

The Medina County Environmental Action Association, Inc.

202 CR 450, HONDO, TX 78861

www.dontmesswithquihi.com

Phone 830-741-5040

Fax 830-426-2060

January 13, 2006

Ms. Rini Ghosh
Section of Environmental Analysis
Surface Transportation Board
ATTN: Finance Docket No. 34284
1925 K Street, NW
Washington, DC 20423-0001

received
1/25/06

Re: Finance Docket 34284
Proposed Vulcan Materials/Southwest Gulf Railroad Rail Line
Medina County, Texas

Dear Ms. Ghosh:

We have reviewed EI-1802, Vulcan's reply to an earlier submission of ours regarding flood hazards in the Quihi area.

In that letter, Vulcan disputes that its quarry and rail line will create and exacerbate flood hazards and are, as presently proposed, failing to plan for flood impacts through the National Environmental Policy Act (NEPA) process. As expressed in EI-1802 and EI-1769, Vulcan's current position is that flood modeling is "alignment specific" and therefore can only be done during the mitigation process. This of course, illegally renders the Surface Transportation Board's environmental review a rubber stamp on Vulcan's preferred alignment alternative, causing the agency to illegally abdicate review of the most relevant factors within its jurisdiction: design of the rail line and its structures, including bridges and embankments.

Having not seen from Vulcan any grounding in law or the facts of this case that would allow such delegation of the most relevant factors, we were pleasantly surprised to see a new tack in EI-1802:

[Vulcan] is not aware of any claims made in the DVDs submitted by MCEAA, or elsewhere, that such rail lines [with trestle bridges and embankments] contribute to flooding. This is the case even though virtually all of these existing rail lines were designed and constructed prior to the enactment of NEPA and thus without environmental reviews or mitigation conditions of any kind.

There are times when representatives of the applicant should stop speculating and stretching for arguments, because it just puts the agency further behind the eight-ball in the analysis of whether relevant factors have been ignored. This is one of those times.

As we have stated from the start, trestle bridges and rail embankments across floodplains are *per se* flood hazards in areas subject to flash flooding. The historical record is full of evidence of trestle bridges washing out and embankments and levees altering the course of floodplains. As we have noted, in January 2005, embankments and trestles were washed out in a flash flood along the Union Pacific's Caliente route in Nevada, which has been proposed to haul high-level nuclear waste to Yucca Mountain. Closer to home, a trestle bridge over Hondo Creek failed in flash flooding in 1997, after first backing water up Quihi, Elm, and Cherry Creeks. We could no doubt collect, from news reports and the agency's own files, overwhelming evidence of the *per se* flood hazard posed by building these structures in and around floodplains in flash flood prone areas.

Fortunately, there is a comprehensive historical study that concludes the same. A 1999 historical study of the Los Angeles River basin, a basin where flash flooding is essentially the exclusive class of hydrologic event, leaves no doubt of the role of railroad structures:

But nothing exacerbated the flood danger more than the railroads. The most serious problem caused by the three national lines built across Los Angeles County during the last three decades of the nineteenth century was their use of trestle bridges, which often obstructed the free flow of water in the rivers and streams. Such bridges were typically built upon wood piles driven at close intervals into riverbeds. The bridge supports were so close together that they frequently acted as dams during heavy storms, when rain-swollen streams carried large quantities of trees, brush, and other debris. If enough material accumulated behind the trestles, water was forced out of stream channels and over nearby lands. Sometimes, when the pressure upon the trestles became great enough, the bridges themselves gave way, unleashing a torrent of water and debris that endangered bridges, buildings, and human lives downstream.

Even railroad bridges that did not rely on trestles for support often impeded the free flow of storm waters. The Los Angeles and San Gabriel Valley Railroad bridge over the Los Angeles River, for example, was built so low to the ground that it would seem to have been designed by someone who had seen the river only in summer. It was clearly destined to fail. Railroads further heightened the flood danger by building their tracks across floodplains, thus confining waters that would have formerly spread unimpeded over a wide area. Such tracks were often built on artificial embankments several feet high. Where natural stream banks were low, these embankments, in effect, became set back levees and, by forcing the floodwaters into an area smaller than the river's natural floodplain, increased the depth, speed, and cutting power of flood flows. The purpose of levees built for flood protection is to keep water away from development, but these embankments sometimes enclosed already settled areas.

Gumprecht, The Los Angeles River: Its Life, Death, and Possible Rebirth 151–152 (Johns Hopkins 1999).

Trestle bridges . . . often acted as dams during heavy storms, when stream-carried debris backed up behind bridge supports.

Railroad embankments, such as this one built across the river floodplain . . . confined floodwaters into a smaller area, which increased the intensity of flood flows and heightened their destructive power.

Id. at 152.

The sequence of events in the [January 1886] flood demonstrated the effect of railroad development on flood risk.

Id. at 159.

Once again [in 1889], storm-induced damage to the railroad bridges precipitated destruction and contributed to flooding farther downstream.

Id. at 162.

More than ever before [in February 1914] the railroads were a factor in the flooding . . . The Los Angeles River was crossed in sixteen places by railroad bridges, many of them trestle bridges, which slowed and sometimes blocked debris-laden flood flows. After the flood, county flood control officials received “a large number” of letters from residents critical of the railroads for their continued use of trestle bridges. Within days of the flood, furthermore, the Los Angeles County Board of Supervisors passed a resolution calling on the railroads to replace their pile bridges with more permanent span structures that would allow stream flows to pass more freely. Railroad representatives expressed a willingness to cooperate.

Id. at 170.

The above excerpts from The Los Angeles River: Its Life, Death, and Possible Rebirth are just a preview of the irrefutable historical evidence that the study presents. We have enclosed the entire chapter pertaining to flooding for the agency’s review and inclusion in the record.

As the introductory pages to the chapter make clear, the common denominators here are 1) flash flooding as the dominant if not exclusive means of significant runoff; 2) significant underground flow and hydrologic connections between groundwater and surface water; 3) shallow stream channels often filled with debris washed down from higher elevations; 4) surrounding agricultural lands that absorbed overland flow and frequent out-of-channel flow; 5) significant groundwater withdrawals for consumptive use and irrigation in the basin; 6) high flood frequency as historically documented by local residents. The hydrologic conditions in pre-railroad Los Angeles had much in common with those currently existing in Quihi basin.

As the railroads arrived in Los Angeles, settlement boomed and agrarian land use in and around the floodplain became crowded out in the late 19th century and early 20th century. During

this time, the railroads built their trestle bridges and embankments. The results are in the historical record and the enclosed chapter from The Los Angeles River: Its Life, Death, and Possible Rebirth for everyone to see: *per se* cause of and contribution to flood hazards when constructed in flash flood areas. As the chapter explains, this was true even for structures constructed on tributary streams; the adverse impacts were by no means limited to the main river stems.

The “lessons learned” that should apply in this proceeding were literally recognized over a century ago. In this proceeding, there is no serious debate that the design of the rail structure is the most relevant factor in the analysis of direct impacts from the rail line. It is also a necessary component of any adequate cumulative impact analysis.

Vulcan is out of arguments. Their reliance on a post-licensing delegation of analysis from the agency is legally impermissible if the design of the rail line is a relevant factor in determining flood impacts that must be analyzed in the EIS. Obviously, design is a relevant factor. So the new tack has been to deny the obvious—that design is a relevant factor—by claiming that, because they have been used historically, trestle bridges and embankments couldn’t cause flooding here because they allegedly didn’t cause flooding elsewhere. But, surprise, they do cause flooding! And it has been recognized for over 100 years in flash flood prone areas.

