February 2013

Walnut Creek

WATERSHED INVENTORY

Prepared for the Walnut Creek Watershed Council

by Restoration Design Group

Cover photo: Shell Ridge above Ginder Gap overlooking Willow Spring Pond (David Ogden)

Walnut Creek Watershed Council

Government *Agency Members:*

City of Lafayette

City of Pleasant Hill

City of San Ramon

City of Walnut Creek

Contra Costa County

Contra Costa Resource Conservation District

East Bay Regional Park District

Town of Moraga

Non-profit *Agency Members:*

Friends of the Creeks

Greenbelt Alliance

Mount Diablo Audubon

Muir Heritage Land Trust

Save Mount Diablo

Walnut Creek Open Space Foundation

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February 2013

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The Contra Costa County Flood Control and Water Conservation District

Contra Costa County Fish and Wildlife Committee

Table of Contents

1 Introduction

"[Walnut Creek] came by its present-day name in recognition of it being the habitat, and the only one in the West, of the black walnut, which flourishes in all its glory along the banks of the waterway which meander through the town, and is fed by a thousand rills and brooks that reach torrential heights during the rainy season."

-Frederick J. Hulanski
The History of Contra Costa County (1917)

Lesley Hunt of Friends of the Creeks compares knowledge of the Walnut Creek Watershed to the Buddhist parable "Hands on the Elephant." Four blind men argue over the nature of an elephant. One, feeling the legs, insists that it is the trunk of a great tree. Another, examining the back, believes it to be a small hill. A third, in contact with the tail, states that it is a duster for cleaning. The last, holding the trunk, resolves that it is a snake. Without the vision to see the whole creature, each reaches his own conclusion.

The Walnut Creek Watershed is sufficiently complex that it is difficult to understand as a whole. Different needs in the watershed require different skill sets, knowledge bases, and institutions. The Walnut Creek Watershed Council is prudent to not only examine the component parts but to try to envision the entire elephant.

At least part of the elephant looks something like this: much of the higher elevations of the Walnut Creek Watershed remains open space but within the watershed are thriving, productive cities. Four cities are partially or completely within the upper watershed: Orinda, Moraga, Danville, and San Ramon. Four cities - Lafayette, Walnut Creek, Pleasant Hill, and Concord - occupy the core of the watershed. Part of the lower watershed is within the City of Martinez.

In response to the very immediate and frequent problem of flooding in the mid-20th Century, engineers designed an efficient and economical system to convey water through these cities and out to the Suisun Bay. While this system has mostly abated flooding, it has also contributed to the loss of habitat and decrease in water quality in the watershed. Shifting cultural values, an evolving legal system, a warming climate, and an aging infra-

structure that is about halfway through its intended service life and may need to be replaced in 30 to 50 years all require a change in how the watershed is managed. Yet each proposed solution immediately encounters funding constraints, private property rights, competing resource demands, endangered species protections, and myriad other complications. The Contra Costa County Flood Control and Water Conservation District Board of Supervisors recognized this challenge when it adopted its "50 Year Plan – From Channels to Creeks" (CCCFCD, 2009).

The Walnut Creek Watershed Council now has the opportunity to convene people, agencies, and organizations to focus on a single problem: *What should the Walnut Creek Watershed of the future look like?* By bringing many hands together and facilitating a dialogue, the Watershed Council can better understand the elephant and how to manage it.

This report represents an early effort to describe the watershed and create a shared understanding of it. The intent of the inventory is to provide the Watershed Council and other interested parties with a brief overview of the status of the Walnut Creek Watershed and its management opportunities and constraints. The inventory is based on interviews of experts identified by the Watershed Council and a review of select materials. The report was intended to be completed quickly and efficiently so as to not delay the nascent Watershed Council in establishing its preliminary goals and objectives. As such, it serves as a broad overview rather than a detailed, thorough accounting of the watershed.

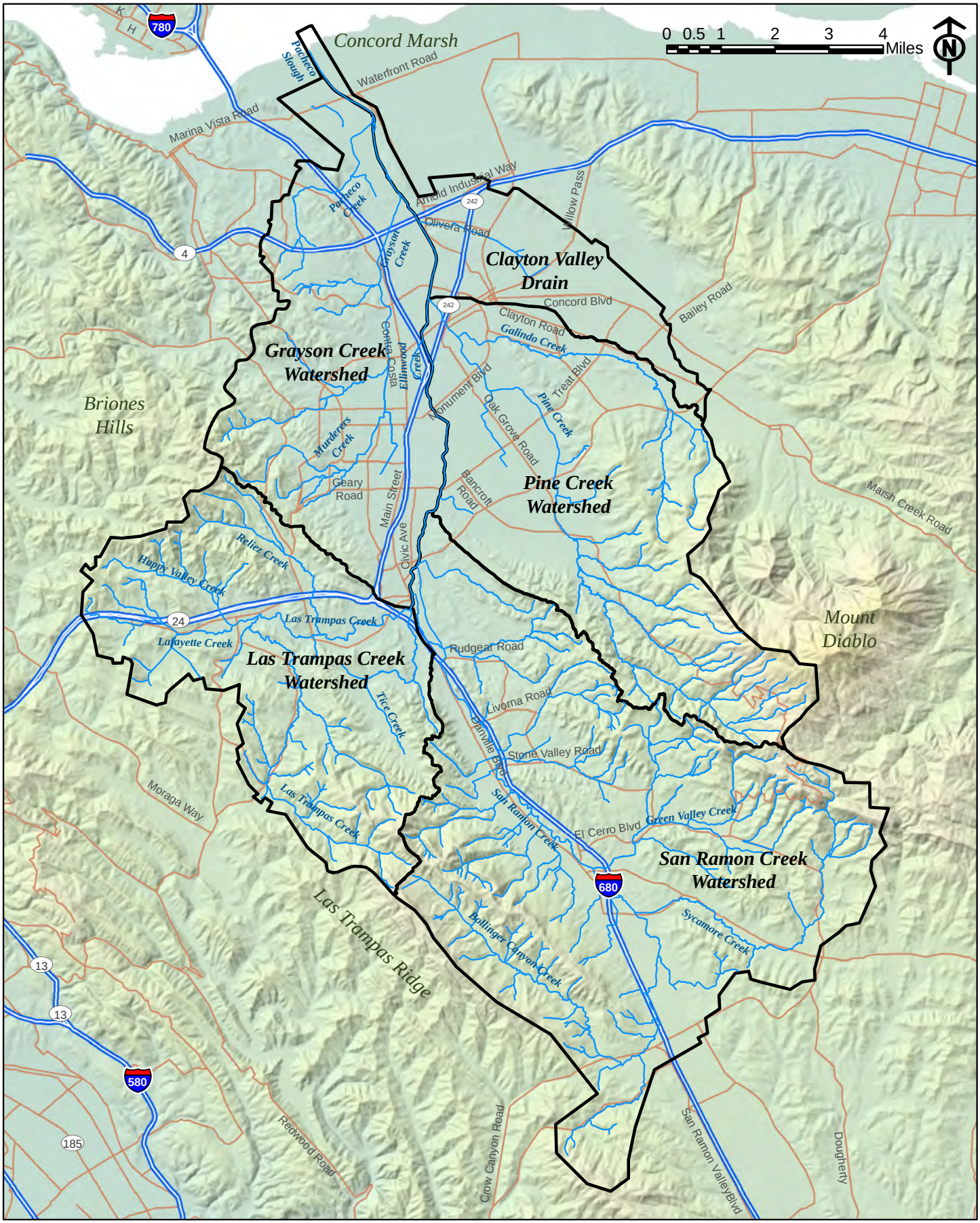
Watershed experts interviewed for this inventory include:

- Pete Alexander, Fisheries Biologist, East Bay Regional Park District
- Jamie Burman, Local Angler
- Tom Dalziel, Program Manager, Contra Costa County Clean Water Program
- Paul Detjens, Senior Civil Engineer, Contra Costa County Flood Control and Water Conservation District
- John Ginochio, Local Rancher
- Matt Graul, Water Resources Manager, East Bay Regional Park District
- Jim Hale, Wildlife Biologist, Naturalist, and Ethnobotanist
- Tony Medina, Assistant Field Operations Manager, Contra Costa County Flood Control and Water Conservation District
- David McCants, Local Angler
- Malcolm Sproul, Managing Principal, LSA; Board President, Save Mount Diablo
- Scott Stonestreet, Hydraulic Engineer, US Army Corps of Engineers

Additional information cited in this report was provided by Mary Grim, Watershed Coordinator, Contra Costa Resource Conservation District.

Funding for the inventory was provided by the Contra Costa County Flood Control and Water Conservation District (CCCFCD) and the Contra Costa County Fish and Wildlife Committee. The Contra Costa Resource Conservation District (CCRCD) managed the contract and a committee of representatives from the CCRCD, CCCFCD, and Friends of the Creeks oversaw the work.

Figure 1. Walnut Creek Watershed and Subwatersheds



2 Walnut Creek Watershed Overview

Effective discussions among the members of the Walnut Creek Watershed Council require a common vocabulary and a shared understanding of the watershed. This overview provides basic facts about the watershed and suggests a nomenclature for key features.

The Walnut Creek Watershed (Figure 1) is in central Contra Costa County, California. To the west, it drains the Briones Hills and Las Trampas Ridge. To the east, it drains Mount Diablo and its foothills. The San Ramon and Ygnacio Valleys form the spine of the watershed. At its mouth, it joins the Suisun Bay.

At 146 square miles, it is Contra Costa's largest watershed and covers over 20% of the county. With 309 miles of mapped creek channel, it contains 23% of the county's channels. Its 340,000 inhabitants account for over 35% of the county's population (CCCCDD, 2003). Nine cities (Martinez, Pleasant Hill, Concord, the City of Walnut Creek*, Lafayette, Orinda, Moraga, Danville, and San Ramon) are wholly or partly in the watershed (Figure 2).

The watershed exhibits a Mediterranean climate of warm dry summers and mild, wet winters. Mean annual precipitation on Mount Diablo is 25 inches. At the watershed's mouth, mean annual precipitation is 17.5 inches (Roberts & Associates, 1993).

Due to steep slopes and land protection efforts, the upper watersheds along the perimeter of the Walnut Creek Watershed generally remain undeveloped open space. The valleys of the watershed are densely urbanized and populated.

* To avoid confusion with the watershed and creek name, the City of Walnut Creek is referred to in this report as the City of Walnut Creek or the town of Walnut Creek if the reference predates incorporation.

Subwatersheds and Main Waterways

The Contra Costa County Watershed Atlas divides the Walnut Creek Watershed into five subwatersheds: the Clayton Valley Drain, Pine Creek Watershed, San Ramon Creek Watershed, Las Trampas Creek Watershed, and Grayson Creek Watershed. Walnut Creek itself forms the boundary between four of the subwatersheds. The mouth of the creek, which flows through the Concord Marsh, is referred to alternately as Pacheco Slough or as part of Lower Walnut Creek.

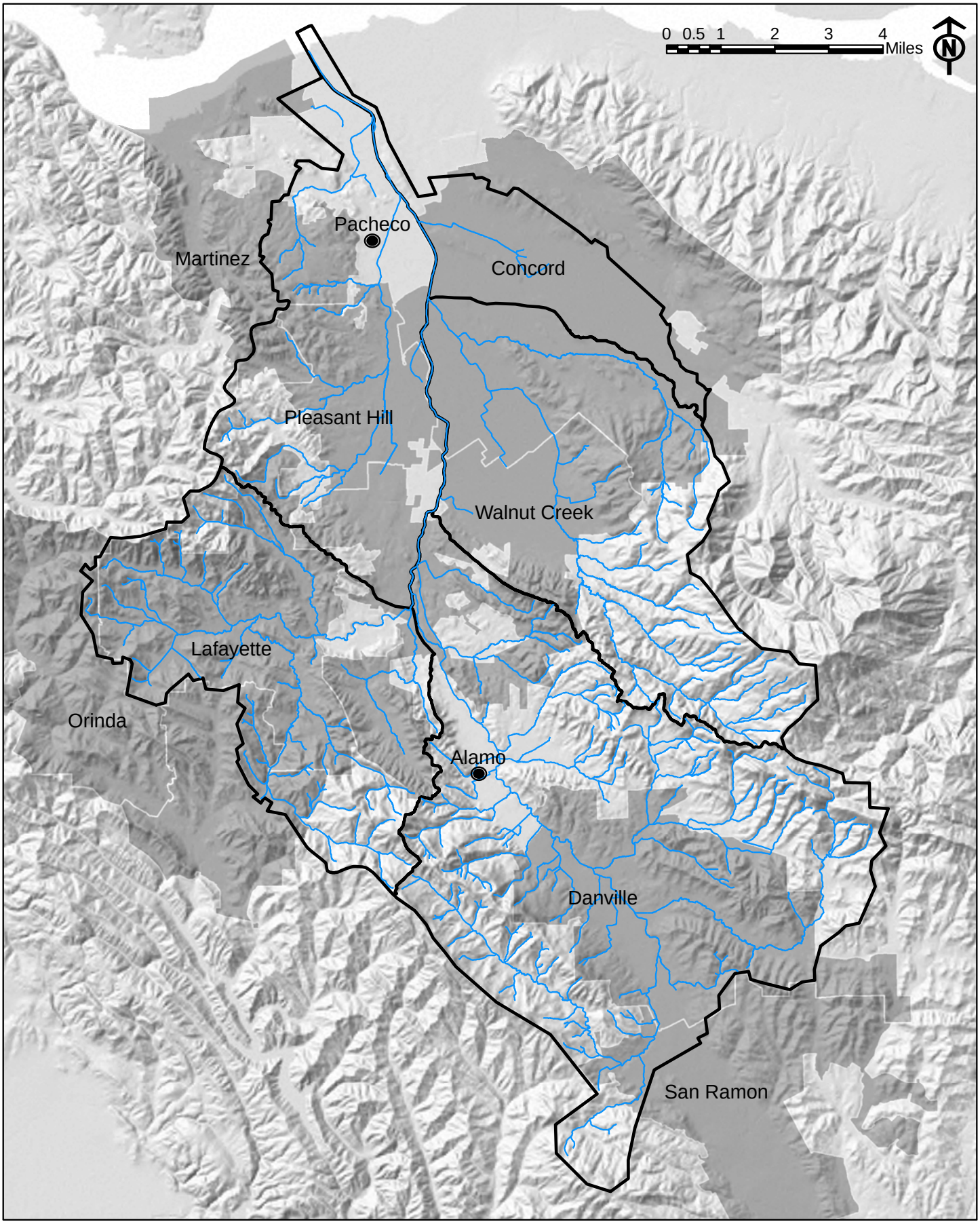
Clayton Valley Drain

The nine-square mile Clayton Valley Drain is the smallest of the subwatersheds in the basin. It is entirely within the City of Concord and, except for a small section on the Concord Naval Weapons Station, it is fully urbanized. As the name suggests, the waterway historically used to drain Clayton Valley and Mount Diablo Creek. Before Mount Diablo Creek was diverted into Seal Creek along the east side of the valley, it drained into Lower Walnut Creek through the Clayton Valley Drain. The drain enters the Walnut Creek channel just upstream of Highway 4.

Pine Creek Watershed

The Pine Creek Watershed drains the northwestern slopes of Mount Diablo through the cities of Walnut Creek and Concord. At 31 square miles, it is the second largest subwatershed in the basin. The main stem of Pine Creek flows through Mount Diablo State Park, Diablo Foothills Regional Park, Castle Rock Regional Recreation Area, and the Ku-

Figure 2. Cities and Communities in the Walnut Creek Watershed



bicek and Pine Creek detention basins. The main tributary, Galindo Creek, flows from private ranch lands on Mount Diablo through the City of Concord, Newhall Community Park, and Markham Nature Area. Galindo Creek and Pine Creek converge downstream of Monument Boulevard and flow into the Walnut Creek channel downstream of Waterworld in Concord.

San Ramon Creek Watershed

At 54 square miles, San Ramon Creek is the largest subwatershed in the basin. The main western tributary, Bollinger Canyon Creek, drains the eastern flank of the East Bay hills. The two main eastern tributaries, Green Valley Creek and Sycamore Creek, drain the western slopes of Mount Diablo. Bollinger Canyon becomes San Ramon Creek just upstream of the intersection of Crow Canyon Road and Old Crow Canyon Road. San Ramon Creek flows northerly through the San Ramon Valley into the City of Walnut Creek. Shortly after it crosses Rudgear Road, flood flows are diverted into the San Ramon Bypass channel. Downstream of Newell Avenue, the main (non-bypass) channel flows underground and joins Las Trampas Creek near the intersection of Mount Diablo Boulevard and Broadway to form Walnut Creek. Flows from the bypass channel rejoin the Walnut Creek channel downstream of Civic Park.

Las Trampas Creek Watershed

Las Trampas Creek drains 27 square miles of Lafayette, Orinda, Moraga, the City of Walnut Creek, and unincorporated county in the western Walnut Creek Watershed. Lafayette and Reliez Creeks drain the southeastern slopes of the Briones Hills. Las Trampas and Grizzly Creeks drain the Las Trampas Ridge. Lafayette Creek converges with Las Trampas Creek in downtown Lafayette. Downstream in the City of Walnut Creek, Tice Creek joins with Las Trampas Creek. Downstream of Main Street, the creek flows underground to the confluence with San Ramon Creek near the intersection of Mount Diablo Boulevard and Broadway to form Walnut Creek.

