydrology on Coyote Creek, capturing the grandeur of distinct,

FIGURE II-24. EARLY AERIAL PHOTOGRAPHIC EVIDENCE FOR VALLEY OAK SAVANNA. Several large trees scattered within the orchard at upper left in the 1939 image (left image) are probably valley oaks. Additionally, the circular disease patterns visible at center right indicate the probable location of valley oaks recently removed for orchard planting, whose roots have caused oak root rot. There are no obvious residual trees in 2002 (right image) (AAA 1939; 2002 imagery copyright 2005 AirPhotoUSA, LLC, All Rights Reserved).

non-continuous sycamores on a seasonally dry stream:

> "[t]he dry bed of a winter stream, whose course is marked with groups of giant sycamores, their trunks gleaming like silver through masses of glossy foliage" (Carroll 1903: 185).

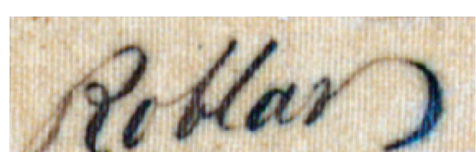
VALLEY OAK SAVANNA

Perhaps the signature habitat of the Santa Clara Valley, valley oak savanna (*Quercus lobata*) dominated the alluvial fans. Valley oak lands were naturally scarce in the Bay Area, limited to a few fertile valleys including Santa Clara (Grossinger unpublished data, Holstein 1999). Within Santa Clara Valley, varying patterns of density and oak species composition were found, but stands of widely spaced valley oaks, often of remarkable size and age, characterized the fans along the Coyote. The valley oak savanna was among the most well described and celebrated components of the Santa Clara Valley landscape, from Font's 1776 description of "a very beautiful plain full of oaks" to Vancouver's famous description. Before the proliferation of property lines and roads, the *roblars*, "white oak groves," were an important landmark, noted in historical accounts and land case testimony.

Some authors have suggested that the valley oak savanna described by many accounts was itself remnant of much more dense woodland, reduced by Spanish and early American logging (e.g. Friedly 2000: 312-318). Schick (1994: 24-25), for example, states that "the Spanish deforested any oaks that were in the way." Yet very early accounts repeatedly describe the Valley as "scattered" or "studded" (Santa Clara Mission report for 1782 *in* LoCoco n.d.) with trees in a park-like setting. Healy (1857) describes the "[O]ak openings, which are not close enough together to prevent the growth of grass and have the appearance from a distance of vast orchards." Intensive logging appears reserved to the Santa Clara Mountain redwoods, which had much higher value for lumber than valley oaks.

This is not to say that most of the oaks were not cut down over time, but that the decline was gradual and heterogeneous, varying by property and land use (as can be seen by examining remnant patterns in the 1939 aerial photography). In those parts of the Bay Area naturally endowed with valley oak savanna, there tended to be some recognition of their cultural value. For example,

FIGURE II-25. DEPICTIONS OF VALLEY OAK SAVANNA using a tree stamp and text (lower right) (Healy, U.S. Dist. Court 1859, courtesy The Bancroft Library, UC Berkeley).



Thompson, in the General Remarks for a Napa GLO survey (1857a), notes that "the scattered oak trees and groves afford tasteful sites for residences." Chaparral and scrub oak seemed to have been the preferred firewood sources.

At this time, we have created only a preliminary sketch of the distribution of oak savanna for illustration. This picture should not be used for technical or planning purposes. This initial view is based upon, in particular, over 1000 "probable valley oak trees" mapped from the early aerial photomosaic (**FIGURE II-24**). These data were supplemented with mid-19th-century Mexican *diseños* and General Land Office surveys. A number of other important sources have not yet been used and compilation is still at a coarse scale. Fuller compilation and analysis will allow an accurate assessment of historical distribution and abundance as well as spatial characteristics such as patch size, spacing, and density.

FIGURE II-26. "THE VALLEY WAS COVERED WITH BIG OAKS." Image from the San Jose Mercury's centennial yearbook (Shortridge 1896, courtesy History San José).

From this preliminary analysis, however, it is clear that valley oak savanna, currently a recognized rare and "Very Threatened" oak habitat (Sawyer and Keeler-Wolf 1996), covered substantial portions of the valley floor, and that while habitat reduction has been dramatic, a surprising number of trees from this original habitat still remain. While willow groves and redwood groves were rapidly clear-cut in the mid-19th century, the decline of valley oak savanna has been more gradual. As a result, preservation and restoration of historic valley oak habitat within the Santa Clara Valley has potential.

On Spanish maps, *roblar* is represented by various methods: numerous, individually drawn trees, the use of an oak tree "stamp," the word itself sometimes with additional spatial information (e.g. "*punto del roblar*", point of the oak grove), or, simply, the letter "R" (**FIGURE II-25**).

Of all the Valley's habitats, oak savanna, particularly the grand valley oaks, received the most appreciation by American immigrants. Parallel to their widespread destruction, smaller numbers were also revered and preserved, reproduced in postcards and lithographs, eloquently eulogized (**FIGURE II-26**). More so than most habitats, they could be selectively integrated into the new landscapes of American towns and farms. Ac-

FIGURE II-27. BLOSSOM HILL ROAD IN 1939 (LEFT) AND 2002 (RIGHT). Aerial photographic overlay allows the identification of at least one persisting, heritage oak tree, shown in **FIGURE II-28** (AAA 1939; 2002 imagery copyright 2005 AirPhotoUSA, LLC, All Rights Reserved).

cordingly, a surprising number of trees have persisted in yards and along roads, preserving portions of the *roblars* that intersected fortuitously with the rectilinear division and development of the alluvial fans (**FIGURES II-27** and **II-28**).

SYCAMORE GROVE

In the Coyote watershed, most evidence of sycamore trees was associated with the riparian habitats along Coyote Creek. However, we identified a single, large sycamore grove outside of the Coyote channel area — on the valley plain adjacent to the creek near the present-day Oakland Road and Highway 101 crossings. Characteristics are described in the Mid-Coyote section.

DRY GRASSLAND

The dry grasslands have many similar species to the wet meadows, but they occupy well-drained alluvial fans and consequently have less of a wetland component. Within the region, the well-drained grasslands were composed primarily of rhizomatous grasses and perennial bunch grasses (Holstein 1999). Frequent low intensity fires set by Native Californians probably had a strong influence on the maintenance of dry grasslands as an open, herbaceous habitat. In the absence of Indian burning, large areas would likely have converted to brushland or woodland (Stewart 2002). Dry grassland also comprised the understory of valley oak savanna.

FIGURE II-28. RESIDUAL VALLEY OAK AMONG PALMS, BLOSSOM HILL DRIVE. This grand tree has been preserved as a landscape centerpiece.