Even a glance at MCEAA’s scoping comments, where we present an output from a flood analysis model showing the clear alterations in the floodplain caused by five rail bridges in the Brownsville, Texas area, underscores this. Combined with the *per se* cause and contribution evidence from Los Angeles, it is clear once again that the entity speculating that historical lessons and evidence do not apply to this project is Vulcan, not MCEAA.

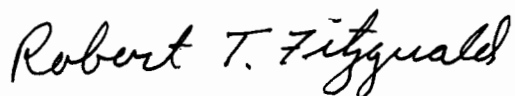
We commend the enclosed historical study to the agency. We have underlined the most relevant paragraphs and sections to assist the agency, but the whole chapter is well worth the read. It is our hope that this will give all of the agency’s technical and environmental review staff a deeper understanding of the *per se* hazard posed by building rail trestle bridges and embankments in flash flood prone areas.

The “debate” over whether the design of the rail line is a relevant factor in an analysis of flood impacts is over. The evidence shows that it was settled before any of us were even born. Because design is *the* relevant factor, a comparison of modeled flood impacts among the alternative design alignments is required before a license may be issued. Runoff impacts from the quarry must be input to produce an adequate cumulative impact analysis. Because the quarry’s contribution is highly relevant in determining the preferred alignment design, and because it is allegedly certain to occur, it should be assumed as part of a baseline scenario in the impact analysis for the alignments.

Finally, we decline to address Vulcan’s repeated attempts to save its argument that delegation through mitigation is a sufficient substitute for disclosure in the environmental impact statement and comparison of alternatives, because it has no legal basis. We do reiterate, however, that it is the position of the agency and Vulcan that no other agency or unit of government’s laws, regulations, or standards—procedural or substantive—will be enforceable besides those STB chooses to require compliance with in the license. This is interesting because attempting to convert NEPA from a procedural to a substantive statute in the manner proposed by Vulcan begs the

question of where STB will derive its mitigation standards from. Are they strictly procedural, or, if they include substantive mitigation targets, are there situations where more substantive mitigation is required? We know that your argument cannot be that delegation of analysis is always permitted, because that position is probably worthy of sanction. So, is the ultimate substantive mitigation standard that would allegedly justify the delegation of procedural analysis from the agency to the applicant a “no impact” standard, a “no significant impact” standard, a less stringent standard, or no standard at all? Given the potential for arbitrary and capricious action between fact patterns and cases, perhaps the agency can understand why this is not a question that NEPA leaves to its discretion.

Sincerely,

A handwritten signature in cursive script that reads "Robert T. Fitzgerald".

Dr. Robert T. Fitzgerald, President
MCEAA, Inc.

Enclosure:

Gumprecht, Blake. The Los Angeles River: Its Life, Death, and Possible Rebirth 131–171 (Johns Hopkins 1999).

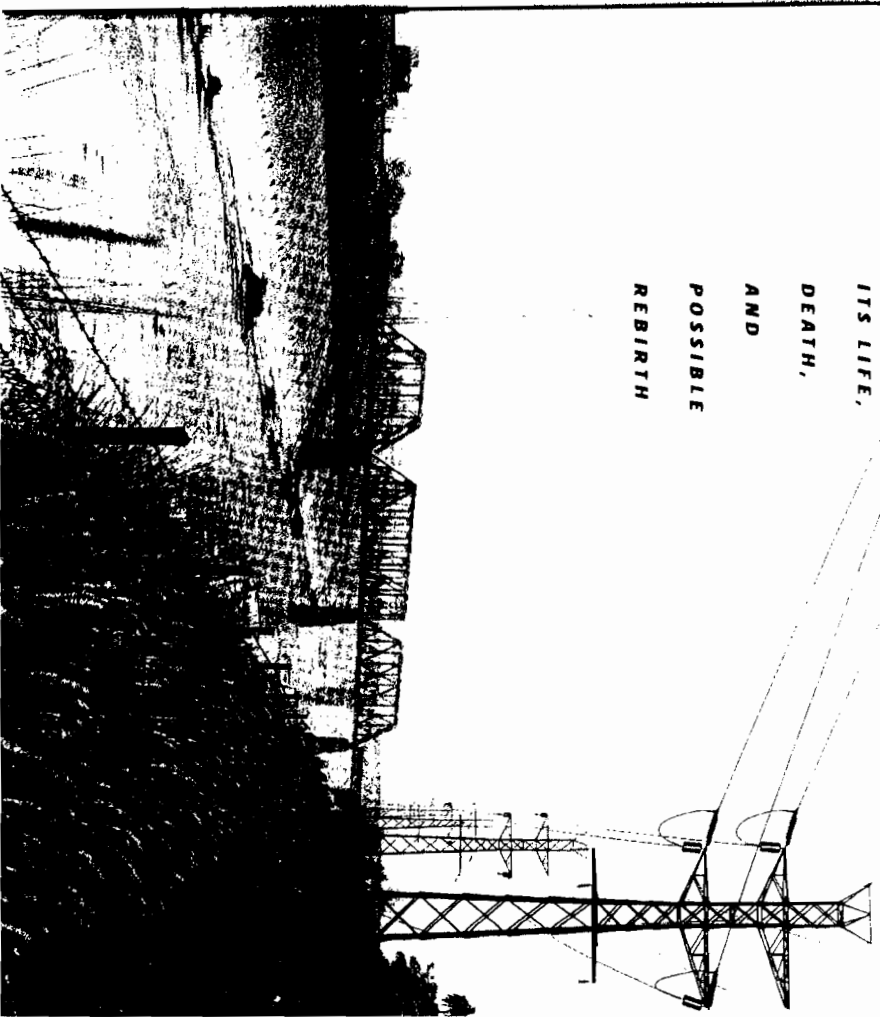
cc:

U.S. Congressman Henry Bonilla
County Judge James Barden
County Commissioner, Pct. 1, Chris Mitchell
County Floodplain Administrator Pat Brawner
Texas Historical Commission Executive Director Larry Oaks

MCEAA, Inc., for your Home, Health, and Heritage

**The
LOS ANGELES RIVER**

**ITS LIFE,
DEATH,
AND
POSSIBLE
REBIRTH**



CREATING THE
NORTH AMERICAN
LANDSCAPE
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DESPITE ITS REPUTATION AS A LAND OF PERPETUAL SUNSHINE and little rain, Southern California probably faces a greater natural hazard from catastrophic floods than any other metropolitan area in the nation.¹ More than half of the nonmountainous portion of Los Angeles County was once threatened by floods. Before the region's waterways were confined and controlled, rivers and streams overflowed often, carving ravines through fertile farmland, destroying homes and businesses, crippling transportation and communication lines, and occasionally washing away entire towns. Rivers became torrents, sometimes breaking through their banks and cutting completely new courses to the ocean. Periodically, the floodwaters from dozens of streams would join on the coastal plain and spread across the landscape to form huge lakes. Such floods were also deadly; in fact, more people have been killed in Los Angeles County in floods than by earthquakes. Flooding became an increasing hazard as the population grew and development expanded. Human beings made matters worse by building on the floodplain, removing trees and vegetation that had kept soils in place, cutting openings in stream banks to divert water for irrigation, erecting levees that constricted flood flows, and constructing railroads that interrupted natural drainage patterns.²

Southern California has experienced more than sixty significant floods since settlement by the Spanish. Many of those occurred on the Los Angeles River. The earliest written report of a flood in California, in fact, concerned the Río de Porciúncula. Representatives of the first Spanish land expedition to California in 1769 found trunks of numerous trees on the banks of the river near its confluence with the Arroyo Seco, "giving clear indication of great floods in the rainy season." When the Portolá expedition returned to the area on 17 January 1770, representatives noted that the river's banks were littered with uprooted trees and debris, evidence that "a few days previous there had been a great flood, which had caused it to leave its bed." Historical climate studies have since estimated that the Los Angeles area received

more rain that winter than at any time in the next forty years.³ Though details about many early floods are unknown, the Los Angeles River has overflowed its banks at least two dozen times since then. Floods, moreover, have altered the course of the river again and again.