Grayson Creek Watershed

The Grayson Creek watershed drains the eastern flank of the Briones Hills. This 23-square mile watershed includes all of Pleasant Hill and portions of Martinez, Walnut Creek, and unincorporated county. The main stem of Grayson Creek is joined by Murderer's Creek and Hidden Valley Creek before it flows into Walnut Creek just downstream of Highway 4.

Walnut Creek

From the confluence of Las Trampas and San Ramon Creeks to the confluence with Pacheco Creek, the channel is called Walnut Creek. Walnut Creek flows through the City of Walnut Creek, Concord, Pleasant Hill, and unincorporated county. Grayson Creek, Pine Creek, and the Clayton Valley Drain flow into Walnut Creek. The entire length of the channel is either concrete or earthen flood control channel. Lower Walnut Creek generally refers to the eight mile section from Drop Structure #1 (between the Willow Pass Road and Highway 242 crossings) to the mouth of the creek.

Pacheco Slough

At the confluence with Pacheco Creek, the creek name changes to Pacheco Slough, though it is sometimes still referred to as Lower Walnut Creek. This tidal slough flows for approximately two miles through the Concord Marsh to its mouth at Suisun Bay. To the west is Pacheco Marsh, a possible restoration site. To the east is the Tesoro Refinery.

Concord Marsh

Concord Marsh is the 6,500 acre complex of tidal marshes that lines Suisun Bay from Interstate 680 to Port Chicago. Peyton Creek (to the west in Martinez), Walnut Creek, and Mount Diablo Creek watersheds all drain into and through Concord Marsh. Though impaired by roads, railroads, levees, fill materials, hydraulic constrictions, and an oil refinery, the Concord Marshes are some of the most biotically rich lands in the watershed. The Contra Costa County Watershed Atlas lists the Concord Marshes as part of the Peyton Slough and Mount Diablo Watersheds but they are included and discussed in this inventory as part of the Walnut Creek Watershed.

Channels of the Walnut Creek Watershed

The Walnut Creek Watershed has over 300 miles of creek channels accounting for almost a quarter of all mapped creek channels in Contra Costa County. Figure 3 displays the creeks in the watershed by bank or channel characteristic. Over 70% of the channels (by length) in the watershed are natural, meaning they have no obvious reinforcements. Nearly 16% of the creeks are in concrete channels. Another 12% are constructed earth channels. Less than 1% of the channels are riprapped. Over 11% of the channels are underground (CCCCDD, 2003). Table 1 below shows the bank and channel characteristic by subwatershed and the county average.

In comparison to county averages, the Walnut Creek Watershed has a lower percentage of natural channels and a correspondingly higher percentage of altered channels. Of the subwatersheds, Grayson Creek has the greatest percentage of non-natural channels.

Figure 4 displays long profiles of the main channels and key tributaries of the Walnut Creek Watershed.

Table 1. Creek Length by Channel Characteristic

Type of Bank or Channel	Pine Creek Watershed		San Ramon Creek Watershed		Las Trampas Creek Watershed		Grayson Creek Watershed		Walnut Creek Watershed Total		County-wide
	Miles	%	Miles	%	Miles	%	Miles	%	Miles	%	
Natural	49	81.0%	101	73.5%	50.7	79.1%	15	59.5%	222	71.5%	85.1%
Concrete	7.3	12.2%	21.9	16.0%	8.7	13.5%	5.7	22.3%	49.2	15.9%	9.9%
Earth	3.7	6.1%	13.8	10.1%	3.8	5.9%	4.6	18.2%	37	12%	4.2%
Riprap	0.4	0.7%	0.4	0.3%	0.6	0.9%	0	0%	1.4	0.5%	0.8%
Under-ground	2.7	4.5%	20.1	14.7%	7.5	11.7%	3.2	12.5%	36	11.6%	8.3%

Notes: Natural, Concrete, Earth and Riprap sum to 100%. Underground is an overlapping category. These statistics are from the Contra Costa County Watershed Atlas which does not report values for the Clayton Valley Drain.

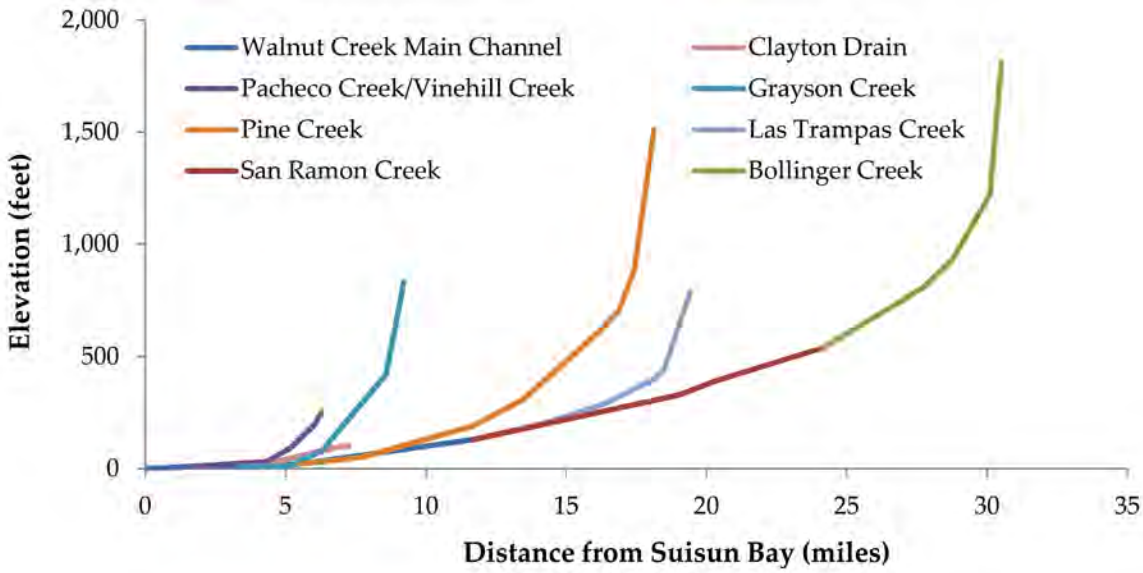
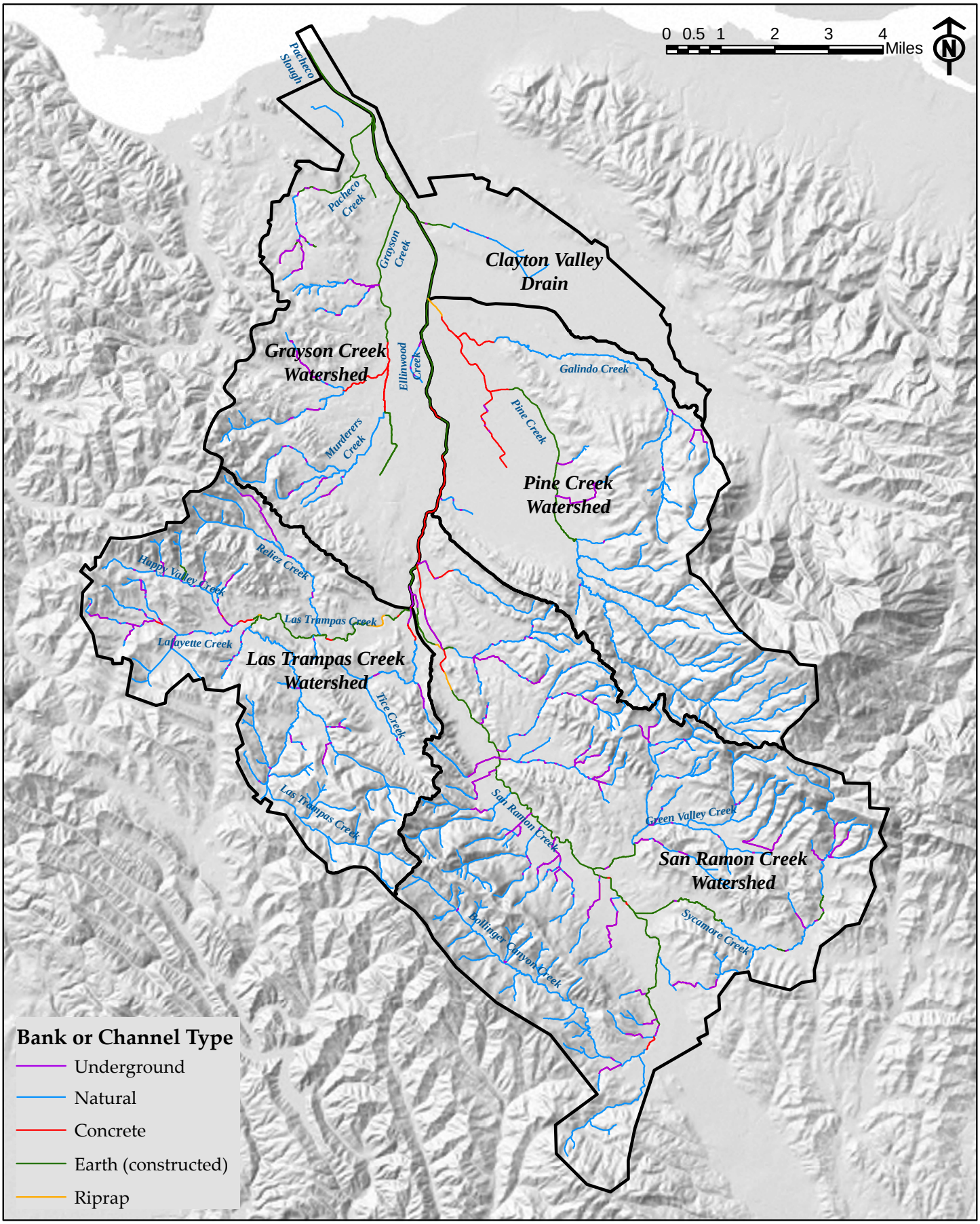


Figure 4. Long Profiles of Walnut Creek and Key Tributaries

Figure 3. Bank or Channel Types in the Walnut Creek Watershed



Key Watershed Infrastructure

With nearly 100 miles of reinforced channels, there are many built features and modifications in the watershed. Figure 5 locates some of the most significant.

Drop Structures

Twenty concrete drop structures stabilize channels in the Walnut Creek Watershed. The most frequently discussed are Drop Structures #1 and #2 on Walnut Creek. The 12-foot tall Drop Structure #1 straddles Walnut Creek upstream of Willow Pass Road and downstream of Highway 242. Drop Structure #1 is generally recognized as the upstream extent of salmonid migration in the watershed, though some salmonids are able to pass it at high flows. The 14-foot tall Drop Structure #2 is on Walnut Creek just downstream of Bancroft Road. Just upstream of the confluence with San Ramon Creek sits a 15-foot drop structure on Las Trampas Creek.

Detention Basins/Reservoirs

The 325-acre-foot Kubicek Detention Basin detains floodwaters on Pine Creek half a mile upstream of North Gate Road adjacent to Northgate High School. Farther upstream in the Diablo Foothills Regional Park, the 312-acre-foot Upper Pine Creek Basin also detains floodwaters on Pine Creek. Both these basins were constructed by the SCS and are owned and operated by the CCCFCD.

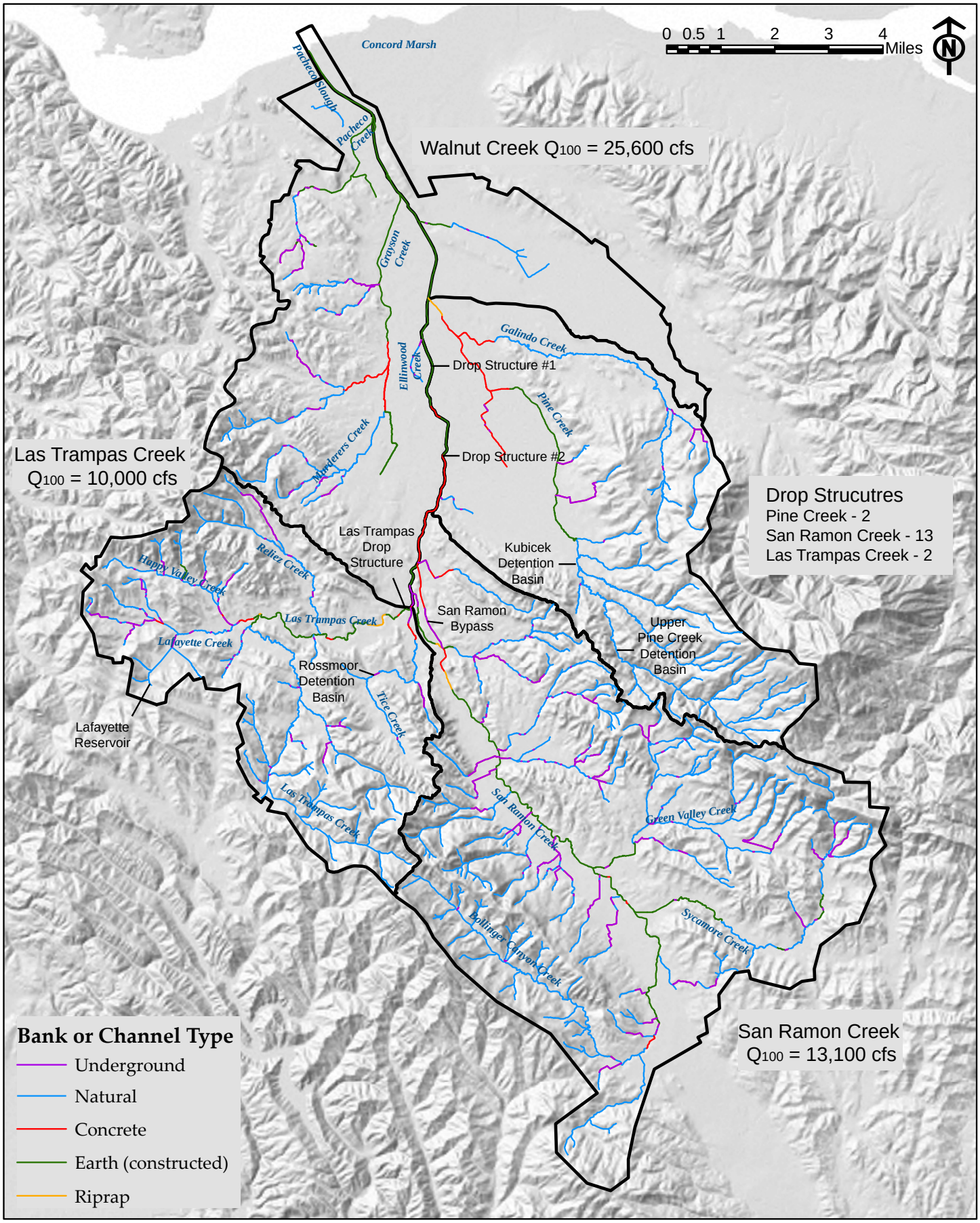
The East Bay Municipal Utility District operates the 4,000 acre-foot Lafayette Reservoir to provide standby water supply. The reservoir has not been used for water supply for over 40 years. In-flow into the reservoir is limited to runoff from the surrounding watershed. It sits within a 925-acre open space operated by EBMUD.

The Rossmoor Detention Basin is a recently expanded detention basin on Tice Creek in the City of Walnut Creek. The 55-acre facility operated by the Flood Control District alleviates flooding downstream in Tice and Walnut Creeks. Other detention basins, such as Viano Basin on Pacheco Creek, detail floodwaters throughout the watershed.

Drop Structure #1

Drop Structure #2

Figure 5. Key Features of the Walnut Creek Watershed



Parks and Open Space and Regional Trails

Forty-three square miles (29%) of the Walnut Creek Watershed consists of lands zoned for parks and recreation or open space. The eight largest publicly owned open spaces (Figure 6) are:

- Briones Regional Park
- Diablo Foothills Regional Park
- Lafayette Reservoir
- Las Trampas Regional Wilderness
- Lime Ridge Open Space
- Mount Diablo State Park
- Shell Ridge Recreation Area
- Sycamore Valley Open Space

The Iron Horse Trail

Eighty-six miles (28%) of creek channels flow through parks or open space. Details by subwatershed are given in Table 2 below.