Los Angeles is naturally flood prone because of the region's topography and climate. Mountains ring the valleys and coastal plain, trapping storms and speeding runoff (fig. 4.1). Elevations rise to more than 7,000 feet in the area drained by the Los Angeles River. Though some portions of the coastal plain receive as few as ten inches of rain a year, a few mountain peaks receive more than forty inches of precipitation annually. It has been estimated that nearly 75 percent of the runoff in the county originates in the mountains. Nearly all of the precipitation occurs during four winter months, and most falls as rain, concentrated in brief but often violent storms. Drainage lines are short, and their fall to the ocean relatively rapid. The watershed of the Los Angeles River drops more than 7,000 feet in a little over forty miles, from its highest point at 7,124-foot Mount Pacifico to the river's mouth at Long Beach. The river itself falls 795 feet on its fifty-one-mile course, a seemingly insignificant slope but comparatively abrupt for a major lowland waterway passing through a heavily urbanized area. The Mississippi River, in contrast, falls just 605 feet in more than two thousand miles.⁴

The San Gabriel Mountains, which contribute the greatest runoff to the Los Angeles River system, are composed primarily of igneous rock that is cut by numerous faults and is heavily fractured. The mountains are relatively young in geologic terms, so their slopes are extremely steep and rugged, rising 1,000 to 3,000 feet per mile. They are taller from base to summit than the Rocky Mountains by three thousand feet. Because they are in a nearly constant state of disintegration, moreover, craggy ridges and narrow V-shaped canyons are common.⁵ In places, the inclines are nearly vertical. As a result, soils are thin and rocky, and the lack of rain most of the year inhibits vegetation growth. Few trees can survive in such conditions. Scattered chaparral and coastal sagebrush cover most of the mountains, with small pockets of conifers in the higher elevations. A state government engineer in 1888 wrote that "bare granite slopes, great crumbling masses of rock, and glistening ridges innocent of a tree, are the ruling features of the landscape."⁶ Before flood control work began in the mountains, there was little to absorb or slow runoff. Fire only made matters worse, frequently burning the brushy slopes bare. The mountains were subject to intense erosion.

The winter storm systems that stall over these mountains often produce torrential rain, with precipitation rates of two inches per

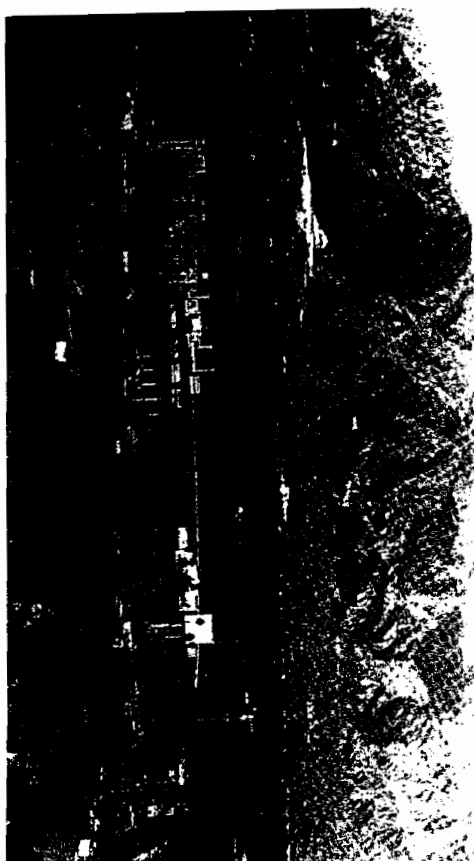
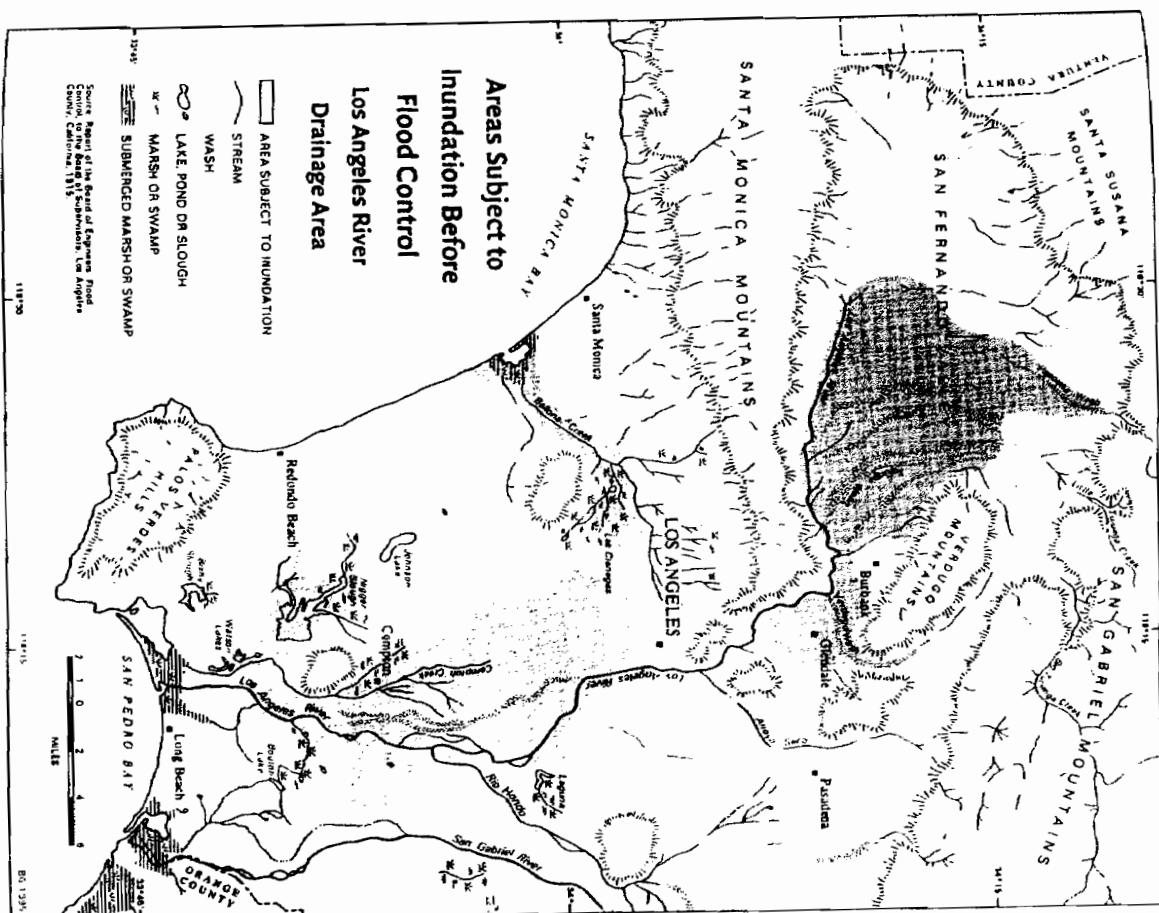