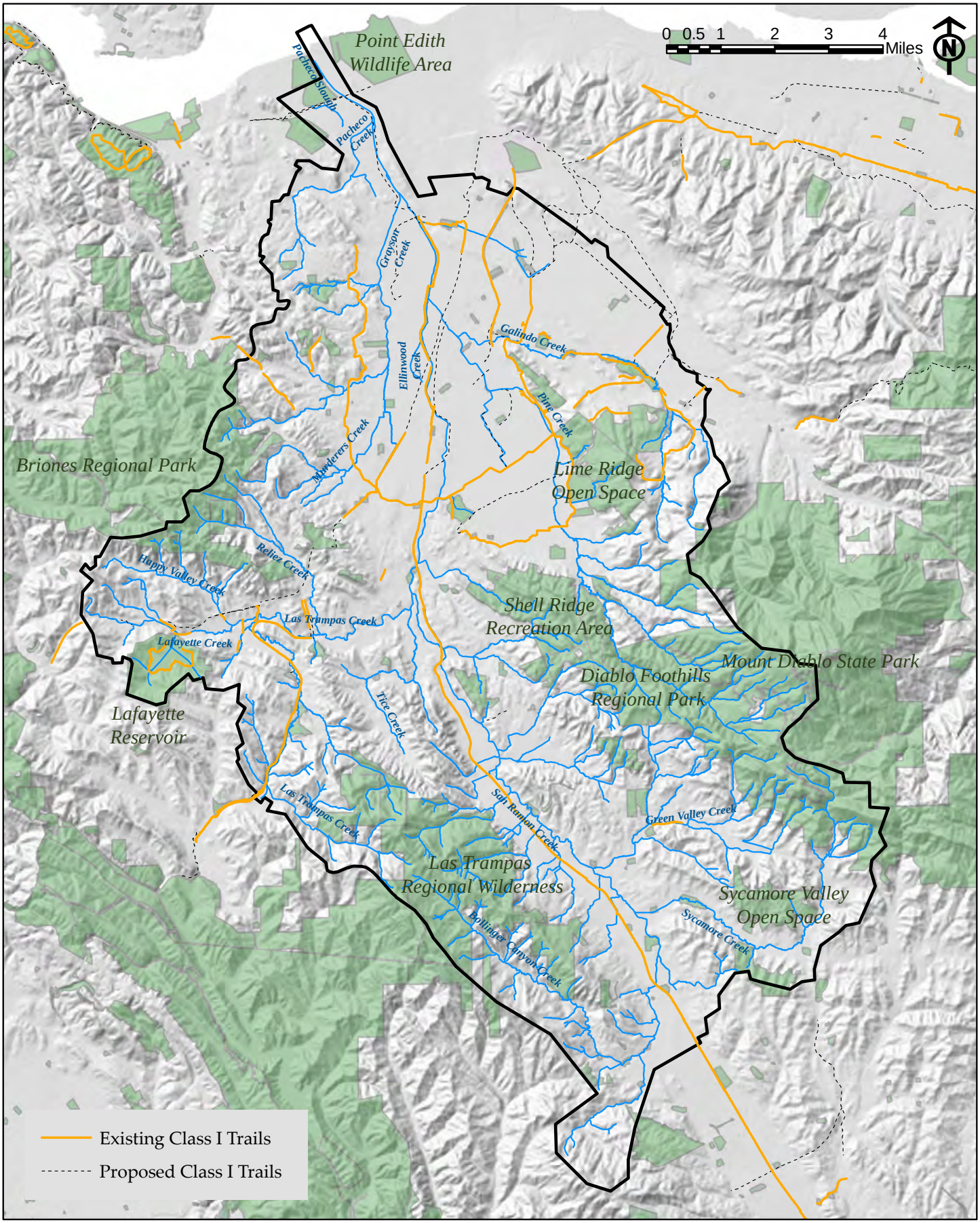
Table 2. Length and Percentage of Stream Channel in Parks or Open Space by Subwatershed

	Length in Parks or Open Space (miles)	Total Length of Channel in Watershed (miles)*	Percentage in Parks or Open Space
Clayton Valley Drain	0.8	3.35	24%
Pine Creek Watershed	27.5	59.96	46%
San Ramon Creek Watershed	41.7	136.7	31%
Las Trampas Creek Watershed	11.75	64.1	18%
Grayson Creek Watershed	4.5	25.4	18%
TOTAL	**86.25**	**309**	**28%**

**Total stream miles as reported in Contra Costa County Watershed Atlas*

Public open spaces provide access to over a quarter of both the watershed area and the total channel length in the watershed. Regional trails provide additional opportunities for users to explore and understand the watershed. Figure 6 shows existing and proposed regional (Class I) trails in the watershed. In particular, the Iron Horse Trail runs up the spine of the watershed and parallels Lower Walnut Creek for over three and a half miles. Trails along Las Trampas, Lafayette, Pine, Galindo, and Green Valley Creeks increase the total length of creek that users can experience outside of the parks and open spaces.

Figure 6. Protected Open Space and Regional Trails in the Walnut Creek Watershed



3 A Brief History of the Walnut Creek Watershed

To understand the current condition of the Walnut Creek Watershed, one must examine the past. A watershed's history can reveal constraints and opportunities that are no longer immediately evident. The San Francisco Estuary Institute will complete a detailed examination of the Walnut Creek Watershed's historical ecology in the near future. What follows is a brief description of the watershed's evolution.

Pre-European Contact

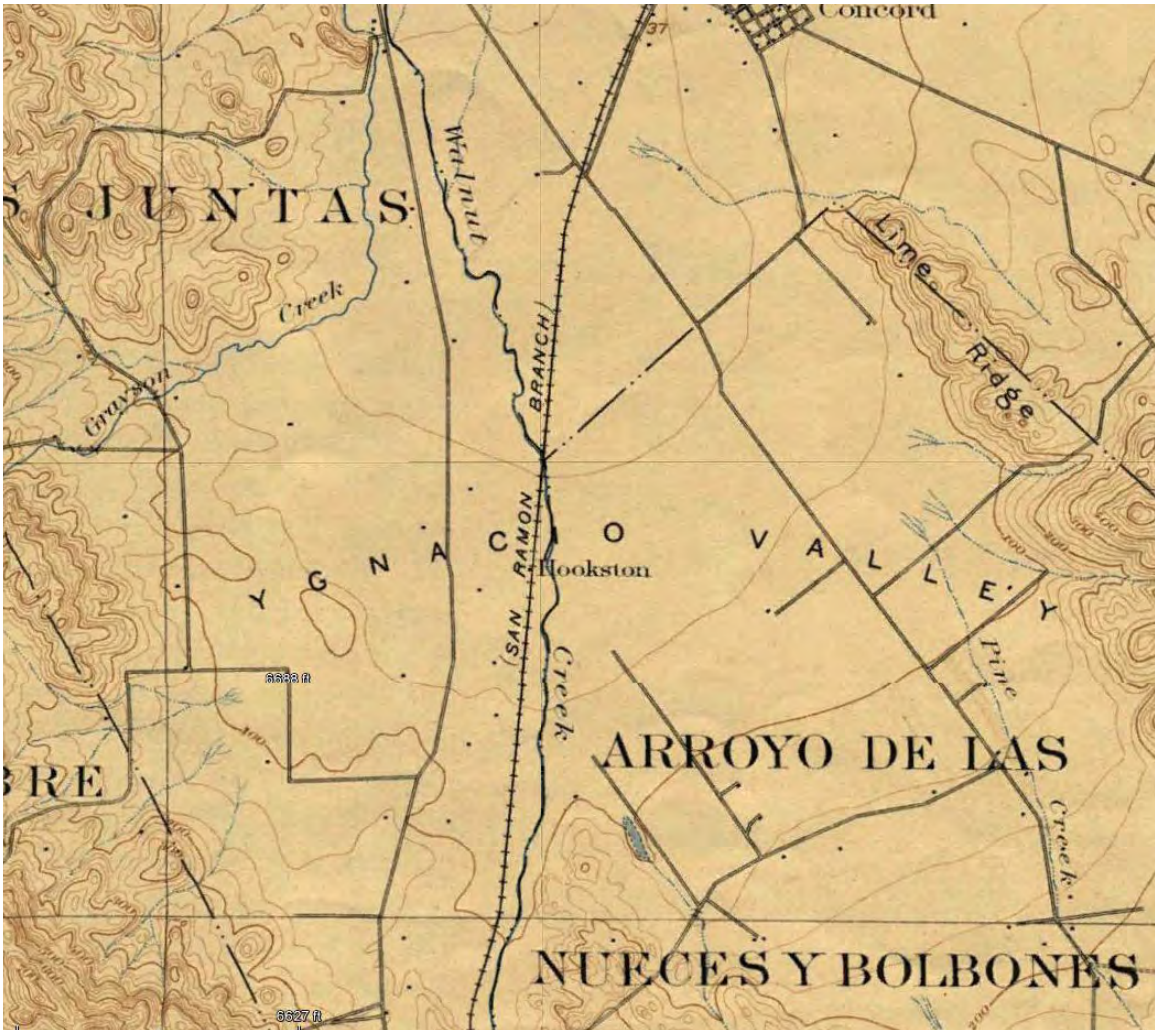
Much of the lower Walnut Creek Watershed was a vast, open plain full of elk, pronghorn antelope, mule deer and grizzly bears (M. Sproul, pers. comm.; Font, 1776). Several creeks traversed this plain: some of these creeks converged in a massive, sprawling willow thicket that would come to be known as the Monte del Diablo ("Thicket of the Devil"). Other creek channels terminated in the middle of the plain where their waters seeped into the deep substrate or spilled across the plain during floods. Downstream, along the Suisun Bay, freshwater channels entered a fecund marsh where brackish tides ebbed and flowed. These creeks and their tributaries ran thick with salmon and steelhead trout from the mouth at Suisun Bay all the way to the base of Mount Diablo and Las Trampas Ridge (Leidy, Becker, and Harvey, 2005). California walnuts, oaks, and cottonwoods grew in abundance throughout the watershed.

The bounty of freshwater and food provided by the watershed supported the Bay Miwok, a hunter-gatherer culture. Three tribelets are inferred to have lived in the Walnut Creek Watershed: the Chupcan lived near present day Concord, the Tactan lived on San Ramon Creek, and the Saclan (origin of the name Acalanes) lived near Lafayette (Milliken, 1995). Early population estimates for Contra Costa vary wildly, but a Chupcan village on Walnut Creek was described during an expedition into the valley as "very large and extremely well peopled" (Fages, 1772). Their periodic vegetation burning likely affected the botanical species composition in the watershed but otherwise their activities impacted the creeks very little (Roberts & Associates, 1993).

Agricultural Era

In the late 18th Century, the Spanish established a permanent presence in the Bay Area. By the early 19th century, the Spanish began winter grazing in the Walnut Creek Watershed (MDIA, 2012). After Spain ceded California to Mexico in 1822, the Mexican government began issuing land grants in the watershed including Monte del Diablo, Las Juntas, Arroyo de las Nueces y Bolbones, Acalanes, Laguna del los Palos Colorados, San Ramon, and others. For the next few decades, the watershed was used mostly for ranching and intense cattle grazing. Five thousand cattle ran on the Rancho Monte del Diablo alone. Hulanski (1917) described the local landscape during the era:

Figure 7. Pine, Galindo, and OtherTributaries to Lower Walnut Creek in 1897



Source: USGS, 1897.

> *"Broad-spreading plains and the gracefully undulating hills all clothed in verdure and beautified, as if by special ornamentation, with scattered groves of ever green oaks, and here and there the tortuous fringes and dense clusters of the willows, marking the course of the rivulets and the locations of the living spring. This was simple, inanimate nature, but the life of the landscape were the cattle upon a thousand hills. Myriads of cattle...were feeding and roaming without limit over all the land, over all the sides and summits of the green hills, and over all the green-covered valleys and plains.... Over all the land no vandal plow had ever scarred and mutilated the face of nature, over all the land no square miles of nature's green had been discolored to the dirty brown of tillage."*

The introduction of cattle to the watershed initiated a long period of channel instability. Cattle consumed and trampled riparian vegetation leading to bank instability and increased erosion. They left denuded hillsides and compacted earth which caused increased runoff into the creeks, furthering erosion (Roberts & Associates, 1990).

The watershed experienced its first population boom soon after the California gold rush began in 1849. Fertile soils, ideal climate, available mineral resources, and convenient location between San Francisco and the Sierra gold fields attracted people to the watershed. In 1850, the first lime quarry and kiln opened and the first orchards were planted. By 1853, the first crop of wheat was harvested. Settlers established the towns of Pacheco, Alamo (Spanish for cottonwood), The Corners (eventually renamed Walnut Creek), and nearby Martinez. Sea-going ships docked at Pacheco (four miles upstream from Suisun Bay) to transport wheat, lime, and other locally produced goods east to the gold fields and west to San Francisco and beyond (Hulanski, 1917). By 1854, 25 families lived in the Ygnacio Valley (Munro-Fraser, 1882).

In 1862, a massive flood wiped out Pacheco and silted in the mouth of the creek. Presumably, thirty years of unconstrained grazing and over a decade of tilling and road building eroded sediment from hillsides, banks, and floodplains. A large flood transported the sediment to the mouth of the creek, shutting off the port and ravaging the town. By 1868, much of Pacheco had moved to higher ground nearby in the newly formed Todos Santos, now known as Concord (P. Detjens, pers. comm.).

Though the watershed's main port was lost, agriculture and mining continued. In 1863, copper was discovered in nearby Clayton. In 1865, petroleum was discovered to the east in Antioch (Hulanski, 1917). By 1880, 300 people lived in Concord and 300 people lived in the town of Walnut Creek (MDIA, 2012). In 1891, the Southern Pacific Railroad completed its San Ramon Branch linking Alamo to the rest of the continent by rail. By 1913, the Oakland, Antioch & Eastern Railroad linked the watershed more directly to the ports in Oakland. In 1916, crops from the watershed had diversified to include "products of field, orchard, vineyard, nut groves, poultry yard, and stock pastures" (Hulanski, 1917).

During this era, Mount Diablo Creek, which flowed off of the northern slopes of Mount Diablo through Clayton and into Walnut Creek via the Concord Valley Drain, was diverted away from Walnut Creek and into Seal Creek to the east. Once diverted, waters from Mount Diablo Creek flowed through Seal Creek into Hastings Slough and joined Suisun Bay two miles east of the mouth of Walnut Creek. Whether this was to prevent flooding in Walnut Creek or to fulfill some other motive is unclear, but it effectively removed 20 square miles of land from the watershed (Cain and Walkling, 2005). Similarly, Pine and Galindo Creeks, which had previously terminated in the plain of the lower watershed, were connected to Lower Walnut Creek (Figure 7). It is likely that other modifications, such as the eastward relocation of San Ramon Creek through Alamo, were made to creek channels to reduce flooding or otherwise improve conditions for agriculture and commerce.

Urbanization and Population Growth

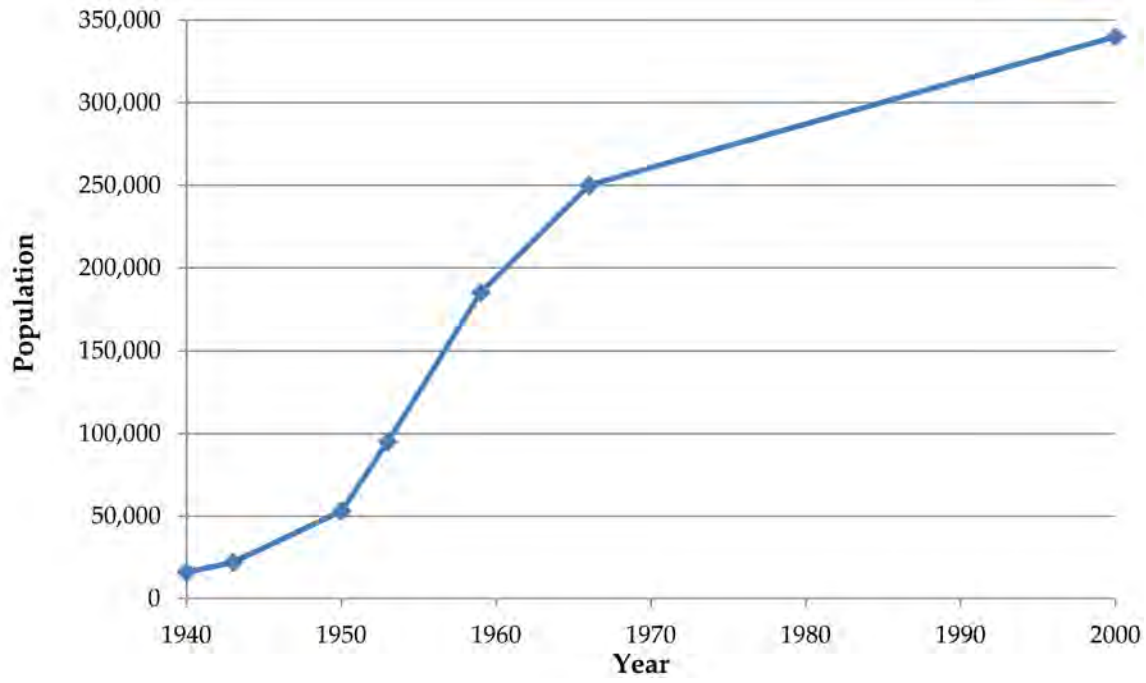
When World War II commenced, 16,000 people lived in the watershed. Over the next quarter century, the population grew to 250,000; a fifteen-fold increase (P. Detjens, pers. comm.). Figure 8 shows population growth over that period. By comparison, since 1966, the population in the watershed has only grown an additional 35% to 340,000 (CCCCDD, 2003).

Rapid development of the watershed both attracted and accommodated the population boom. As happens in developing watersheds, the increase in paved features, buildings, and other impervious surfaces prevented rainfall from percolating into the ground and travelling slowly to the creeks. Instead, rainfall hit these surfaces and flowed rapidly over pavement and through storm drains into nearby creeks. The same amount of rainfall resulted in much larger floods, continuing the destabilization of local creeks and threatening new homes and businesses with frequent inundation. Major floods occurred in 1938, 1941, 1950, 1951, 1955, and 1958 (P. Detjens, pers. comm.). The 1955 flood caused over $1.5 million in damages. Three years later, floods caused another $1 million in damages (CCSCD, 1966).

Flood Control Era

Floods, the damage they caused, and on going erosion and instability in local creeks led to demands to formally and collectively address the crisis. As early as 1941, the Contra Costa Soil Conservation District formed and, with the Soil Conservation Service (SCS), began working with farmers and ranchers to reduce erosion. In the 1940s and 1950s, landowners adjacent to Lower Walnut Creek channelized the creek to convey flood waters more efficiently (CCCPW, 2012). In 1951, the Contra Costa County Flood Control District formed and a year later the SCS selected the Walnut Creek Watershed as a pilot project (P. Detjens, pers. comm.).

Figure 8. Population Growth in the Walnut Creek Watershed



Source: Detjens, 2012; CCCCDD, 2003.

Between 1953 and 1964, the SCS and the Contra Costa County Flood Control District (CCCFCD) channelized over 10 miles of San Ramon, Las Trampas, and Grayson Creeks; installed thirteen drop structures on San Ramon and Las Trampas Creeks to stabilize the creek and control grade; built the Pine Creek Dam; and implemented agricultural land treatment measures to reduce erosion (P. Detjens, pers. comm.). The new channels were designed to handle the 50-year flood. The SCS project cost $6.7 million (CCSCD, 1966).

The U.S. Army Corps of Engineers (USACE) began work in the watershed in 1963. Over the next 30 years, the Army Corps transformed an additional 22 miles of channel, added two drop structures, built the San Ramon Bypass Channel, and channelized, deepened, and widened portions of Grayson, Pacheco, Pine, and Walnut Creeks and the Clayton Valley Drain. The USACE continues to co-manage the project with the CCCFCD (P. Detjens, pers. comm.).

Restoration Era

The flood control projects prevented catastrophic flooding in the watershed and stabilized rapidly eroding creek channels. But the projects also contributed to the loss and deterioration of habitat and water quality in the creeks. As early as the 1970s, citizens in the Walnut Creek watershed began seeking flood control alternatives that better accommodated habitat. In 1979, a proposed project that would have channelized reaches of San Ramon and Walnut Creeks was rejected in favor of a bypass alternative which left mature riparian vegetation intact in the main stems.

Also in 1979, the CCCFCD and SCS constructed the Kubicek Detention Basin on Pine Creek. In sharp contrast to the 87-foot-high Pine Creek dam build on the same creek only twenty years earlier, the CCCFCD and SCS integrated Kubicek Basin into the topography. The project featured lush riparian and wetland areas and a City of Walnut Creek walking trail. The basin blended into the environment well enough that many trail users remain unaware of its flood control function (P. Detjens, pers. comm.).

By the early 1990s, three coordinated efforts to improve habitat functions and complete creekside trail projects were underway in the watershed. The East Bay Regional Park District, the City of Walnut Creek, and the City of San Ramon led collaborative planning processes for distinct portions of the channel (Arbegast, Newton, and Griffith, 1993). Friends of the Creeks formed in 1993 to work with the City of Walnut Creek to implement the creek and trail improvement plan (Friends of the Creeks, 2012). In the ensuing years, additional creek groups formed to encourage habitat and water quality improvements in the watershed. Other groups include Friends of Pleasant Hill Creeks and Friends of San Ramon Creek.

The Clean Water Act Amendment of 1987 spurred additional changes in the watershed. In response to new requirements, the Contra Costa Clean Water Program formed (T. Dalziel, pers. comm.). The County and its municipalities implemented development standards to improve water quality and began formal monitoring of pollutants of concern.

In response to shifting cultural values, the CCCFCD continues to investigate changes to the flood control system that would improve habitat function without impairing flood conveyance. The CCCFCD has evaluated opportunities in Lower Walnut Creek, Grayson and Murderer's Creeks, and in 2005 constructed the Rossmoor Detention Basin on Tice Creek which was honored with the Contra Costa Watershed Forum Project of the Year award. The CCCFCD continues to work on implementing a restoration project on Lower Walnut Creek.

The most recent action in the Restoration Era has been the formation of the Walnut Creek Watershed Council. The council formed to "protect and enhance the watershed and…to facilitate actions that increase awareness of the watershed, implement watershed projects and to be a forum for sharing information and activities that affect the watershed" (WCWC, 2012). To date, five municipalities, the county, two special districts, and six non-profit organizations have passed resolutions indicating support for the Watershed Council.

4 Flood Control in the Walnut Creek Watershed

"The economic vitality [of the watershed] is a result of the largely forgotten [flood control] infrastructure."

-Paul Detjens
CCCFCD

The Contra Costa County Flood Control and Water Conservation District manages or co-manages over 30 miles of flood control channels in the Walnut Creek Watershed. Twenty-two miles of that is co-managed with the U.S. Army Corps of Engineers who originally designed and built part of the facility. Collectively, the flood control system in the watershed is known as Zone 3B. Figure 9 shows the location of flood control facilities and easements.

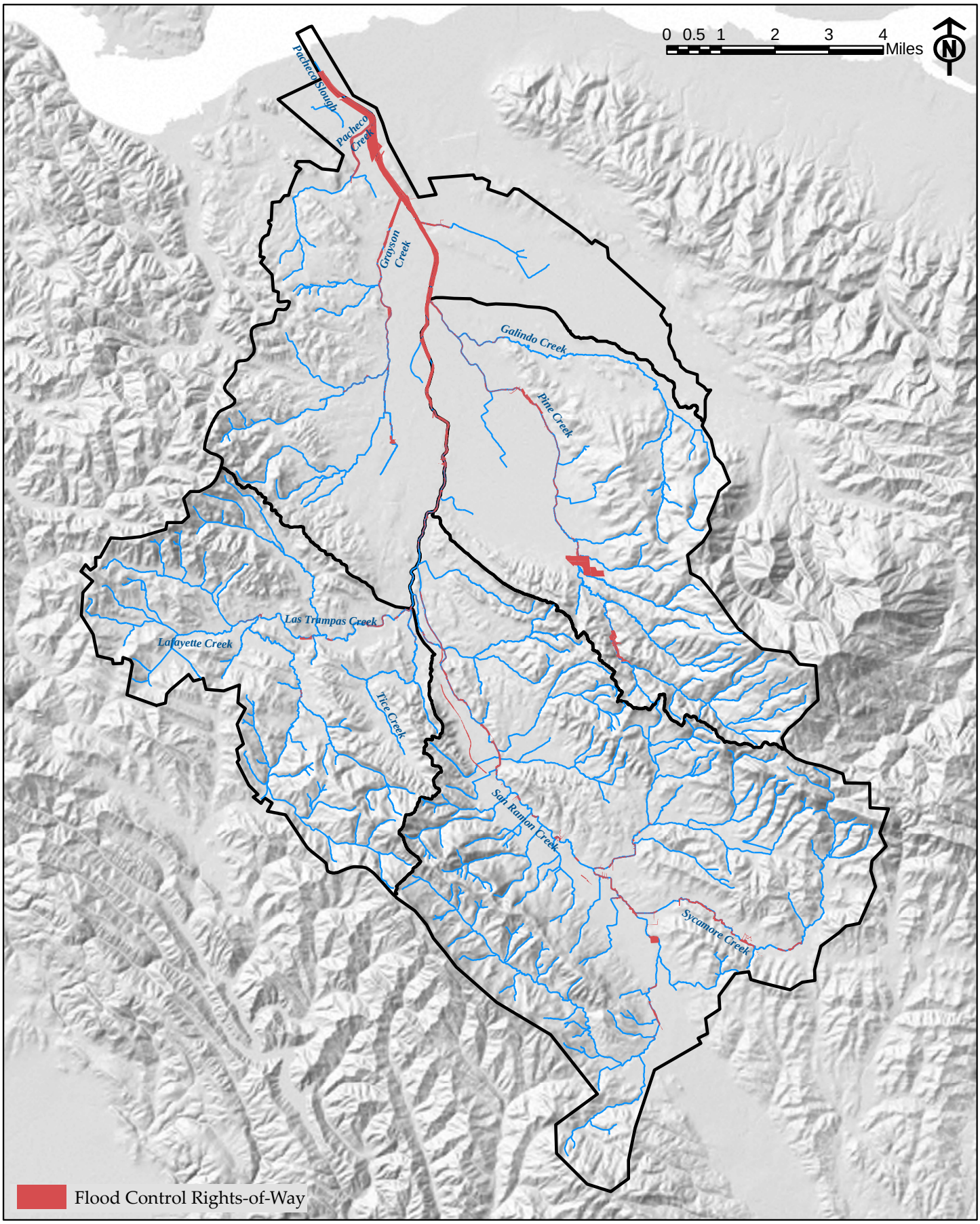
When the Corps' flood control project was being planned, the CCCFCD was responsible for acquiring the land rights of the project. The CCCFCD had several incentives to keep the flood control corridors narrow. If land had to be condemned, there was no legal justification for condemning more than the minimum width necessary to provide flood conveyance. Similarly, if land was purchased from a willing seller, there was no incentive to purchase more width than necessary. In some cases, such as Grayson Creek, new flood control channels were retrofitted between newly built houses which severely limited channel width (P. Detjens, pers. comm.).

Originally, the federal government covered 65% of the costs for the Army Corps project. The state covered much of the remaining cost. Currently, the cost of any new projects would be equally split between the CCCFCD and the Army Corps. The state no longer provides funding. The Army Corps involvement is funded through the congressional earmark process which complicates dedicating a consistent funding stream. These challenges and others have made the planning process with the Army Corps increasingly complex and implementation of future federal projects less likely (P. Detjens, pers. comm.).

Once a project is completed, the Army Corps provides a specific maintenance manual that must be followed by the local sponsor, which, in this case, is the CCCFCD. The Army Corps inspects the system annually and must approve of any channel changes. This oversight protects the federal investment, but it complicates the accommodation of requests to add vegetation or to improve habitat in the system (P. Detjens, pers. comm.).

The CCCFCD's work in Zone 3B is funded by local taxes that were frozen in 1978 by Prop 13. Whereas some zones in the county are completely without tax funding, Zone 3B collects about $3.8 million per year (P. Detjens, pers. comm.). About $2 million per year funds channel maintenance activities including tree trimming, channel clearing, access road grading, flap gate maintenance, sub-drain maintenance, graffiti removal, and fence repair (T. Medina, pers. comm.).

Figure 9. Flood Control Rights-of-Way in the Walnut Creek Watershed



Management Challenges

The CCCFCD faces multiple management challenges in the Walnut Creek Watershed. Those challenges, as reported by the CCCFCD, are listed below (T. Medina and P. Detjens, pers. comm.).

- *Sediment management and loss of channel capacity (discussed below):* Due to sediment accumulation and deposition in the watershed, particularly in Lower Walnut Creek, channels have lost their design capacity to convey floods.
- *Aging infrastructure:* Much of the flood control infrastructure in the watershed is around 50-years old. The facility is generally well-built, but elements are showing signs of aging. For example, the bottom of the San Ramon bypass is no longer smooth and has worn down to an aggregate surface. Hairline cracks are forming in the concrete channels of Pine, Galindo, and Grayson Creeks. Trees outside of concrete channels are growing and their roots are pressing against the walls. No plan exists for funding and replacing aging structures. When they are replaced, citizens will expect new flood control structures to be designed and built differently, but the corridor widths will be severely limited.
- *Funding:* The CCCFCD is not a utility like water or wastewater and cannot set rates for its customers. Its funding rate is frozen by Prop 13 at 1978 rates. This funding stream covers current maintenance costs but no source exists for replacement costs.
- *Army Corps requirements for maintenance:* As co-owner, the Army Corps sets requirements for facility maintenance which are increasingly difficult to achieve. Part of the challenge of meeting the mandatory maintenance established by the Army Corps is also meeting the mitigation requirements set by other permitting agencies. The CCCFCD finds these requirements difficult to achieve and at times prohibitive.
- *Levee certification/FEMA:* Because they lack sufficient freeboard, none of the levees in the Walnut Creek Watershed are FEMA certified. Partnering with the Corps and FEMA assists with funding but requires a difficult planning process.
- *Invasive species:* Zebra mussel, *Arundo donax* (giant reed), and other invasive species are entering the Walnut Creek Watershed threatening native species and complicating management. These invasive species are often out-competing native species and reducing the quality of available habitat.
- *Easement/license holders exceeding rights:* A number of users and agencies hold easements or licenses on flood control property. Increasingly, these license or easement holders are exceeding the rights explicit in their agreements. This can complicate flood control management, maintenance, and operations.
- *Creek and channel safety:* High flows, especially those in concrete channels, pose a threat to anyone entering the channels. The CCCFCD has examined a creek restoration alternative to improve creek safety by replacing concrete channels with naturalized creeks and found that it would cost $1.3 billion and require the removal of hundreds of homes.
- *Right-of-way encroachment:* Pools, decks, gardens, and fences have all encroached on flood control access easements. Cities fail to enforce easements or contact the CCCFCD when issuing building permits that encroach on easements. As a result, the CCCFCD has to have impediments removed from easements or work around them.
- *Sea level rise:* The flood control system was designed with certain assumptions about sea-level elevations. As sea-level rises, the channels effectively lose capacity and the threat of flooding, particularly in the lower watershed, increases.
- *Homelessness/Trash/Pollutants:* Homeless encampments, trash in the channels, and pollutants of concern impair water quality and complicate management.
- *Lack of public knowledge about the flood control system:* Floods are infrequent and customers in the watershed generally don't know that they're protected by the CCCFCD system. Given the complexity of the system, very few people, including professionals and creek enthusiasts, understand it fully.

Efforts to Address to Management Challenges

As cultural values around creeks change and management challenges increase, the CCCFCD, the Army Corps, and others have worked together to plan for the future and adapt the system.

Lower Walnut Creek

One of the greatest flood management challenges in the watershed is sedimentation in the Lower Walnut Creek channel. The facility was built by the Army Corps and is currently co-managed with the CCCFCD. When it was constructed in the 1960s, the Army Corps assumed a sedimentation rate of 30,000 cubic yards a year (150,000 cubic yards a year and a 20% channel trapping rate). In the 1970s, the Army Corps calculated an actual sedimentation rate of closer to 160,000 cubic yards a year (250,000 cubic yards a year and a 65% channel trapping rate). Initial calculations had been off by a factor of five (P. Detjens, pers. comm.).

To preserve the flood conveyance capacity, the channel would need to be dredged approximately every seven years. Selective de-silting of non-tidal areas occurs about every seven years but the last dredging of the tidal reach occurred in 1973 (P. Detjens, pers. comm.). The 1973 dredging removed 850,000 cubic yards of sediment. By 2004, 810,000 cubic yards had re-deposited in the channel, much of that depositing soon after the initial dredging (CCCFCD, 2007). The accumulation of sediment has reduced the channel capacity from 25,000 cfs to 20,000 cfs (S. Stonestreet, pers. comm.) Figure 10 shows total amounts of accumulated sediment in the Lower Channel between 1973 and 2004.

Sedimentation in the Lower Walnut Creek Channel

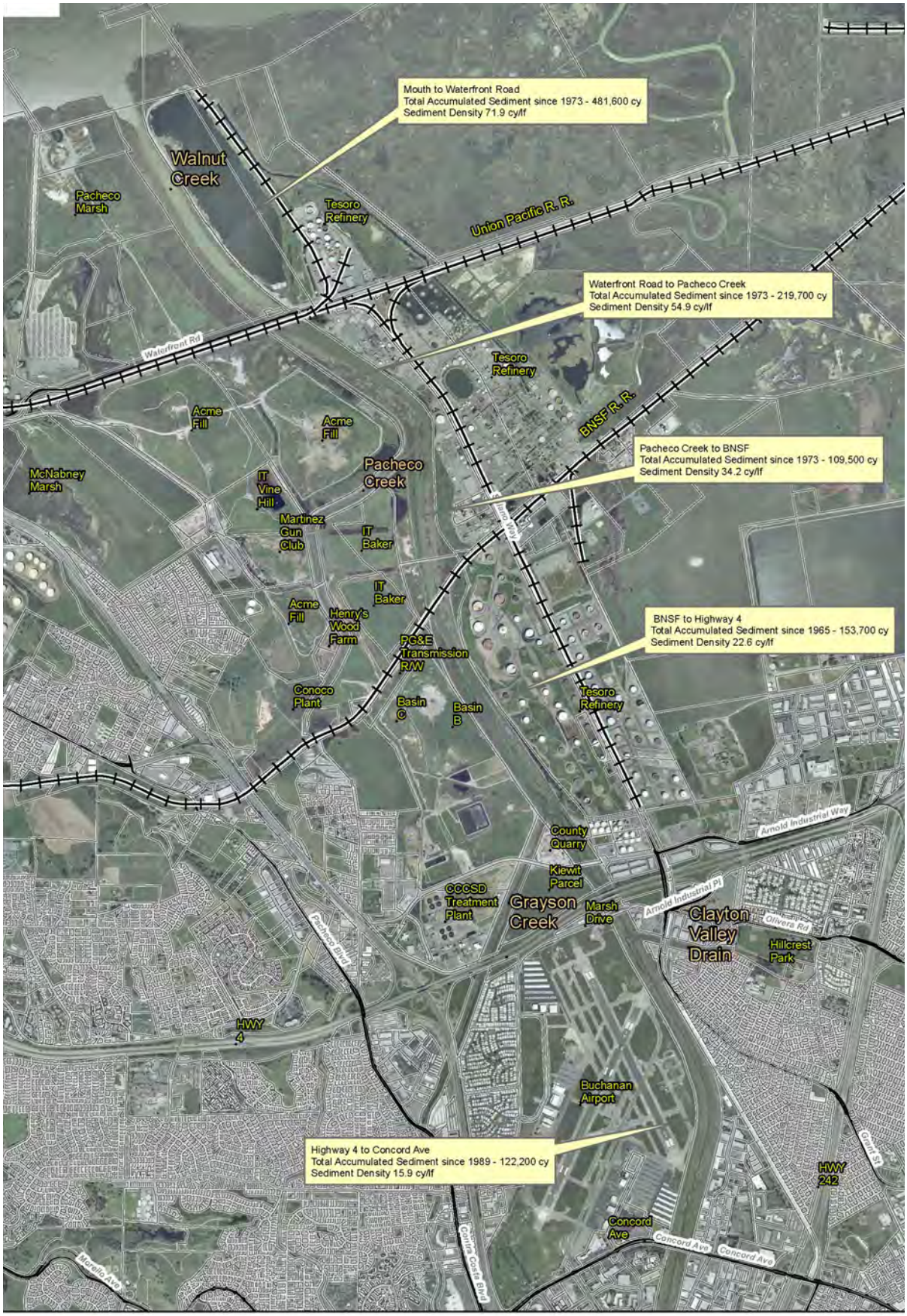
Sediment has accumulated both on the floodplains and in the bed of the channel. The large plug of sediment at the mouth is likely the result of coastal (littoral) depositional processes. Sediment from Suisun Bay enters the mouth of the creek on high tides and deposits in the relative calm of the channel. For much of the year, high flows that would flush this sediment out of the Walnut Creek Watershed are non-existent, allowing this plug to accumulate. When high flows return, not all of the sediment is washed out. Riverine processes are responsible for sediment upstream of the plug. Floods deliver and deposit sediment on the floodplains, reducing channel capacity (S. Stonestreet, pers. comm.).