FIG. 4.1. The San Gabriel Mountains, rising to more than seven thousand feet in the watershed of the Los Angeles River, dwarf the giant Rose Bowl in Pasadena, which seats 104,000 people. The lined channel of the Arroyo Seco, a major tributary of the Los Angeles River, is visible in the foreground. Photograph by the author, 1997.

hour not uncommon.⁷ Some of the most concentrated rainfall ever recorded in the United States has occurred in the San Gabriel Mountains. During such storms, the mountain soils quickly become saturated. Rainfall runs off rapidly, carrying mud, rocks, and trees down the precipitous slopes and narrow canyons, many of which are often blocked by boulders that had been transported during earlier storms. Even today, massive, catastrophic debris flows—moving mixtures of boulders, mud, sand, and water that can wipe out entire residential subdivisions in minutes—are a fact of life in foothill communities.⁸ Until dams and other flood control works were built in the mountains and foothills, this debris was often carried to the valleys and coastal plain below, clogging stream channels. The rivers and streams of the lowlands were ill-equipped in their natural state to carry the great quantities of water and other materials that cascade from the mountains during heavy storms. The result was floods of such fierceness that an anonymous U.S. government engineer likened their power to "the discharge of a bursting dam."⁹

Precipitation is rare in lowland Southern California except during winter, so until stream channels were lined with concrete by flood control projects, most were dry except during the rainy season. Lacking a continuous flow, they were unable to dig deep channels or establish well-defined courses. Their banks were low and their beds wide. Even in moderate storms, floodwaters quickly spread over the landscape. Before a comprehensive program of flood control was developed, at least 215,300 acres in Los Angeles County, more than 336 square miles, were subject to inundation (fig. 4.2). Floods threatened most of the eastern half of the San Fernando Valley, vast areas of the San Gabriel Valley, and much of the coastal plain from Los Angeles to San Pedro Bay and along Ballona Creek.¹⁰ Silt, sand, and gravel carried from the mountains during the rainy season gradually filled stream channels to capacity, eventually raising channel bottoms above the level of the surrounding countryside. When this happened, swollen streams would cut new channels across lower ground. Even as late as the 1890s, the braided channels of Tujunga Wash, for example, wandered over an area seven miles wide in the eastern San Fernando Valley.¹¹ As development spread, the area subject to flooding actually increased because buildings and pavement prevented natural runoff from sinking into the ground. The porous ground surface of the San Fernando Valley had served as a natural regulator of flood flows, but as it was covered by homes, businesses, and streets, its absorptive ability was seriously reduced. By 1940, in fact, with the country's population approaching three million and despite the millions of dollars that had already been spent on flood control work, the area subject to inundation had increased by 50 percent. Some 325,000 acres in Los Angeles County, 59 percent of the nonmountainous area, were subject to overflow. In the Los Angeles River Basin alone, 160,000 acres were threatened, 44 percent of the lowlands.¹²

Before flood control projects dramatically altered natural drainage patterns, the Los Angeles River and its eighteen principal tributaries drained roughly 890 square miles. The bulk of storm runoff destined for the river was carried by just five streams, all but one draining the west end of the San Gabriel Mountains. The floodwaters from three of these streams—Pacoima Creek, Little Tujunga Creek, and Big Tujunga Creek—often mingled on the floor of the San Fernando Valley, inundating a vast area north of the river. During one major flood in 1914, the discharge from these three streams alone was equal to three-quarters of the flow in the Los Angeles River near downtown Los Angeles. Big Tujunga Creek, all by itself, carried half as much water as the river. Farther downstream, Verdugo Creek, emptying into the river opposite Griffith Park, had a flow equal to one-quarter of the river's



flood volume. The peak discharge of the Arroyo Seco, draining the south side of the San Gabriels above Pasadena, was 36 percent of the river's maximum flow. The combined flow of these five streams was greater than the peak discharge of the Los Angeles River because some of the water they carried spread across the landscape, never reaching the coastal plain.¹³

The Los Angeles River had seldom been visible west of Encino before flood control, even during heavy runoff. It was here that water in the subterranean reservoir beneath the San Fernando Valley, forced above ground by the submerged base of the Santa Monica Mountains, first spilled to the surface to form the river. The river slowly widened as it flowed southeast and met the divided channels of Tujunga Wash. Held in place by the gentle slope of the valley and the mountains that prevented it from drifting farther south, the river remained relatively narrow and its course comparatively consistent through the San Fernando Valley. Once the river rounded the bend of the Santa Monica Mountains at Griffith Park, however, its path became much more circuitous. Between the mouth of Verdugo Wash and the Arroyo Seco, the river spread over a broad depression two thousand feet wide, its course meandering considerably from year to year. One early resident reported that the river had no defined bed in the Glendale Narrows until 1825, when the region was hit by a major flood that changed drainage patterns throughout Southern California. Floods were so common in the Narrows that once-fertile bottomlands along the river were eventually abandoned as unsuitable for cultivation because they were so regularly covered with sand. The river also had its greatest dry season flow through this section because the bedrock that forces its underground flow to the surface—the same rock that forms the Santa Monica Mountains—is sometimes only forty feet deep.¹⁴

The flood risk from the Los Angeles River was greatest on the coastal plain, where the river's meager year-round flow prevented it from establishing a well-defined course and few obstructions hindered the movement of floodwaters. Once the river emerged from a narrow gap between the Blysian and San Rafael hills, just north of downtown Los Angeles, its channel widened considerably and its banks diminished in size. S. B. Reeve, a nineteenth-century Los Angeles city surveyor, once said that, until the first primitive levees were built near downtown, the river had "practically no banks" south of Seventh Street.¹⁵ As a result, floodwaters sometimes stretched more than a mile wide, from the terrace upon which the pueblo was built to the bluffs of Boyle Heights. Even after settlement of the pueblo, the river sometimes flowed along what is now Alameda Street (fig. 4.3). At other times, it hugged the base of the Boyle Heights bluffs (fig.

4.4). A decade after the founding of Los Angeles, in fact, floods forced pueblo officials to move the town to higher ground.¹⁶

The Changing Courses of the River

Before its channel was deepened, widened, and confined between walls of concrete, the Los Angeles River changed its course between the city and the sea again and again. Many of these changes were minor, but others altered the entire drainage of the coastal plain and helped transform the character of vegetation that grew on the lowlands. It is generally acknowledged that the river once flowed west after leaving Los Angeles, emptying into the ocean at Santa Monica Bay, before shifting its mouth twenty miles down the coast to San Pedro Bay. Reports of early settlers suggest that, at an earlier time, the river may have emptied into the sea at Alamitos Bay, another six miles down the coast. Throughout the first half of the nineteenth century, the main channel of the lower Los Angeles River shifted at least nine times. The most significant known changes in the course of the river occurred in 1815, 1825, 1889, and 1914 (fig. 4.5).¹⁷

Until 1825, the river is believed to have flowed west from the pueblo along the present course of Ballona Creek. There is much evidence to support this view. A member of the prominent Sepúlveda family, whose ancestors had first arrived in Los Angeles shortly after the pueblo was founded in 1781, told an interviewer in 1914 that the river once flowed southwest through the pueblo along what is now Los Angeles Street (which could help explain the general southwestern orientation of many of the streets in downtown Los Angeles) before turning more sharply west and following the route of Ballona Creek to Santa Monica Bay. Several witnesses in an 1897 hearing in Los Angeles County Superior Court also said that the river once took this route. When a historic palm tree was transplanted in 1914 from downtown Los Angeles to Exposition Park, more than three miles west of the river's present course, gardeners at its new home found river sand and gravel just a foot below the ground surface.¹⁸