Sedimentation in Lower Walnut Creek is complex and vexing to those who study it. Geology in the watershed is naturally unstable, but less so than other watersheds in the county. Walnut Creek has a higher proportion of fine sediments than other watersheds. No one subwatershed seems to be contributing a majority of sediment. The watershed has a huge legacy sediment load from centuries of instable channels and poor sediment management. The combination of littoral and riverine processes create a very complicated watershed. As a result, modelers have not been able to calibrate a sediment model of the watershed (P. Detjens, pers. comm.).

Dredging has not occurred in the tidal reach of the channel since 1973 because the only feasible means of removing the sediment is by suction dredging. Suction dredging is indiscriminant about what it picks up and removes and therefore poses a threat to the many endangered species in the tidal reach of the channel. Resource agencies will no longer issue a permit for suction dredging in Walnut Creek. After 34 years without dredging, the Army Corps rated the lowest reach of the project "unacceptable" in 2007. Two consecutive years of "unacceptable" ratings make the project ineligible for federal emergency repair funding (P. Detjens, pers. comm.).

In response, the CCCFCD spent $6 million to de-silt the portion of the channel between Highway 4 and the BNSF railroad and continued to seek, with the Army Corps, a long-term program to manage the channel more sustainably. In order to

Figure 10. Sedimentation Location and Density in the Lower Walnut Creek Channel



Source: CCCFCD, 2007.

provide flood conveyance without suction dredging the tidal channel, the CCCFCD would need to secure flowage easements across properties along the channel where the risk to life and property is low and then breach, remove, or add culverts to adjacent levees. This would provide sufficient flood capacity to compensate for the sediment in the channel. The full dredge project required by the Army Corps is expected to cost $40-$50 million. Planning for the less expensive and more sustainable alternative is on going (P. Detjens, pers. comm.).

Grayson and Murderer's Creek

In 1997, Grayson and Murderer's Creeks flooded approximately 80 homes in Pleasant Hill. In 2005, a similar flood occurred and caused $2-3 million in damages. In 2008, Murderer's Creek flooded again. In response to these events, the Army Corps and CCCFCD examined alternatives to improve flood protection without channelizing creek channels or removing riparian vegetation (CCCFCD, 2001). The sponsors evaluated the costs and impacts of four possible upstream detention basins (Brookwood Park, Greenhills, Beatrice, and Oak Park) and other improvements (USACE, 2011). The analysis identified modifications that would reduce flooding but their costs outweighed the benefit of reduced future flood damages.

Creek and Trail Plans

As described above, three coordinated efforts to improve habitat functions of flood control channels and develop creekside trail projects were underway in the watershed in the early 1990s.

The East Bay Regional Park District, CCCFCD, Central Contra Costa Sanitary District, Pleasant Hill Recreation and Park District, the Cities of Concord, Pleasant Hill, and the City of Walnut Creek participated in the Walnut Creek Channel Recreation and Revegetation Project for the section of creek between Ygnacio Valley Road and Suisun Bay including Ellinwood Creek, a meander of the original Walnut Creek channel cut off by the Army Corps project. The study evaluated alternatives to improve biotic function in Walnut Creek and Ellinwood Creek and recommended specific actions (Arbegast, Newton, and Griffith, 1993). These recommendations are summarized in the Recommendations section of this document. In the intervening years, some of these actions have been realized, including some on Ellinwood Creek completed by the Friends of Pleasant Hill Creeks (M. Grim, pers. comm.).

In 1993, the City of Walnut Creek and a citizen task force completed a planning process for the Creeks Restoration and Trails Master Plan for the section of creek within the City. The four-volume master plan evaluated opportunities for improving creek function. The resulting recommendations are also included in the Recommendations section of this document. The completion of the plan was the impetus for the creation of Friends of the Creeks. Friends of the Creeks, in partnership with the City of Walnut Creek and other agencies, have since completed some of the actions recommended in the Master Plan (Roberts and Associates, 1993).

In 1994, the San Ramon Creek Task Force completed the San Ramon Creek Greenbelt and Parkway Study. The task force was a collaborative of the City of San Ramon, the Town of Danville, East Bay Regional Park District, and Contra Costa County Services Area R-7A. The resulting goals and recommendations are included in the Recommendations section of this document.

Additional Information on Flood Control

The following sources provide additional detailed information on flood control and possible modifications in the Walnut Creek Watershed:

Arbegast, Newton, and Griffith. 1993. "Walnut Creek Channel Recreation and Revegetation Project." Prepared for the East Bay Regional Park District.

Detjens, P. R. 2012. "Walnut Creek – History, Issues, and Challenges." Presentation on behalf of Contra Costa County Flood Control and Water Conservation District. September.

Roberts & Associates. 1993. "Creeks Restoration and Trails Master Plan – City of Walnut Creek, California." Prepared by John Northmore Roberts & Associates for the City of Walnut Creek.

5 Water Quality in the Walnut Creek Watershed

Water quality in the Walnut Creek Watershed suffers from two afflictions common in urban settings. The first is an increase in pollutants that accompanies increased human activity in the watershed. As the population grows, more products and practices are applied in the watershed, resulting in an increase in pollutants in the creek.

The second affliction is the loss of the ability of the watershed to cleanse its own waters. Paved surfaces send pollutants quickly into storm drains that rapidly convey them into the creeks. In undeveloped watersheds, rainfall percolates into the ground and reaches the creeks more slowly. During this slow conveyance to the creek, soils and plants begin to cleanse the water. Even once it reaches the creek, high flows in natural systems will send water out over floodplains, slowing their velocities, allowing for percolation and additional cleansing of polluted waters. In highly efficient flood control channels, there is much less opportunity for the creek to cleanse itself.

In the Walnut Creek Watershed, impervious land cover is a useful indicator of water quality impacts. There is a strong correlation between percent imperviousness and watershed impacts on hydrology, geomorphology, habitat, and, especially, water quality. Impacts become evident even when a watershed is only 10% impervious. At 30% impervious, watersheds become severely degraded (T. Dalziel, pers. comm.). The Contra Costa County Watershed Atlas estimated percent imperviousness for the subwatersheds based on zoning maps and general plans. At build-out (assuming all land is converted to the intended use) 30% of the watershed will be covered in impervious surfaces. Table 3 below shows the breakdown by subwatershed.

Table 3. Estimated Percent Impervious Cover at Build-out

Subwatershed	Percent Impervious
Clayton Valley Drain	n/a
Pine Creek Watershed	30%
San Ramon Creek Watershed	20%
Las Trampas Creek Watershed	25%
Grayson Creek Watershed	45%
TOTAL	**30%**
County-wide	35%

Water Quality Monitoring

Individual municipalities in the watershed are responsible for water quality discharges from their streets and stormwater systems but in Contra Costa County those actions are coordinated and assisted by the Contra Costa Clean Water Program (CCCWP).

In 1990, the US Environmental Protection Agency issued a final rule expanding the National Pollutant Discharge Elimination System (NPDES) to prohibit separate storm sewer discharges without a NPDES permit. In 1991, Contra Costa County, the CCCFCD, and 17 incorporated cities and towns came together to form the Contra Costa Clean Water Program and prepare and submit a joint municipal NPDES permit. The San Francisco Bay Regional Water Quality Control Board issued the county a permit in 1993 and has renewed it every five years since (with modifications). Many of the permit-mandated activities for protecting and improving water quality are the responsibility of individual municipalities. The CCCWP is responsible for public information and outreach programs, water quality and pollutant monitoring, training, and development of guidance, policies, and model tools that assist municipalities in implementation (T.

Dalziel, pers. comm.).

The CCCWP began wet weather water quality monitoring in 1993 on Walnut Creek near Monument Boulevard. The San Francisco Bay Regional Water Quality Control Board suspended wet weather monitoring in 1996 because it was costly and did not help inform regulatory policies or effective control strategies. Wet weather monitoring only provided a snapshot in time and did not provide information on pollutant sources, pathways, or impacts (T. Dalziel, pers. comm.).

In 1999, the CCCWP initiated a countywide creek inventory study aimed at characterizing local creeks. The following year, the CCCWP created a monitoring plan to assess watersheds and water quality with the intent of collecting baseline information necessary to identify and eventually reduce or eliminate major sources of pollutants. The monitoring characterized watershed health through the collection of physical, biological, and basic chemical data (bioassessment monitoring).

Bioassessment Monitoring

Storms and water quality are episodic and variable. The CCCWP accommodates for this variability by performing bioassessments. Bioassessment surveys collect, identify, and quantify benthic macro-invertebrates from selected sites in the watershed. The species composition of insects that survive at these locations indicates the water quality and overall creek health. Certain species have a low tolerance for pollution. If these species are present in abundance, it suggests that the creek at this location is relatively clean and healthy. If the site produces only insects that have a high tolerance for pollution, then creek health and water quality are likely impaired, even if the offending pollutant has moved through the system and is undetectable at the time of surveying (CCCCDD, 2006).

Since 2003, the County has performed bioassessment monitoring at 32 sites in the Walnut Creek Watershed. Each site is given an Indicator of Biologic Integrity (IBI) score between zero and 50 based on the species found. Figure 11 shows the average IBI score at each of the stations. The spatial pattern that reveals itself in Figure 11 is that IBI scores decrease as one moves downstream and urbanization increases. The highest scores are in the headwaters and upper watershed. Scores decrease as creeks descend through urbanized areas, pick up pollutants and lose their natural capacity to cleanse (Ruby, 2012).

Pollutants of Concern

The pollutants of concern in Walnut Creek are similar to those county-wide. The most significant are pesticide toxicity, trash, bacteria from animal excrement and homeless encampments along the creeks, oil and grease from leaky automobiles, metals from paints, vehicles, and building materials, PCB's, mercury from atmospheric deposition, sediment from construction sites and stream bank erosion, and nutrients (T. Dalziel, pers. comm.).

The CCCWP's initial wet weather monitoring found pesticide toxicity in creeks primarily from diazinon. Toxicity from pesticides results from individual and commercial operations applying pesticides, even when applied exactly as instructed on the labeling. Stormwater program efforts led to legislation that phased out diazinon use. However, current monitoring is detecting toxicity from the next generation of pesticides (pyrethroids) in local waterways.

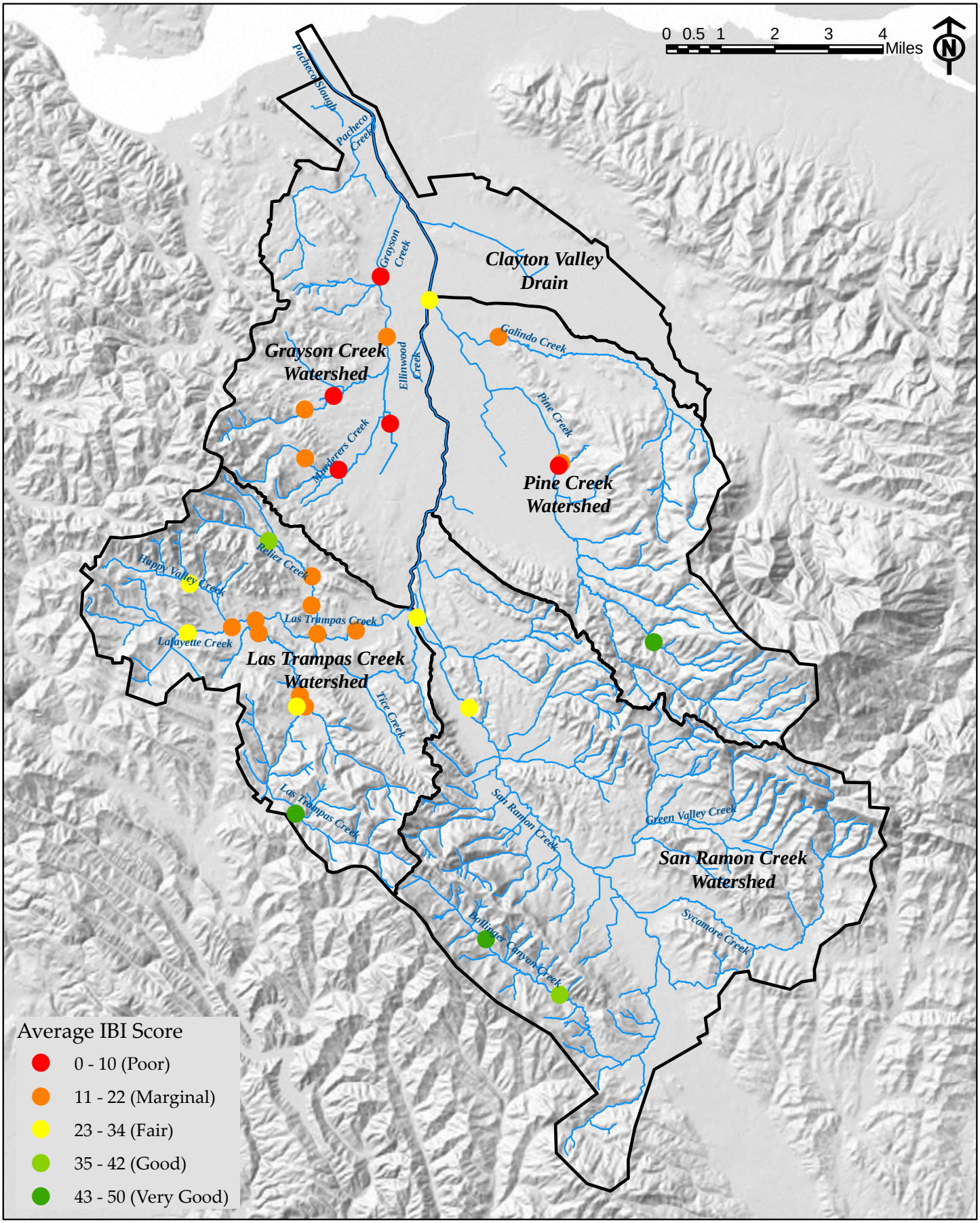
Additional Information on Water Quality

The following sources provide additional detailed information on water quality in the Walnut Creek Watershed:

CCCCDD. 2006. "Data from the Creeks – An Overview of the Contra Costa County Volunteer Creek Monitoring Program 2001 to 2005." Contra Costa County Community Development Department.

Ruby, A. 2012. "Summary of BMI Monitoring – 2001-2011, Walnut Creek Watershed" Presentation to the Walnut Creek Watershed Council. November 1.

Figure 11. Bioassessment Rankings in the Walnut Creek Watershed



6 Salmonids in the Walnut Creek Watershed

"The soldiers purchased four fish somewhat more than a [yard] long and about a [foot] wide. At first we did not recognize it, but on opening it, and especially when we ate it, we saw that it was salmon, tenderer, fatter, and more savory than that which we ate at [Carmel], for perhaps because there is so much fresh water here it grows larger, fatter, and better flavored."

-Pedro Font on salmon near present-day Concord in April of 1776

The Walnut Creek Watershed attracts Chinook salmon (*Oncorhynchus tshawytscha*), federally threatened coho salmon (*Oncorhynchus kisutch*) and federally threatened steelhead trout (*Oncorhynchus mykiss*) to its waterways. These three species are of particular interest due to their importance to sport and commercial fishing, their size and charisma, and in the case of steelhead and coho, their status as federally threatened species. All three species are anadromous, meaning they hatch in freshwater streams and rivers, migrate to the ocean to mature, and return to fresh water several years later to reproduce (McGinnis, 2006).

Types of Salmon

Chinook (or king) salmon are the largest species of Pacific salmon, often exceeding 40 pounds and three feet in length (NMFS, 2012a). Salmonids arrive in "runs" denoting the season they return to the freshwater streams (McGinnis, 2006). Chinook in the Walnut Creek Watershed are fall-run. They arrive in the watershed after the first high tide/high flow event of the rainy season, generally in October or November (D. McCants, pers. comm.). Chinook prefer to spawn in rivers and in the main stems of streams where water flow is sufficiently deep for their size (WDFW, 2012a). Upon return, females use their tail to move gravel and create a "redd" in the bed of the creek. They can lay up to 8,000 eggs in their redd which are then fertilized by males. Both parents die after spawning, though females may live to defend a redd for several weeks. In ideal conditions, the fertilized eggs receive cold, oxygenated water throughout the winter until the newborn Chinook hatch in March and begin their journey downstream to the ocean. After two to three years in the ocean, they return to their natal streams to spawn (McGinnis, 2006). Recent stud-

ies in the Yolo Bypass show that young salmon that rear in floodplains and marshes rather than in open river channels have access to more food and grow much larger (Philp, 2012).

Coho (or silver) salmon are smaller than Chinook. Their average weight is around eight pounds but they can grow to 30 pounds and two feet in length (NMFS, 2012b). Their range is mostly limited to coastal streams, but a few have been known to venture as far inland as the Walnut Creek Watershed. Their life cycle is similar to that of the Chinook except that their out-migration to the ocean as juveniles may take as long as a year or more (McGinnis, 2006). Juveniles rearing in freshwater streams feed primarily on insects (NMFS, 2012b).

Steelhead trout are anadromous coastal rainbow trout (*Oncorhynchus mykiss*). Non-anadromous coastal rainbow trout are among the most abundant trout species in California but the much larger ocean-going steelhead trout are federally threatened. Again, their life cycle is similar to salmon with a few exceptions. Steelhead trout prefer to spawn in smaller, fast flowing tributaries but will overlap with Chinook in deeper main stems if necessary (WDFW, 2012b). Unlike salmon, steelhead trout can repeat their journey between the ocean and freshwater several times. Additionally, young steelhead trout will remain in their natal steams for at least an entire year before venturing to sea (Frose et al., 2006). They require a year-round source of water or cool, deep pools to survive in the watershed over the summer (USFWS, 1995). Adult steelhead trout tend to enter and remain in the watershed a little later than salmon. Local anglers report seeing them in the watershed as late as April or May (J. Burman, pers. comm.). With an average weight of five to ten pounds, they tend to be considerably smaller than Chinook (Hale, 2012).

Historical Range

Steelhead trout were first identified in the Walnut Creek Watershed in 1855 (Hale, 2012). Figure 12 shows the historic range of steelhead trout in the Walnut Creek Watershed. Walnut Creek, Pine Creek (well up into the foothills), and San Ramon Creek (including Bollinger Canyon and Green Valley Creeks) had steelhead runs. Las Trampas, Lafayette, and Tice Creeks probably had runs of steelhead. Grayson and Galindo Creeks may possibly have had runs of steelhead. Other tributaries in the watershed had insufficient data to make a determination (Leidy, Becker, and Harvey, 2005).

Coho, Chinook, and steelhead remains were all found at the confluence of Reliez and Las Trampas Creeks. Salmon were observed in the 1950s and 1960s on Pine Creek as far upstream as Castle Rock (J. Hale, pers. comm.).

Current Barriers to Passage

Figure 13 shows the current range of steelhead trout in the watershed. Salmon and steelhead are now mostly limited to the lower reaches of Walnut, Pine, and Grayson Creeks. Creek stabilization and flood control modifications installed in the 1960s and 1970s prevent most salmonids from advancing upstream beyond drop structures, concrete channels, and other barriers (Jones and Stokes, 2004).

Drop Structure #1 in Lower Walnut Creek is perhaps the best known and most obvious of the migration barriers in the watershed. The 12-foot tall folded crest weir is 0.5 miles upstream of Willow Pass Road and easily viewed from the Iron Horse Trail and Interstate 680. The drop structure is a barrier to most salmonids. Some hearty individuals have been seen passing the drop structure at high flows (J. Hale, pers. comm.), but the infrequency of suitable flows limits passage for most salmonids (Jones and Stokes, 2004). Those few salmonids that pass the Drop Structure #1 during ideal flow conditions confront a 14-foot drop structure near Bancroft Road, seven extended reaches of rectangular concrete-lined channel, a 100-foot chute, and a reinforced concrete box culvert beneath downtown Walnut Creek (Jones and Stokes, 2004).

In addition to the barriers on Walnut Creek, there are at least 13 drop structures on San Ramon Creek; a 15-foot drop structure on Las Trampas Creek just upstream of Main Street in the City of Walnut Creek; two culverts over 750 feet long on Tice Creek, 15 barriers on Reliez Creek; and multiple other barriers preventing salmonids from reaching good habitat in the upper watershed (Leidy, Becker, and Harvey, 2005; P. Detjens, pers. comm.).

In 2004, Chinook salmon swam at least as far as Sunshine Drive in Pine Creek, 1.25 miles upstream of the confluence with Walnut Creek. The first impassable drop structure on Pine Creek is about

three miles from the confluence with Walnut Creek. Approximately 10 constructed barriers including the Pine Creek Dam prevent salmonids from reaching good habitat in the upper watershed of Pine Creek Watershed (Jones and Stokes, 2007).

No surveys have examined the extent of salmonid passage in Grayson Creek (Jones and Stokes, 2004). Grayson Creek is closed to fishing as it is a steelhead trout rearing area of key concern (D. McCants, pers. comm.).

It is important to note that successfully expanding the range of salmonids is about more than providing upstream passage. It is also necessary to provide good water quality (cool, high dissolved oxygen levels, and low amounts of suspended sediments) to ensure that eggs in redds survive and hatch. Lack of cover, increased water temperatures, and lack of cool summer pools (in the case of steelhead) impair downstream out-migration and rearing for juveniles.

Habitat Conditions

Salmonids face other challenges in the Walnut Creek Watershed other than barriers to passage. Effectively all of the stream reaches accessible to salmonids are channels that have been straightened, stabilized, and managed to improve flood conveyance. A 2004 survey of Lower Walnut Creek identified two immature willows and one piece of large woody debris along four miles of channel between Highway 4 and Monument Boulevard. The lack of vegetation along the creek contributes to bank erosion, high levels of fine sediment in the water, decreased habitat complexity, lack of shade for cooling and refuge, and fewer insects – a key food source for juvenile salmonids (Jones and Stokes, 2004). In concrete sections of the channel, critical natural features are missing entirely.

The best habitat for salmonids is in the upper watershed well above multiple passage barriers. Bollinger Canyon, Las Trampas, and Tice Creeks and their tributaries have suitable summer temperatures, densely vegetated riparian corridors, and multiple in-stream habitat types suitable for salmonid spawning and rearing (Jones and Stokes, 2005). Of these, Las Trampas may provide the best habitat (Leidy, Becker, and Harvey, 2005).

Population Status

In the early 1990s, anglers estimated the run of Chinook salmon and steelhead at 1,000 to 1,500 each (Arbegast, Newton, and Griffith, 1993). Jones and Stokes estimated that Lower Walnut Creek could potentially support 296 steelhead and 166 Chinook redds (Jones and Stokes, 2004). In 2006, Jones and Stokes estimated that between 189 and 630 Chinook salmon entered Lower Walnut Creek to spawn (Jones and Stokes, 2006). No estimates are available for Pine or Grayson Creeks.

Coho salmon enter the watershed only infrequently. Anglers report having last seen them in Pine Creek around 2005 or 2006 (D. McCants, pers. comm.).

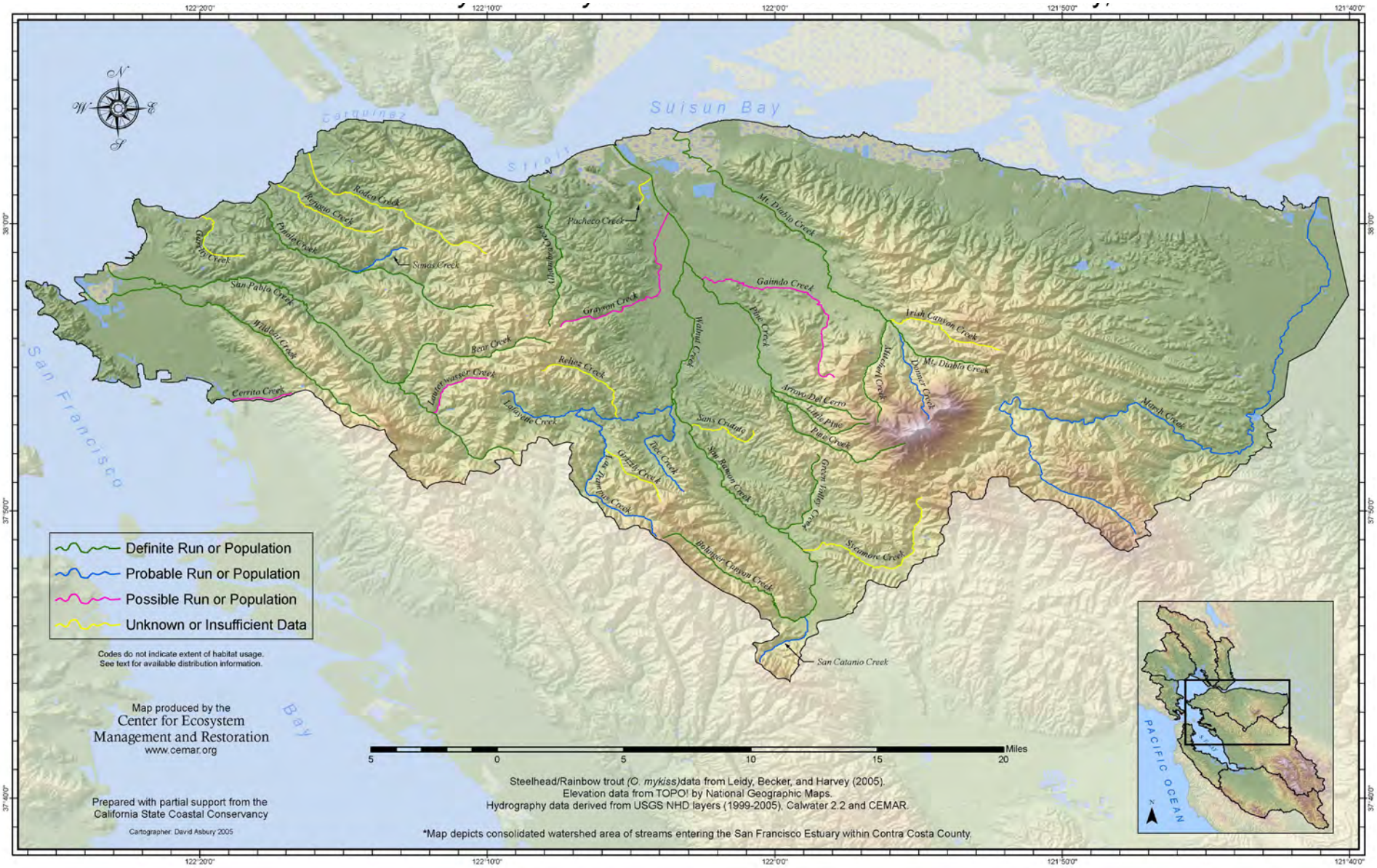
Recently, the USFWS moved the launching point for Central valley hatchery salmon from upstream of Suisun Bay to downstream in San Pablo Bay. Given that most of the salmon in Walnut Creek are likely hatchery strays, this change in launching locations may be reducing the number of adult salmon coming into the watershed (P. Detjens, pers. comm.).

Other Fish in the Walnut Creek Watershed

Fish other than salmon and steelhead also populate the Walnut Creek Watershed. Striped and black bass come into the tidal reaches on high tides (J. Burman, pers. comm.). Green and white sturgeons share these waters with the bass (J. Hale, pers. comm.). Squawfish, warmouth bluegill, roach, and carp can be found throughout the lower watershed. The ponds and reservoirs in the watershed, including Lafayette Reservoir, Heather Lakes, Oak Hill Park Pond, and Martinez Lakes, have fish typical of still waters; trout, bass, bluegill, catfish. Some of these lake fish are self-sustaining and some are imported for fishing (D. McCants, pers. comm.).

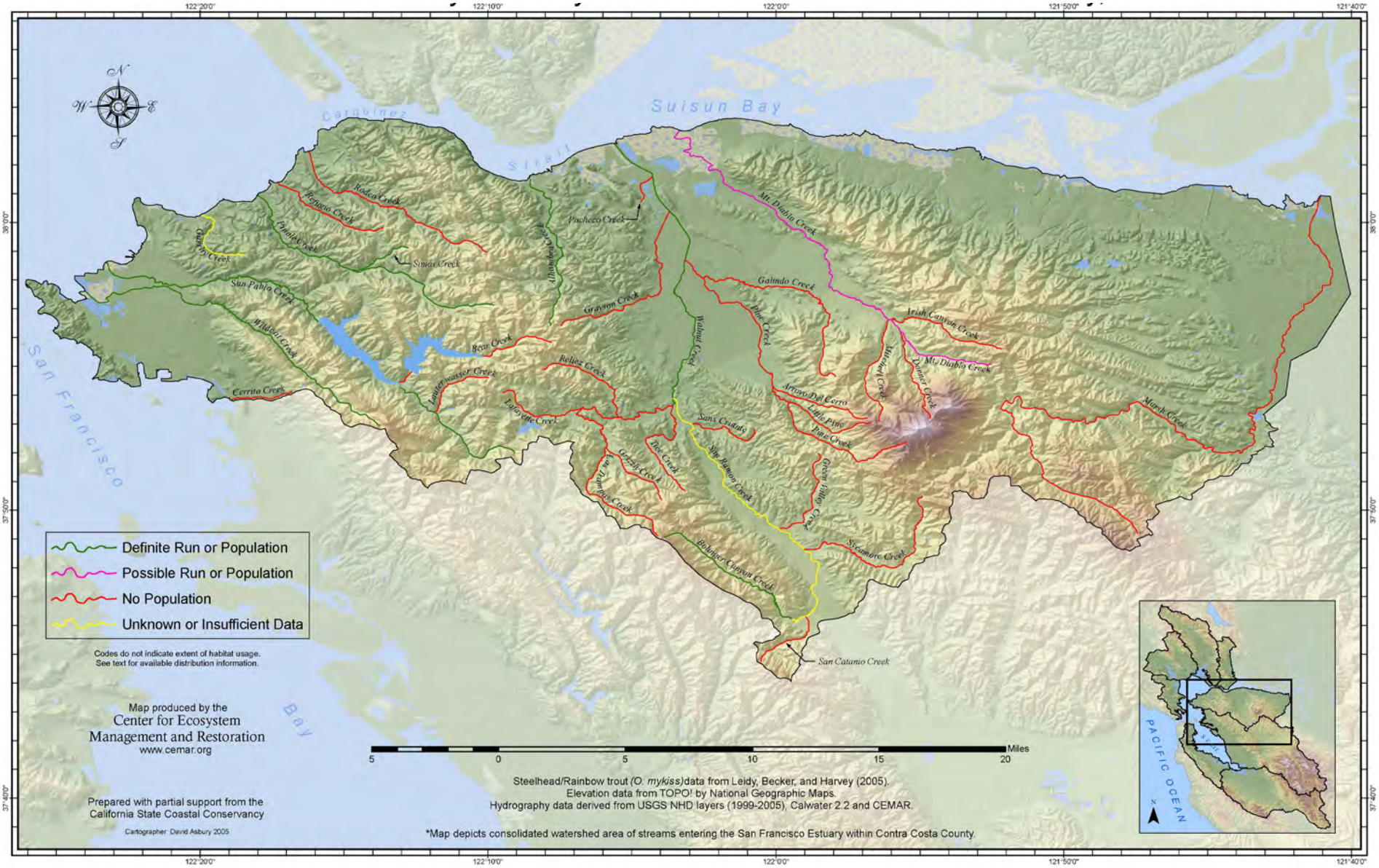
Additional Information on

Figure 12. Historical status of *Oncorhynchus mykiss* in streams of Contra Costa County, CA



Excerpted from Leidy, Becker, and Harvey, 2005. Used by permission.

Figure 13. Current status of *Oncorhynchus mykiss* in streams of Contra Costa County, CA



Excerpted from Leidy, Becker, and Harvey, 2005. Used by permission.

Salmonids

The following sources provide additional detailed information on salmonids in the Walnut Creek Watershed:

Jones and Stokes. 2004. "Final Data Summary Report for Baseline Surveys of Anadromous Fish Habitat in Lower Walnut Creek, Contra Costa County, California," Prepared for the US Army Corps of Engineers in coordination with Contra Costa County Public Works Department.