River sand has also been found stretching westward from the intersection of Twenty-fourth Street and Maple Avenue, south of downtown Los Angeles, more than two miles west of the river's current channel. Construction of Hamburger's department store at the corner of Eighth Street and Broadway in 1906 also unearthed significant quantities of river sand and gravel. Dozens of interviews conducted by Los Angeles County flood control officials in the early part of the twentieth century provide further anecdotal evidence of the river's former courses. "There is no doubt that the Los Angeles River once flowed out through Ballona Creek," said one man, who had arrived in

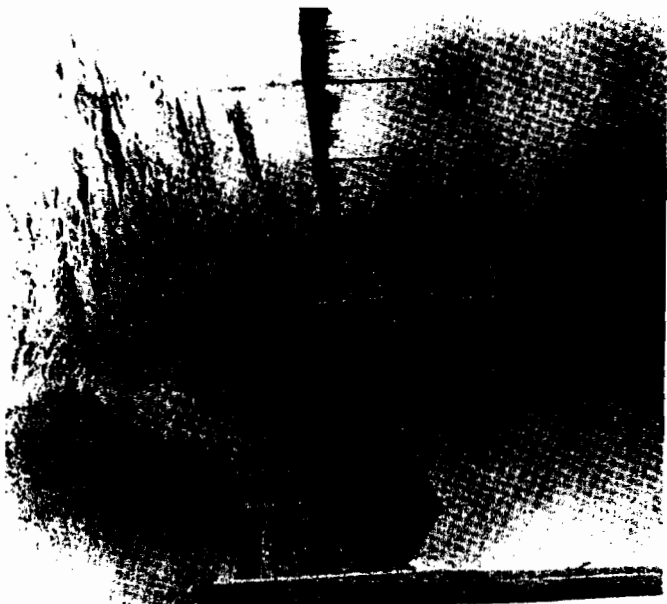


FIG. 4-3. Even after levees were built in downtown Los Angeles, floodwaters often turned Alameda Street into a river. In this photograph, taken during a storm in December 1897, water flows in a wide channel near the Southern Pacific Railroad's Arcade Depot at Fifth and Alameda Streets. Used with permission, Los Angeles Public Library/Security Pacific Collection.

Los Angeles in 1886. "An old stage driver by the name of Gorton who was here in the very early years, and who carried mail from here to Santa Barbara, has told me many things of the early days and that the Los Angeles River flowed out through the southwest into the Cienega and on into Ballona [Santa Monica] Bay."¹⁹

It is uncertain whether the Los Angeles River always flowed into Santa Monica Bay before it shifted south, though this seems doubtful. Juan Crespi was diarist for the first Spanish land expedition to California in 1769. After crossing the river near the present location of downtown Los Angeles, he wrote in his journal that "from what we could see of how [the] trees wound along, we guessed" that the river emptied into "the Bight of San Pedro." A subsequent visitor to Southern California in 1776 wrote that the river, "running toward the Bay of San

Pedro, spreads out and is lost in the plains a little before reaching the sea."²⁰ Maps depicting the underground flow of water beneath the coastal plain suggest that the river probably alternated between its route via Ballona Creek and its southerly course to San Pedro Bay.²¹ Artesian basins fed by the Los Angeles, San Gabriel, and Santa Ana Rivers once underlay nearly three hundred square miles of Los Angeles and Orange Counties, from Beverly Hills south nearly to Long Beach, east to Whittier, and southeast as far as Mission Viejo.

The first recorded shift in the course of the Los Angeles River occurred in 1815. In the midst of ten days of nearly continuous rain, the river overflowed its banks and abandoned its former channel, then located east of the agricultural lands of the pueblo. It veered southwest through the vineyards and cornfields, along the present route of North Spring Street. The plaza was flooded and several adobe houses were destroyed. An Indian village beside the river was washed away. The pueblo church, its walls weakened by floodwaters, had to be rebuilt on higher ground three years later. Since the pueblo church was



FIG. 4-4. The prominent meander scar visible in the foreground of this photograph, taken about 1880, shows that the river in relatively recent times had run near the base of the bluff that forms Boyle Heights, east of its present channel. The river runs horizontally from the center to the left, defined by a line of dark vegetation. In this view. Used with permission, Department of Special Collections, University of Southern California Library/Title Insurance & Trust Company Collection (USC 1-1-1-2-355).

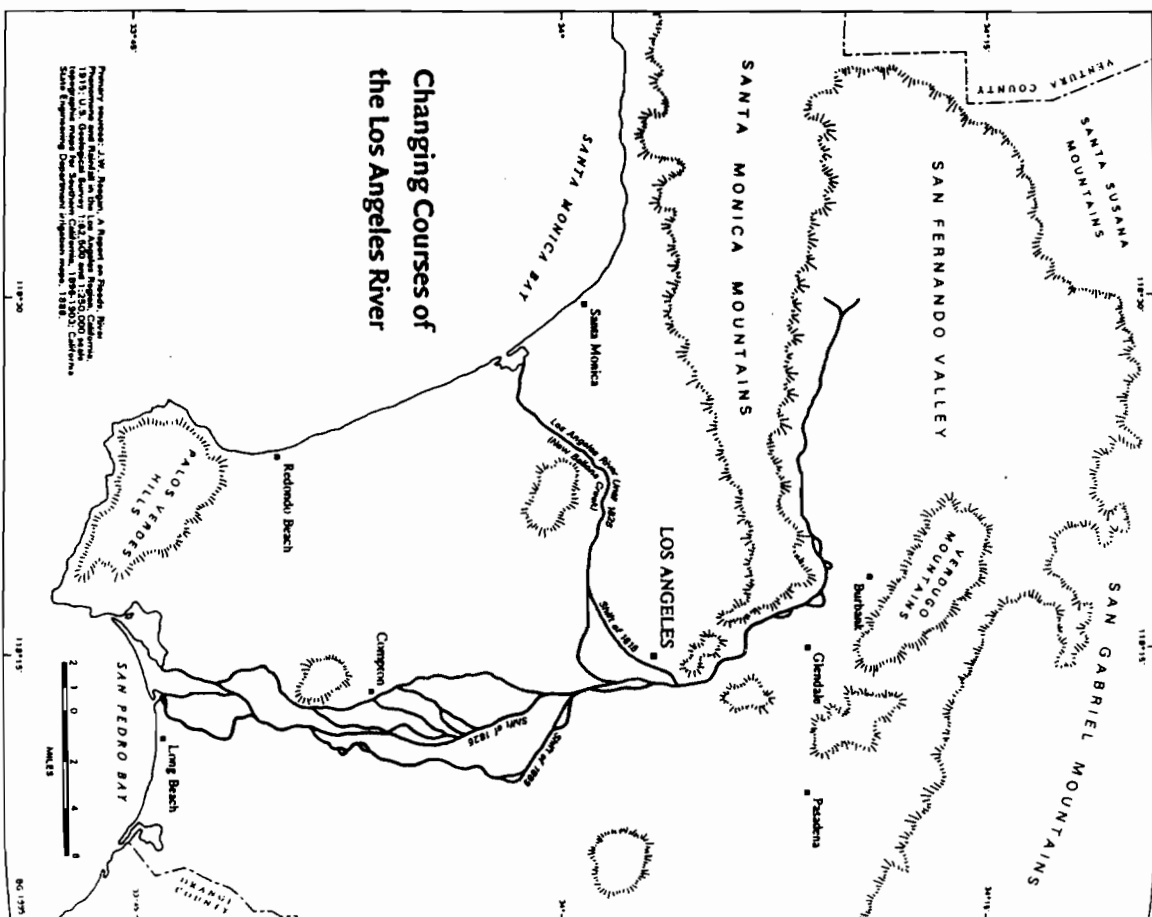


Fig. 4-5. The Los Angeles River shifted back and forth across the coastal plain before it was controlled. This map shows a few of the river's channels and courses during the last two hundred years, as disclosed on historic maps and suggested by anecdotal evidence. Map by the author.

supposed to front on the plaza, the plaza was also moved. Early residents said the river flowed for a decade along an embankment sixteen to eighteen feet high between the present routes of Main and Los Angeles Streets, curving slowly southwest to about where Seventh Street is today. A well-defined channel six to eight feet deep and fifteen to twenty feet wide was once visible near the current intersection of Ninth and Hope Streets in downtown Los Angeles. The river then flowed toward Exposition Park before turning west and rejoining its normal course through the sloughs and marshlands known as Las Cienegas. From there, it followed the route of Ballona Creek to the sea.²²

The most dramatic change in the course of the river occurred in 1825, when the flood-swollen waterway broke through its banks near the pueblo and cut a new channel directly south. At least some of the river's water has emptied into San Pedro Bay ever since. The flood began on a clear spring night. Torrential rain had fallen in Los Angeles and the surrounding mountains two days earlier, but lingering showers had stopped that morning. The heavy mountain runoff, however, was delayed in reaching the town. Suddenly, about midnight, a torrent of water surged through the sleeping pueblo. Don Jose del Carmen Lugo, a member of one of Southern California's most prominent ranching families and then a twelve-year-old boy, had been sleeping under the stars in the pueblo:

My father heard a great noise. The river ran about 100 varas [275 feet] from our house. I went to the bank, and discovered that it was a sea of water which was overflowing vegetable gardens, fences, trees and whatever was before it. The water was running with great violence, making enormous waves. I warned my father immediately of the terrible danger. He . . . sent me without a moment's delay to inform the commissioner of the pueblo.

My brothers and some of my father's servants were already running through the town warning the people. Orders were given speedily for all the inhabitants of the town to move to a place of safety. They did so, everyone loading family and belongings into carretas drawn by oxen, along with their cows and other animals. At daybreak I saw that the water in the old channel of the river was subsiding, and was running toward the other side of the narrow valley—which is where the river has its bed today. The channel changed.²³

The force of the water carried by the river in the 1825 flood was reportedly so powerful that it cut a new channel directly south to San Pedro Bay. Old timers said the shift changed the drainage of much of the lowlands and helped to alter the landscape of the coastal plain. Until that time, large parts of the countryside between the city and the ocean had been covered by a willow and cottonwood forest, inter-

persed with marshes, sloughs, and small ponds, with the river's floodwaters often spreading over the lowlands. Now, with most of the river's waters traveling in a more direct line south, many of the marshes and ponds began to dry up. The floodplain forest gradually disappeared and was replaced by wild mustard and native grasses. Floods in 1832 deepened the newly cut stream channel just enough to hasten the demise of the wetlands still further.²⁴ The grazing of cattle and the removal of trees by settlers intensified the transformation of the coastal plain, so much so that a traveler from San Pedro to Los Angeles in 1843 wrote that there was not "a single tree or shrub of any kind to be seen on this extensive tableland."²⁵

Many of the factors that made the river so prone to shifting its course were exacerbated as diversions from the river for irrigation and domestic use increased and the use of wells became more prevalent on the coastal plain. Diversions near Los Angeles reduced the dry season flow of the river, which further limited its ability to dig a definite channel for itself and build banks of sufficient height to contain heavy winter runoff. Ground water use lowered the water table, reducing the subsurface flow of the river that had helped it maintain a more consistent course. Previously, even where the river channel had been dry in summer, water often continued to flow just below the surface, but as water use escalated the wetlands formed by its underground supply disappeared altogether and the river bed looked like a beach. A U.S. government surveying team that visited the city in 1854 reported that "a few hundred yards below the town of Los Angeles, the river, in summer time, ceases to flow."²⁶ The draining of the river intensified after the arrival of the railroads. Detailed irrigation maps published in 1888 show the river as a dry wash for most of ten miles from the city limits to its meeting with the old San Gabriel River, southeast of Compton.²⁷

The flow of the river south of Los Angeles became so meager during most of the year that it was unrecognizable as a river. "Many times I was up to Los Angeles, and on crossing the valley just below town, I would ask where the Los Angeles River was," recalled an early Long Beach resident, who had settled in Southern California in the 1880s. "They would tell me I was in it and that it never flowed except in extreme high water."²⁸ As a result, the river could not contain even moderate increases in runoff, and its course therefore became more unpredictable. Floodwaters quickly spread over the countryside, cutting new channels with each storm. Before the river was confined in a narrow path by flood control projects, its overflow "spread out annually" between Downey and Compton. Sometimes the river broke southeast toward the San Gabriel River. At other times, it followed the routes of

ing. local use and
San Antonio /
Edwards Aquifer
pumping

Cerritos and Dominguez Creeks to the sea. Old maps show a dozen dry stream courses between Los Angeles and Compton.²⁹

The vagrant nature of the river led to many boundary disputes during the early 1800s between two of the largest ranches in Southern California, the Rancho San Pedro and the Ranchos Los Nietos, which became the Rancho Los Cerritos. The Rancho San Pedro once occupied 75,000 acres on the west side of the river, from Wilmington halfway to Los Angeles. Rancho Los Nietos spread across 167,000 acres on the east side of the river. The river served as the boundary between the two ranches, but that boundary was altered almost every year as the braided channels of the river shifted and subdivided during winter runoffs. After one flood had moved the main channel of the river east, draining marshy land and creating rich grazing land on the new west bank, heirs to the Nieto property began grazing their cattle on the San Pedro side of the river channel, insisting that the land still belonged to them.³⁰ Elsewhere, changes in the river's course spurred similar disputes, which sometimes ended up in court. Legal remedies proved short-lived, however, because, as one U.S. government engineer noted, "the river can change faster than our courts could follow."³¹

The course of the Los Angeles River was most ambiguous just above its mouth. South of Compton, the bed of the river was coincident with the level of the water table, so even though its flow here was enlarged by the outflow of the Rio Hondo, it was unable to dig a distinct channel. As a result, floodwaters carried by the river often spread fan-shaped over the flatlands between San Pedro and Long Beach. Lagoons and marshes swelled by the river's overflow once extended from the Palos Verdes Hills all the way to the high lands near Long Beach before they were reduced in size by deposits of silt carried by the river during floods. Detailed maps drawn as late as 1919 show that the Los Angeles River had no definite course south of the present route of the San Diego Freeway, four miles north of its mouth. Floods were so common in this area that even residents who lived far inland and away from any permanent lake or stream kept boats at their homes so they could get around during high water.³²

A Litany of Floods

Much more is known about flooding in Los Angeles after California became a state in 1850 and migration to the region increased. The city had no newspapers during the Spanish and Mexican periods, and many official records from those years have been lost. Those that remain are brief and short on nonadministrative details. Firsthand accounts of any type about Los Angeles before 1850, in fact, are scarce. Most of the descriptions of floods that occurred before that time were

simply part of the local lore, vague on specifics and a little more dubious with each telling. But Los Angeles got its first newspaper, the *Star*, in 1851, and the city has had newspapers continuously since then. The first precise measurements of rainfall were made in 1857, and regular records began to be kept soon after that. Before long, the new class of settlers who came to Los Angeles after the Gold Rush, weary of continually being stranded during the rainy season, demanded that bridges be erected over stream courses. As they built homes and businesses and planted vineyards and orchards in close proximity to the river, they also began to petition city officials for the construction of the first rudimentary flood protections. Information about floods and the public reaction to them, consequently, became much more plentiful.