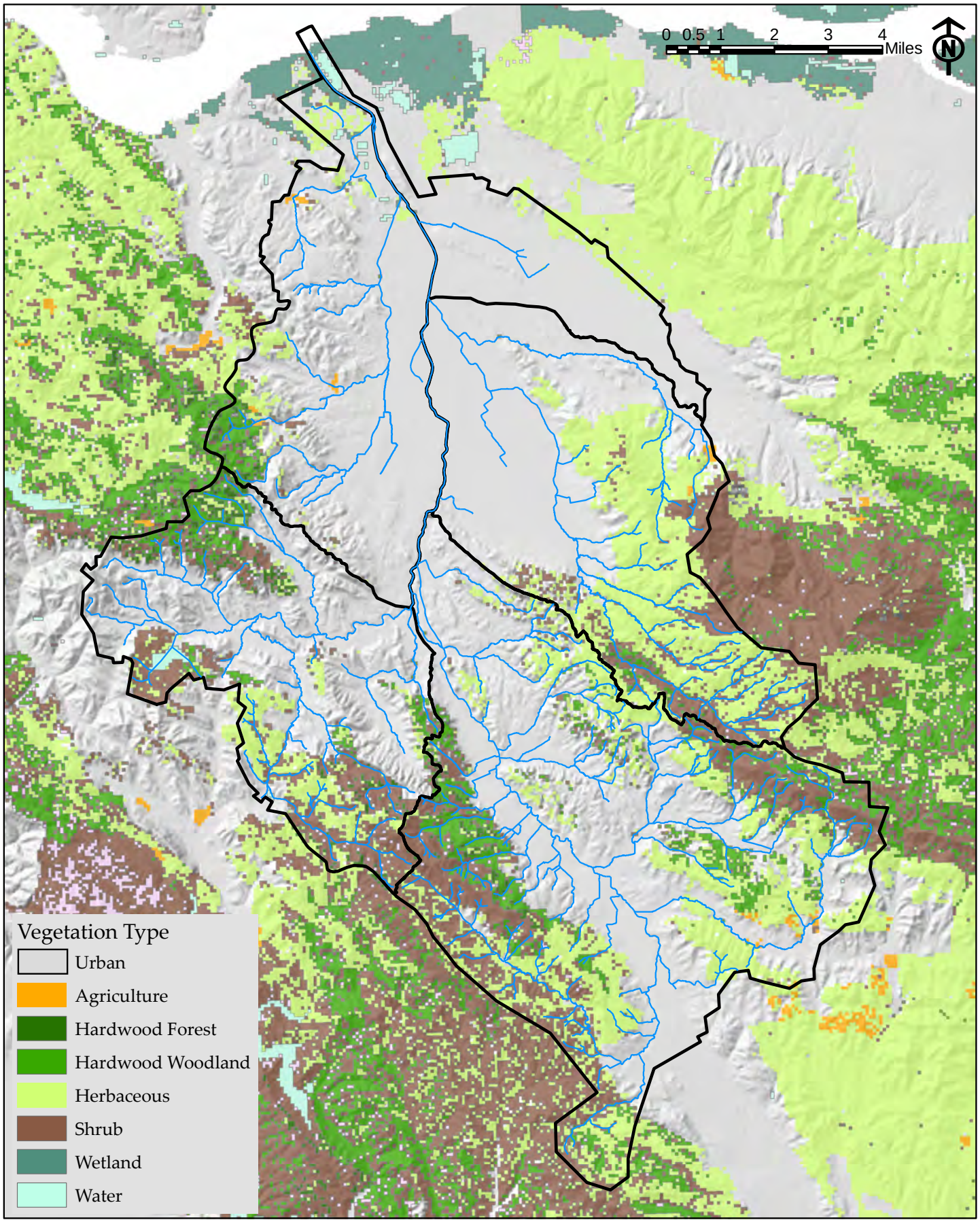
Jones and Stokes. 2005. "Lower Walnut Creek Project - Revised Salmonid Habitat Suitability and Fish Passage Assessment on Upper Walnut Creek and Tributaries (Final)." Prepared for the US Army Corps of Engineers in coordination with Contra Costa County Public Works Department.

Jones and Stokes. 2006. "Lower Walnut Creek Project - Preliminary Results of Water Year 2006 Chinook Salmon Carcass Survey." Prepared for the US Army Corps of Engineers in coordination with Contra Costa County Public Works Department.

Jones and Stokes. 2007. "Salmonid Habitat Assessment on Upper Pine Creek and Tributaries, Contra Costa County, California." Prepared for the US Army Corps of Engineers in coordination with Contra Costa County Public Works Department.

Leidy, R.A., G.S. Becker, B.N. Harvey. 2005. "Historical distribution and current status of steelhead/rainbow trout (*Oncorhynchus mykiss*) in streams of the San Francisco Estuary, California." Center for Ecosystem Management and Restoration. Oakland, California. (Available at: http://www.cemar.org/estuarystreamsreport/contracosta.html)

Figure 14. Vegetation/Habitat Types in the Walnut Creek Watershed



7 Wildlife and Habitat

Gone from the watershed are pronghorn antelope, elk*, condors, and bears. The last bear was seen in the watershed in 1968 (J. Hale, pers. comm.). The last elk was removed from the Concord Naval Weapons Station in 2006 (Martin, 2006). Even so, the Walnut Creek Watershed is extremely diverse. The Lower Walnut Creek channel alone supports over 250 species of plants and animals (Arbegast, Newton, and Griffith, 1993). The species diversity reflects the habitat diversity of the region. Figure 14 shows vegetation cover types in the Walnut Creek Watershed. The predominant type is urban which occupies most of the lowlands and some of the foothills and ridges in the watershed. Grasslands (herbaceous), shrub, and oak woodland (hardwood forest) cloak Mount Diablo and its foothills to the east and Las Trampas Ridge to the southwest. Oak woodland and shrub dominate the portion of the Briones Hills that is in the Walnut Creek Watershed. At the mouth of the watershed are the wetlands of Concord Marsh.

Habitat in the watershed can be categorized into three broad areas: upper watershed open spaces (Mount Diablo and its foothills, Las Trampas, and Briones Hills), Concord Marsh, and the urban core.

The Upper Watershed

The watershed is flanked by large, upland open spaces to the east and to the west. To the east is Mount Diablo and its foothills. Much of this highland open space has been formally protected. Some is still privately owned and ranched. Mount Diablo connects to the Central Valley to the east and to the rest of the Diablo Range to the south.

On the western slopes of the Walnut Creek Watershed are the lower and wetter Berkeley Hills (Briones Hills to the north and Las Trampas Ridge to the south). These open spaces are dissected by Highway 24 but connect individually to large open spaces, managed by the East Bay Regional Park District, the East Bay Municipal Utility District, and private land owners.

Large mammals, such as mountain lions and badgers, migrate between the upper watershed's open spaces along circuitous yet well-established corridors. The San Ramon corridor which passes under Interstate 680 via Crow Creek connects Mount Diablo to Las Trampas. The migration corridor between Las Trampas and the Briones Hills travels through Saint Mary's College in Moraga, north of Campolindo High School, through the Lafayette Reservoir open space, and under Highway 24 to the Briones Hills. Both of these corridors have multiple spurs to reach other adjacent habitats (J. Hale, pers. comm.).

Mount Diablo is situated in the relatively dry Diablo Range. Creeks that flow from its peak and flanks generally run dry in the summer. The portion of Mount Diablo in the watershed is covered mostly by chaparral, blue oak woodland, or grasslands.

Chaparral habitats consist of a single layer of shrubs (*e.g.*, chamise, black sage, ceanothus, manzanita) with very little ground cover and no upper canopy. Blue oak woodlands inhabit hilltops and gently sloping flanks such as those in the upper Green Valley and upper Pine Creek Watersheds. These are often interspersed with grey oaks. Below 1,000 feet in elevation, blue oaks grow less densely, creating a savannah with an incomplete canopy. Below 500 feet in elevation, blue oak savannahs are replaced by grasslands. Grasslands are open areas covered by herbaceous plants (Glover, 2009).

* *Las Trampas* is Spanish for The Traps and refers to traps set in the area to capture elk (Gudde, 1998).

Lower and wetter than Mount Diablo, Las Trampas Ridge and the Briones Hills are occupied by chaparral and forest types more common to the Berkeley Hills. The dominant chaparral species on Las Trampas Ridge are black sage, chamise, and buck brush. The woodlands on Las Trampas Ridge and in the Briones Hills are dominated by coast live oak and bay laurel (EBPRD, 2012a; EBRPD, 2012b).

Much of the upper watershed land in the Walnut Creek Watershed is grassland. Grasslands were once the dominant habitat type in the watershed, covering most of the valley flats and much of the Ygnacio Valley (M. Sproul, pers. comm.). Now they are mostly limited to the undeveloped mid- and upper-watersheds. Historically, grasslands in the watershed were native perennial bunch grasses but they have been replaced by introduced wild oats, bromes, and filarees (Glover, 2009).

Most grasslands in the watershed are grazed by cattle. The grasslands on Mount Diablo are notably productive grazing lands. Good rainfall, good soils, and good management result in high quality and abundant food production for cattle (clover and oats). Studies on private ranchland on Mount Diablo show that the species composition of grasslands has not changed significantly since the 1930s (J. Ginochio, pers. comm.).

The ground squirrel is the keystone species of grasslands. Once dependent on grazing mammals to keep grasslands short, they now depend on cattle to perform the same function. Ground squirrel burrows create habitat for California tiger salamanders and burrowing owls. Coyotes will enlarge ground squirrel burrows to use as dens. Ground squirrels also offer an abundant food source for predators in the watershed such as golden eagles, bobcats, and hawks (M. Sproul, pers. comm.). Viewed as pests and a threat to infrastructure, ground squirrels have long been controlled with poison which has subsequently impacted predator species. Between the 1970s and 1990s, badger populations declined greatly in the watershed. As the practice of ground squirrel poisoning has decreased in the watershed, badger and other predators have made a comeback (J. Hale, pers. comm.). Similarly, bobcat sightings are increasingly frequent (J. Ginochio, pers. comm.).

The upper watershed is home to black-tailed deer, bobcats, long-tailed weasel, grey fox, coyote, mountain lion, raccoons, black-tailed hares, opossums, skunks, and squirrels (MDIA, 2010, EBPRD, 2012a; EBRPD, 2012b). It is also home to white-tailed kites, northern harriers, short-eared owls, and a nesting pair of golden eagles (M. Sproul, pers. comm.).

Concord Marsh

The mouth of Walnut Creek passes through Concord Marsh. This broad, 6,500 acre wetland stretches along the Suisun Bay from Martinez to Port Chicago. Historically contiguous, the brackish wetland is now diked and channelized. Dredge spoils, roads, railroads, culverts, levees, oil refineries, and other industries have limited the tidal inundation and changed the character of the marshes (Goals Project, 1999). The dominant species of the Concord Marsh (outside of the industrial areas) are alkali bulrush, pickleweed, Olney's bulrush, tule, broadleaf cattail, rush, saltgrass, and sedges (PWA, 2004).

The Concord Marsh is designated an Important Bird Area by the National Audubon Society for its valuable bird habitat. The marsh supports black rails (threatened), California Clapper rails (endangered), American bitterns, Suisun song sparrows, and thousands of shorebirds and waterfowl. The 1994 Christmas Bird Count identified 5,000 greater scaup and 8,000 other ducks using the marsh (National Audubon Society, 2008). The marshes also provide habitat for the endangered salt marsh harvest mouse (PWA, 2004).

The CCCFCD, Muir Heritage Land Trust, and East Bay Regional Park District have proposed restoring Pacheco Marsh west of the mouth of Walnut Creek channel/Pacheco Creek (Figure 15). The project, when complete, will excavate and regrade the site to restore 69 acres of tidal marsh.

Urban Core

The center of the watershed and most of its lowland valleys have been developed and urbanized. This catch all category (urban) consists of a mosaic of habitat types ranging from asphalt and concrete to industrial to single family homes on large par-

Figure 15. Pacheco Marsh - Plan View of Preferred Alternative

Source: PWA, 2004.

cels. Urban land uses have greatly impacted habitat function and have forced many species into the upper watershed or out of the watershed entirely. However, these lands are not without value to wildlife.

Much of the currently urbanized land was originally grassland and has been converted to something more like woodland to the benefit of Bewick's wrens, chestnut-backed chickadees, and other shrub/woodland species (M. Sproul, pers. comm.). Coyotes, western pond turtles, green herons, wood ducks, common and hooded mergansers, Cooper's and sharp-shinned hawks, screech, great horned, and barn owls, belted king fishers, western tanagers, and western bluebirds have all adapted to live in urban areas of the watershed. Red-shouldered hawks, arboreal and California slender salamanders, western toads, and Pacific tree frogs have adapted to live in trees in more suburban settings. Ten species of bats visit the watershed, many of them roosting in the shingles of houses. Swifts and swallows have flourished under freeway overpasses. Black-tailed deer feed off of backyard horticultural plants, and following close behind are their predators, mountain lions. Mountain lions have shifted in the past generation from strictly east Contra Costa County to central- and west-county and seem to be coexisting with nearby urban environments (J. Hale, pers. comm.). Similarly, bobcats and badgers have increased in numbers recently after decades of decline and absence despite the proximity to people and urban environments (J. Ginochio, pers. comm.).

Wildlife and Habitat Management Issues

Several wildlife and habitat management issues arose during the expert interviews. While open space on the ridges and hilltops in the watershed has been fairly well protected, more large blocks of undisturbed open space, especially lower in the valleys, are still desired. These open spaces would provide different habitat functions and would stem the tide of urbanization that continues to encroach into other habitats. The public open spaces are open to recreation and this can cause conflicts with wildlife. For example, nesting peregrine falcons at Castle Rock do not coexist well with rock climbers. A pair of nesting golden eagles known to nest on private ranch lands in the watershed would probably not nest in a park open to the public. New public open spaces may need to be closed to the public for the benefit of wildlife there.

Even in well-protected open spaces, invasive species can impair habitat functions. Yellow star thistle, purple star thistle, artichoke thistle, and barbed oat grass can convert healthy grassland into something that no longer supports grassland wildlife (M. Sproul, pers. comm.).

Wood ducks and other species are dependent on mature riparian forests with trees large enough to provide cavity nesting sites. There are essentially no mature riparian trees downstream of the City of Walnut Creek (M. Sproul, pers. comm.). Urban creeks are also inviting to animal collectors. Western pond turtles that have adapted to living in Walnut Creek appear to have declined in recent years, perhaps due to collecting (J. Hale, pers. comm.).

As in much of California, horned lizard (or horned toad) populations have declined in the watershed. This is commonly attributed to the introduction of Argentine ants. Argentine ants, which the horned lizard cannot digest, have mostly replaced native black harvester ants. However, even in places that still support black harvester ants, such as ranchlands on Mount Diablo, the horned lizard has nearly disappeared (J. Hale, pers. comm.; J. Ginochio, pers. comm.).

Wild boars remain a continuous problem in the watershed. They are non-native and their habit of rooting with their snouts can be highly destructive to native habitat. Management is a challenge because they respond to depredation and hunting by increasing their litter size (J. Hale, pers. comm.) These highly intelligent boars also adjust their daily schedule in response to hunting. When and where hunting pressure increases, they become nocturnal (CDFG, 2012).

Additional Information on Habitat and Wildlife

The following sources provide additional detailed information on habitat and wildlife in the Walnut Creek Watershed:

Glover, S. 2009. *Contra Costa County Breeding Bird Atlas*. Mount Diablo Audubon Society. Walnut Creek, California.

Various East Bay Regional Park District Land Use Plans

8 Recommendations

During the research process for this report, recommendations for improved management arose either from interviewed experts or documents relating to the watershed. Table 4 summarizes over 140 of these recommendations. The recommendations are for a broad range of scales and specificity. Some are contradictory. Some were made twenty years ago and may or may not still apply. Nearly all require further analysis and investigation before implementation.