Available records indicate that Los Angeles County experienced significant floods—the sort that would overflow rivers and streams—about once every four and a half years during the last half of the nineteenth century. The Los Angeles River flooded eleven times. The first flood on the river during the American period occurred in the winter of 1851-52. That January, rain fell for twelve straight days. The city dam that diverted water into the Zanja Madre was washed away. The flood inspired Abel Stearns, a leading local landowner and the richest man in early Los Angeles, to build a block of buildings in the business district on stilts, five feet above the level of Los Angeles Street. With its storefronts higher than the usual level of floodwaters, Arcadia Block, as the development was named, became the most exclusive block in the city. Natural forces of a different sort caused the river to flood in January 1857, when the Fort Tejon earthquake on the San Andreas Fault, believed to have been more severe than even the catastrophic 1906 San Francisco quake, created fissures in the river's bed and caused the river to spill over its banks.³¹

In December 1859, rain was again the culprit. During one storm that winter, a foot of rain fell in Los Angeles in twenty-four hours, nearly a year's supply, "the most disastrous rain known in the history of the Southland," according to one witness. Vineyards and orange groves beside the river washed away. Numerous houses in town were damaged, and a few collapsed. The destruction of the original pueblo church, begun with the flood of 1855, was completed. "The front of the old Church, attacked through a leaking roof, disintegrated, swayed and finally gave way," recalled a city resident, "filling the neighboring street with impassable heaps."³² The deluge came after four winters of subnormal rainfall had left pastureland surrounding Los Angeles parched. Cattle and sheep, starving after the prolonged drought and unsheltered from the cold rain and accompanying wind, died by the thousands. The river was impassable for months, and the

Los Angeles Common Council, in response, agreed to build the first footbridge over the river thirteen months later.³³

Flooding in January 1862, called "the Noachian deluge of California floods," may have been the most extensive in the history of the state.³⁴ Rain had begun to fall in Los Angeles on the previous Christmas Eve and continued almost without interruption for thirty days. The weekly *Star* remarked on 4 January that "there has been one shower since our last publication, but it lasted all the time. Morning, noon, and night—day in and day out—it has been rain, rain, rain." After one brief break, the paper dead-panned, "On Tuesday last, the sun made its appearance. The phenomenon lasted several minutes and was witnessed by a great number of persons." But the respite was short-lived. The following Saturday, the ground saturated by three weeks of nearly constant rain, another downpour brought the most severe damage yet. "Rivers were formed in every gulch and arroyo," the *Star* wrote on 25 January. "The Los Angeles River already brimful, overflowed its banks, and became a fierce and destructive force." Elijah Moulton, one of the first persons to settle on the east side of the river when he had bought thirty acres north of the Aliso Street crossing a few years before, lost everything he owned—his house, vineyards, and orange groves. T. J. White watched as five thousand of his vines on the west bank of the river were uprooted and carried downstream. The vineyard of William Wolfskill was also heavily damaged. At least four people drowned.³⁵

All told, the city received an estimated fifty inches of rain during the series of storms. The Los Angeles River in flood stretched from Alameda Street to Boyle Heights, splitting in two below present-day Vernon, its overflow again spilling west through Ballona Creek. The coastal plain from the city to the sea was a great lake. Much of Los Angeles was under water. Adobe houses crumbled, and businesses were ruined when their walls caved in. The city dam, rebuilt just months before, was again washed away. There was no mail service for five weeks, prompting a local wag to hang a "To Let" sign on the door of the post office. A U.S. government survey team, camped beside the river before embarking on a trip across the desert to establish the eastern boundary of the new state, was delayed for weeks after floodwaters swept away their tents, saddles, and equipment and killed one of their camels. The normally dry Arroyo Seco, swollen to a raging river, carried great piles of trees from the mountains to the Los Angeles River and then onto the plains. The driftwood that remained when floodwaters subsided supplied firewood to local residents for years.³⁶

During the same series of storms, the Santa Ana River broke out of its banks and washed away the town of Agua Mansa, the first nonmis-

sion settlement in present-day San Bernardino County. The river, according to a history of the county, "became a raging torrent which, washing, swirling, and seething, swept away everything from its path."³⁹ Though town residents had received enough warning of the impending flood to evacuate and there were no fatalities, the town was never rebuilt. The devastation could have been a valuable lesson to the inhabitants of Los Angeles. Agua Mena, too, was an agricultural settlement built beside a river, the bottomlands along its banks covered with productive farms watered from its channel. Los Angeles Judge Benjamin Hayes visited the town site, located about two miles south of the present city of Colton, two weeks after the flood, and his recollections of Agua Mena before its destruction sound remarkably like many descriptions of early Los Angeles:

A dreary desolation presented itself to my eye, familiar dwellings overturned, or washed away; here only a chimney, there a mere door-post or a few scattered stakes of a fence, lofty and stout trees torn up, a mass of drifted branches from the mountain cañons, and a universal waste of sand on both banks of the river, where a few months before all was green and beautiful with orchard and vineyard and garden, the live willow fence enclosing every field and giving a grateful shade for the pleasant lanes and roads.⁴⁰

Damage to private property in Los Angeles during the 1862 floods was estimated at \$25,000, nearly all of that incurred by five property owners who had built their farms close to the river. But it was the destruction of the city diversion dam that stirred the greatest public outcry and prompted what were probably the first serious calls for the government to protect its citizens from future floods. As had almost become a routine after significant storms, Los Angeles again had to rely on water hauled from the river in jugs and barrels after the dam was destroyed. Irrigation ditches filled with sand during the storms and then promptly dried up, since water was no longer being diverted into the *Zanja Madre*. Almost as soon as the sun started shining, the *Los Angeles Star* urged the city to build a more substantial dam farther upstream, out of the path of the outflow of the Arroyo Seco. The newspaper also recommended that the channel of the Los Angeles River be strengthened and its banks strengthened. "This the property holders interested will surely now do, after the severe lesson taught them," the paper wrote. "Without such permanent improvements . . . no reliance can be placed on a supply of water from the river."⁴¹

With no experience in such matters and without an engineer in its employ, the city government was slow to react, but in December 1865

the Common Council agreed to pay a local judge, Murray Morrison, himself a former council member, \$225 to "erect a sufficient dam to turn the water of the Los Angeles River" at the northern boundary of the White vineyard (about where Mission Street crosses the river to this day). The ledger book entry for the expenditure says simply, "For expense of altering course of river." Whether this work was done is not clear, but it seems doubtful in light of future developments. A year later, Mayor Cristóbal Aguilar ordered that the city begin "necessary work for the straightening of the Los Angeles River," and in September 1866 the Common Council approved the establishment of a special tax to create a "River Fund" to pay for future flood protection work. It appropriated \$500 to pay for initial work, but construction was postponed until the following spring because of concerns that work could not be completed in time for the winter rains.⁴²