Kubicek Detention Basin, Pine Creek Subwatershed

Table 4. Recommendations for the Walnut Creek Watershed

Recommendation	Source	Date
General		
Ensure that developers of projects in the City work with landowners in adjacent jurisdictions to incorporate natural creekways as open space amenities into the design of projects as a condition of approval.	City of Concord	2007
Preserve native riparian vegetation and wildlife, and establish riparian corridors along all creeks.	City of Concord	2007
Develop a comprehensive and coordinated park and recreation facility network that visually reinforces the natural character of the community and integrates unique historic and cultural resources, open space areas, and creeks and trails.	Town of Danville	1999
Pursue flood control improvements that strive to retain the natural creek environment rather than those that simply widen and deepen stream channels.	Town of Danville	1999
Work in conjunction with the CCCFCD to maintain natural creek settings to the extent possible while providing for adequate drainage capacity. Creeks should be retained in their natural state whenever possible to maintain water quality, wildlife diversity, aesthetic values, and recreational opportunities.	Town of Danville	1999
Preserve, protect, and restore riparian habitat, particularly the native, riparian woodland species and associated understory plants.	City of Lafayette	2002
Protect and enhance the natural resources associated with creeks and their riparian zones without jeopardizing the public health, safety and welfare.	City of Martinez	2010
Protect the creek area with appropriate development setbacks to protect its riparian environment and address flood risks.	City of Moraga	2002
Require that land development be consistent with the natural carrying capacity of creeks, streams and other waterways to preserve their natural environment.	City of Moraga	2002
Restore riparian corridors and waterways throughout the city.	City of Walnut Creek	2006
Through land acquisition and/or conservation easements, create or improve riparian corridors, riparian lands within parks, wetlands, and buffer zones.	City of Walnut Creek	2006
Cooperate with landowners, the public, regulatory and trustee agencies, and local and State agencies to expand creek restoration efforts and programs.	City of Walnut Creek	2006
Implement the 1993 Creeks Restoration and Trails Master Plan.	City of Walnut Creek	2006
Expose covered creeks and in-corporate open creeks in new development and redevelopment wherever possible.	City of Walnut Creek	2006
Encourage the use of alternative drainage systems that rely on increased retention capacity to lessen or eliminate the need for structural modifications to watercourses wherever possible.	City of Lafayette	2002
Develop a comprehensive and coordinated park and recreation facility network that visually reinforces the natural character of the community and integrates unique historic and cultural resources, open space areas, and creeks and trails.	Town of Danville	2006

Recommendation	Source	Date
Fish Passage		
Do not provide fish passage at Drop Structure #1 (fish - particularly out migrants - would be trapped in concrete channels upstream of drop structure).	J. Burman; D. McCants	2012
Install a fish ladder on Drop Structure #1 unless a means is found to allow fish access via Ellinwood Creek.	Arbegast, Newton, & Griffith	1993
Support efforts of the County to determine the feasibility of constructing fish bypass facilities for flood control drop structures in area creeks.	City of Pleasant Hill	2003
Install a fish ladder on Drop Structures #1 and #2.	Jones and Stokes	2004; 2005
Install low curbs in concrete-lined channels to concentrate flows.	Jones and Stokes	2005
Create shallow plunge pools or steps on the face of the 100-foot-long chute.	Jones and Stokes	2005
Modify Ellinwood Creek outlet structure to create a fish passage structure.	Arbegast, Newton, & Griffith	1993
Install baffles in the concrete U-frame channel in Walnut Creek.	Arbegast, Newton, & Griffith	1993
Create low flow channel in Walnut Creek/San Ramon/Las Trampas culverts.	Roberts & Associates	1993
Install a fish ladder on the drop structure at the lower end of Las Trampas Creek.	Arbegast, Newton, & Griffith; Roberts & Associates	1993
Lower Walnut Creek		
Permit emergent wetland vegetation (*e.g.*, cattails) to grow along the banks of the low flow channel.	Arbegast, Newton, & Griffith	1993
Permit natural revegetation of low growing willows along the west bank of the low flow channel.	Arbegast, Newton, & Griffith	1993
Build set-back levee in Lower Walnut Creek channel in increase flow capacity.	S. Stonestreet	2012
Widen Lower Walnut Creek channel to increase flow capacity.	S. Stonestreet	2012
Replace bridges across Lower Walnut Creek channel with longer/higher bridges, alleviate constrictions to increase flow capacity.	S. Stonestreet	2012
Provide access easements for creek maintenance purposes and public access to creekside amenities.	City of Concord	2012
Add 10-20 cubic yards of 3/4 inch gravels downstream of Drop Structure #1 for salmonid spawning.	J. Burman	2012
Augment existing spawning gravels with washed, river-run gravels (to remove fines) to improve survival of Chinook salmon, and possibly steelhead, eggs and embryos in the gravel. It is recommended that gravel augmentation be undertaken as a pilot study by excavating one or more known spawning areas (*e.g.*, pool tailouts and riffles) and replacing the excavated substrate with clean gravel.	Jones and Stokes	2005

Recommendation	Source	Date
Monitor gravel augmentation sites for gravel quality (*i.e.*, percent fines) annually for three years following installation to document any changes in gravel quality over time.	Jones and Stokes	2005
Add spawning-sized gravel in the low flow channel.	Arbegast, Newton, & Griffith	1993
Recommence DFG gravel augmentation in Lower Walnut Creek	D. McCants	2012
Enhance the pool at the base of Drop Structure #1.	Arbegast, Newton, & Griffith	1993
Place large boulders in the channel to create riffles and pools.	Arbegast, Newton, & Griffith	1993
Investigate opportunities to provide juvenile salmon with rearing habitat on floodplains in the watershed to improve growth.	L. Hunt	2012
Pine Creek Watershed		
Enhance habitat in Pine Creek for salmonids.	J. Hale	2012
Add cobble and pea gravel to lower Pine Creek to enhance spawning habitat.	J. Hale	2012
Recommence DFG gravel augmentation in Pine Creek.	D. McCants	2012
Create more habitat restoration in Lower Pine Creek for salmonids.	D. McCants	2012
Enhance and maintain the natural values of creeks and major drainage ways. This could include restoration measures along Galindo, Mount Diablo, and Pine Creeks to improve ecological systems, slow peak storm runoff, and increase infiltration.	City of Concord	2007
Ellinwood Creek		
Implement habitat restoration and enhancement in Ellinwood Creek.	Arbegast, Newton, & Griffith	1993
Modify Ellinwood Creek outlet structure to create a fish passage structure.	Arbegast, Newton, & Griffith	1993
Refurbish Ellinwood Creek water diversion structure and divert a portion of the flow in Walnut Creek into Ellinwood Creek.	Arbegast, Newton, & Griffith	1993
Remove accumulated sediment from 48-inch culvert from Walnut Creek to Ellinwood Creek.	Arbegast, Newton, & Griffith	1993
Redefine low-flow channel by clearing vegetation and excavating sediment.	Arbegast, Newton, & Griffith	1993
Create varied streambed of pools, riffles, and runs.	Arbegast, Newton, & Griffith	1993
Replace flap gate on Walnut Creek side of the outlet pipe with a slide flap gate to allow fish passage.	Arbegast, Newton, & Griffith	1993
Replant native riparian plant species.	Arbegast, Newton, & Griffith	1993

Recommendation	Source	Date
Stabilize eroding stream bank.	Arbegast, Newton, & Griffith	1993
Install nest boxes.	Arbegast, Newton, & Griffith	1993
Walnut Creek (Downtown Reach)		
Remove concrete from banks and reuse as "boulder" clusters for fish cover.	Roberts & Associates	1993
Place natural boulders on the bank and toe of bank.	Roberts & Associates	1993
Stabilize the two of banks with large rip-rap, backfill, and revegetate in reach between Civic Drive and Mount Diablo Boulevard.	Roberts & Associates	1993
Retrofit existing bank protection using planting collars in reach between Civic Drive and Mount Diablo Boulevard.	Roberts & Associates	1993
Remove non-native plants and replace with native plants in reach between Civic Drive and Mount Diablo Boulevard.	Roberts & Associates	1993
Use triangular wing deflectors or boulder clusters to create more complexity (riffle/run) alongside Civic Park.	Roberts & Associates	1993
Las Trampas Creek Watershed		
Preserve and reclaim the creeks in the downtown area; Happy Valley Creek as a primary visual corridor from the BART Station to Mt. Diablo Boulevard, and Lafayette Creek as a local visual corridor, south of Golden Gate Way.	City of Lafayette	2002
Develop a long-term management plan for addressing creek bank stability on Las Trampas Creek, Grizzly Creek, and other creeks with bank slumping problems. This plan should identify the location of problem areas and develop a strategy for addressing these problems on a watershed basis.	City of Lafayette	2002
Install a fish ladder or a series of check dams to replace the drop structure upstream of the culvert and confluence with Las Trampas.	Roberts & Associates	1993
Retrofit sackcrete between drop structure and culvert with planting collars.	Roberts & Associates	1993
Construct a low-flow channel and resting pool upstream of the drop structure.	Roberts & Associates	1993
Widen and stabilize the reach upstream of the drop structure by encroaching on the parking lot to the north and building vertical walls; build multi-terrace channel and trails; place boulders and wing deflectors; remove invasive plants (would require upstream detention basins or bypassing Tice Creek directly into San Ramon).	Roberts & Associates	1993
Install boulder reflectors and cobble in reach upstream of California Avenue. Add spawning gravels when necessary.	Roberts & Associates	1993
Construct a low-flow channel in the downtown culvert; add levees upstream to compensate for lost capacity.	Roberts & Associates	1993

Recommendation	Source	Date
San Ramon Creek Watershed		
Enhance San Ramon's creeks and riparian corridors by requiring preservation or replacement of riparian vegetation, as appropriate and in conformity with regulatory requirements.	City of San Ramon	2010
Implement habitat enhancements along San Ramon Creek within the communities of San Ramon, Danville, and Alamo, especially the creation of shade and cover for juvenile fish, and planning for laddering of the drop structures.	Arbegast, Newton, & Griffith	1993
Install baffles or otherwise restore the concrete U-frame on San Ramon Creek within the City of Walnut Creek to allow fish passage into Upper San Ramon Creek.	Arbegast, Newton, & Griffith	1993
Modify the diversion structure connecting San Ramon Creek and the flood bypass around the east side of the City of Walnut Creek to allow fish passage into Upper San Ramon Creek.	Arbegast, Newton, & Griffith	1993
Construct low-flow channel in culvert (5-8 feet wide, 1-2 feet deep) with baffles.	Roberts & Associates	1993
Install low check dams in reach of culvert just upstream of confluence with Las Trampas.	Roberts & Associates	1993
Between the bypass and downtown culvert, create a central low flow channel by stabilizing the toe, backfilling, and revegetating; remove sackcrete and replace with planting collars; create riffle/pool sequences; install current deflectors and boulder clusters; install waterfall/pool complex made of logs and riprap.	Roberts & Associates	1993
Above Creekside Drive bridge, remove or retrofit (install boulders backfilled with substrate for vegetation) concrete channel to provide better habitat.	Roberts & Associates	1993
Below Creekside Drive, hide walls with planting collars and vegetation.	Roberts & Associates	1993
Redesign low-flow culvert outfall between bypass and San Ramon Creek to accommodate fish passage; provide resting pool in bypass.	Roberts & Associates	1993
Restore a continuous riparian vegetation corridor (with the exception of freeway interruptions) from the headwaters in San Ramon to the Walnut Creek City Limits.	Keeler Mitchell Caronna	1994
Remove exotic plant material.	Keeler Mitchell Caronna	1994
Identify and enhance important habitat areas for wildlife.	Keeler Mitchell Caronna	1994
Use the existing hydrologic information to analyze and make recommendation to restore bed stability, channel banks, and reduce flood hazard.	Keeler Mitchell Caronna	1994
Retain as much natural character as feasible and integrate the creek in a manner compatible with adjacent urban development.	Keeler Mitchell Caronna	1994
Develop diverse, multi-layered plant community.	Keeler Mitchell Caronna	1994

Recommendation	Source	Date
Retrofit existing bank protections and revegetate with native species.	Keeler Mitchell Caronna	1994
Remove existing structural bank protection.	Keeler Mitchell Caronna	1994
Modify existing steep banks to shallow or moderated slopes and revegetation with native species.	Keeler Mitchell Caronna	1994
Stabilize toe banks with riprap.	Keeler Mitchell Caronna	1994
Stabilize banks with terraces, backfill, and revegetation.	Keeler Mitchell Caronna	1994
Either remove engineering improvements, create holes in bank protection membrane and plant with trees, or leave the improvements and plant along the top of the bank.	Keeler Mitchell Caronna	1994
Eliminate habitat gaps in the corridor through habitat restoration.	Keeler Mitchell Caronna	1994
Increase habitat structural complexity in degraded riparian habitats through restoration.	Keeler Mitchell Caronna	1994
Remove debris and rubble from stream corridors.	Keeler Mitchell Caronna	1994
Remove non-native pines and eucalyptus trees that do not support nesting or roosting raptors.	Keeler Mitchell Caronna	1994
Preserve, restore and rehabilitate creek/trail areas using bio-engineering methodologies and techniques.	Town of Danville	2006
Upper Watershed		
Make improvements to Sycamore Creek, including a creekside trail and flood capacity improvements.	Town of Danville	1999
Survey upper watershed creek to find over-summering pools for resident rainbow trout.	P. Alexander	2012
Re-introduce resident rainbow trout to upper watershed.	P. Alexander	2012
Concord Marsh/Pacheco Marsh		
Grade Pacheco Marsh site to restore 69 acres of self-sustaining, high quality tidal marsh.	PWA	2004
Replace existing southwestern culvert with four 48-inch culverts to allow tidal exchange in Pacheco Marsh.	PWA	2004
Include parking, staging, and trails in final Pacheco Marsh plan.	PWA	2004
Map on-site soil quality to determine extent of selenium and mercury in Pacheco Marsh.	PWA	2004
Restore large areas of marsh in diked and muted tidal areas.	Goals Project	1999

Recommendation	Source	Date
Where tidal marsh cannot be restored, improve waters management to enhance diked wetlands.	Goals Project	1999
Ensure natural transitions between marshes and adjacent uplands and protect adjacent buffers where possible.	Goals Project	1999
Water Quality		
Source control: Reduce outdoor applications of pesticides; infiltrate runoff at the source (maintain or restore a site's natural hydrology); ban plastic bags and polystyrene food containers; support legislation that makes manufactures responsible for end of life disposal of their products (*i.e.*, pharmaceuticals, batteries, oil, fluorescent bulbs, electronic equipment, etc...).	T. Dalziel	2012
Behavioral Change: Use less toxic pesticides; install bay friendly landscapes; stop littering, composting; recycle; scoop your dog's poop, etc….	T. Dalziel	2012
Redesign and retrofit of stormwater drainage infrastructure: Install green infrastructure, rain gardens, green streets, pervious pavements, low impact development; maximize opportunities to infiltrate runoff; shift from collect and convey approach to the infiltration approach (slow it, spread it, sink it).	T. Dalziel	2012
Cities will be pushed to look for retrofit opportunities (e.g., parking lots and green streets).	T. Dalziel	2012
Emphasize Control of Trash: Enhanced street sweeping; prevent over-filled dumpsters; catch basin cleaning; identify places (schools) and events that generate lots of trash; identify creeks where trash accumulates and identify what trash is most prevalent.	T. Dalziel	2012
Seek Regional Solutions: Build strategic regional stormwater retention ponds for flood control, stormwater treatment, and stormwater reuse for landscape irrigation and other non-potable water uses (toilet flushing).	T. Dalziel	2012
Protect remaining pristine creek corridors, and conserve and/or restore impacted and degraded creeks and flood plains.	T. Dalziel	2012
Encourage the use of non-polluting herbicides near watercourses.	City of Lafayette	2002
Engineer future major developments to reduce peak storm runoff and non-point source pollution to local creeks and streams.	City of Moraga	2002
Monitor the condition of waterways within the city limits and take proactive measures to prevent degradation.	City of San Ramon	2010
Determine whether fish taken from lower Walnut Creek channel are safe for consumption.	Arbegast, Newton, & Griffith	1993
Non-aquatic Wildlife		
Protect large blocks of undisturbed habitat.	M. Sproul	2012
Minimize the impacts of recreation/exclude it from some land.	M. Sproul	2012

Recommendation	Source	Date
Continued ranching for wildlife benefit.	M. Sproul	2012
Keep cattle out of the streams proper.	M. Sproul	2012
Control invasive species such as yellow star thistle, purple star thistle, artichoke thistle, and barbed oat grass.	M. Sproul	2012
Establish a riparian field station with mist netting to monitor birds.	J. Hale	2012
Control invasive wild boar.	J. Hale	2012
Through the development review process, encourage wildlife corridors to provide connectivity between established open space areas, where deemed appropriate.	City of San Ramon	2010
Facilitate open space areas so as to provide wildlife movement between Sugarloaf Recreation Area, San Ramon Creek, and connections between Walnut Creek and Bollinger Canyon.	Keeler Mitchell Caronna	1994
Place nest boxes for cavity nesting ducks and songbirds.	Keeler Mitchell Caronna	1994
Watershed Council		
Help secure grant funding.	P. Detjens; T. Dalziel	2012
Apply for and/or support grant opportunities.	T. Dalziel	2012
Vet ideas.	P. Detjens	2012
Coordinate creek groups throughout the watershed.	P. Detjens	2012
Increase awareness of stormwater pollutants, sources, and impacts.	T. Dalziel	2012
Promote positive changes in behavior to protect local creeks.	T. Dalziel	2012
Educate everyone on pollutant sources and their impacts.	T. Dalziel	2012
Identify and prioritize retrofit and/or restoration projects.	T. Dalziel	2012
Encourage and support community involvement and volunteers.	T. Dalziel	2012
Engage and educate local elected officials and other decision makers.	T. Dalziel	2012
Promote source control.	T. Dalziel	2012
Promote Bay-friendly landscapes.	T. Dalziel	2012
Promote need for redesign and retrofit of storm drainage infrastructure.	T. Dalziel	2012
Promote critical need for public investment in stormwater drainage infrastructure.	T. Dalziel	2012

Mount Diablo Creek

Mount Diablo Creek Watershed

A final recommendation to consider is the inclusion of the Mount Diablo Creek Watershed into the Watershed Council's planning efforts. As described earlier in this report, Mount Diablo Creek used to be a part of the Walnut Creek Watershed. It flowed into Clayton Drain before it was diverted to the east where it now flows through Seal Creek and Hastings Slough. Even in its current configuration, it drains part of the Diablo Valley and empties into Suisun Bay less than two miles east of the mouth of Walnut Creek.

As this document demonstrates, the opportunities for restoration along the highly urbanized reaches of Walnut Creek present great challenges. By broadening its geographic scope slightly to include all of the Diablo Valley, the Watershed Council would avail itself to great opportunities for creek, steelhead, and upland restoration along Mount Diablo Creek. The Mount Diablo Creek Watershed does not have an active watershed council and many of the municipalities and agencies involved would be the same ones involved in the Walnut Creek Watershed.

The inclusion of Mount Diablo Creek Watershed would bring its own unique challenges, but they may be well worth it for a young Watershed Council seeking early victories in the improvement of watershed management in the Diablo Valley.

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