As it turned out, the work does not appear to have been done for several years, and in January 1868 the Los Angeles River again overflowed its banks. The story was beginning to sound awfully familiar. The city dam, which had been repaired after the flood of 1862 at a cost of \$3,000, was the first thing swept away. The debris from the dam then destroyed the footbridge that had been built across the river a few years before. (A more substantial, covered bridge would be built at the foot of Aliso Road two years later.) Floodwaters first broke out where North Broadway now crosses the river, destroying "several acres of choice vines" owned by Louis Willhart. Pouring across the lowlands between Alameda Street and the river, floodwaters then washed over the vineyards of Vincent Hoover and swept away the entire front of the White vineyard, carrying away vines that were as much as twenty years old and coming within a few feet of the family's brick residence. The vineyard, according to the *Los Angeles News*, was "lost forever." Three adobe houses on San Pedro Street were destroyed, and water was a foot deep on Main Street. All roads leading into the city were rendered impassable.⁴³

Floods that winter caused the San Gabriel River to cut a new course to the sea. Until that time, the San Gabriel and Los Angeles Rivers had joined north of the present location of Long Beach. From that point south, this waterway was generally known as the San Gabriel River. Surging waters that winter, though, forced the San Gabriel to leave its bed farther upstream, where its channel turned southwest after emerging between two hills south of El Monte, a gap known as the Whittier Narrows. Floodwaters washed away the town of Galatin, settled a few years earlier near the present site of Downey, and dug an entirely new channel south to Alamitos Bay, which straddles the bound-

ary between Los Angeles and Orange Counties. This new channel, initially known as New River, is approximately the course of the San Gabriel River today. Water continued to flow in the river's former channel, which became known as the Río Honda. The last seven miles of the old San Gabriel channel, downstream from its meeting with the Los Angeles River, meanwhile, gradually assumed the name of that river.⁴⁴

The inclination for the rivers of Southern California to shift their courses dramatically in times of flood was, of course, part of an ancient and very natural tradition. The problem was that, as the region became increasingly populated, such movements became a greater hazard to humans. The potential danger in Los Angeles was laid out with remarkable clarity in 1870 by a city surveyor named Frank Lecoureur in a report that accompanied a detailed topographic survey of the city. The survey had been ordered to provide data to help in the grading of the city's streets. Nevertheless, because the topography of much of the city had been shaped by past floods and the sediments they carried, Lecoureur's report also included considerable information about the river. It made quite clear that Los Angeles was in a most precarious position. Lecoureur's report, in fact, may have been what finally provoked the Common Council to build its first flood control works along the river.

The existing west bank of the river, Lecoureur said, was a "feeble barrier" to keeping the river on its present course. It was about thirty feet high where the river left the Glendale Narrows but quickly diminished in size and, about Ninth Street, "it loses its identity" altogether. From that point south, the only thing that prevented the river from wandering still farther west were the tablelands that began just east of Main Street and turned slowly southwest. All of the wedge-shaped area between the Elysian Hills, the tablelands, and the river he called "river bottom." His surveys found, moreover, that Alameda Street was in places actually lower than the existing riverbed. The ground surface between Alameda and the river, he added, was "dead level, excepting a low rise or swelling of the ground, somewhat nearer the river than the street."⁴⁵ This low rise was all that kept the river from returning to the course it had occupied from 1815 to 1825 and submerging year-round the agricultural lands east of the plaza. Such a shift would also have threatened the city's first railroad station, built at the corner of Alameda and Commercial Streets the year before, and the growing industrial district that was developing around it.

The past behavior of the river certainly suggested that such a shift was possible. Future floods would, too. Floodwaters so consistently poured southwest instead of south after leaving the gap that formed

the river's outlet from the Glendale Narrows that, during a flood in the 1880s, a local newspaper remarked that Alameda Street was "as usual" a river.⁴⁶ The location of the Zanja Madre, dug from the river along the bluff at the head of the floodplain, only encouraged this. The channel the river occupied until 1825, Lecoureur said, had gradually filled with sediments until, in the flood of that year, "the river completely dammed up its old bed," forcing it to open a new channel farther east. "In this channel now the same process is repeating itself, and a slow but steady filling in of the river wash takes place." This could be witnessed on a smaller scale, even during the dry season, in the river's wide bed near downtown, where the river's waters, laden with sediments, were carried by numerous intertwining, ever-shifting, small channels, meandering back and forth across its sandy bed. "The velocity of the water is more than sufficient to keep the fine and light particles of sand on which it flows in constant motion, lifting them up in one place and depositing them in another," wrote Lecoureur. "This tendency of the river to fill up old channels and open new ones, being a mere playful and harmless one at the usually low state of the water during the dry season, becomes threatening and dangerous when, swollen by storm waters, the same action takes place on a scale proportionate to the increased volume of water."⁴⁷

Soon after Lecoureur had issued his report, new appeals were made for the city to do something to keep the river in its existing channel. In September 1870, J. J. Warner, an early Los Angeles newspaper editor and one of the founders of the Canal and Reservoir Company, recommended that a "breakwater, or some effective protection" be built "without delay." Three months later, fifteen property owners along the river petitioned the Common Council to "take immediate steps . . . to avert the threatened danger."⁴⁸ Finally, in 1872, the council's Committee on River Improvement reported that the long-contemplated work had been completed. It did not amount to much, however. In all, \$386.75 had been spent, \$356 for tools and the rest for labor. The exact nature of the work was not specified, but the fact that no money was spent on materials suggests workers simply used shovels to build up the riverbank. Even the members of the committee, in their report to the council, hinted that they were not entirely satisfied with the results, saying that they had made "all the improvements that could be made for the amount of funds that were placed at their disposal." Others were far more critical. The Finance Committee of the Common Council said in 1873 that "the money was spent to no purpose and entirely thrown away."⁴⁹ Future floods would prove that the work was grossly inadequate.

The Impact of Development

Until the boom of the 1880s led to rapid subdivision of the agricultural lands and increased urban development throughout Southern California, floods were often seen as beneficial, despite the damage caused by a few major storms. Floodwaters deposited a fresh layer of silt on agricultural lands, enriching the soil. They also restored moisture to parched ground and washed away salts that had accumulated as a result of irrigation. "A flood might be a temporary evil," remarked early historian J. M. Guinn, "but like the overflow of the Nile, a year of plenty always followed." Most of the floods on the coastal plain, moreover, did little damage because rivers and streams, their banks low, usually overflowed before water levels rose significantly or flood flows had the opportunity to intensify. Flood depths outside main stream channels, consequently, were rarely greater than a foot, and the velocity of floodwaters was usually minimal. "In those days, the water would spread all over the country," recalled one early resident in 1914. "It did no damage, and in many ways did good. It was not necessary to fertilize the land, as they are now doing."⁹

There was also less potential for damage from floods before the arrival of the railroads because most of the lands near the river were still devoted to agriculture and few structures had been built on the most flood-prone lands. Maps show that, as late as 1876, nearly all of the land between Main Street and the river and from the river to the Boyle Heights bluffs, was still devoted to farming. Homeowners, for the most part, knew enough not to build in the areas that were regularly inundated. The earliest residential subdivisions in Los Angeles were laid out on the benchlands that stretched beyond Main Street and on the terraces east of the river.¹⁰ This helps explain why, after the flood of 1863, which anecdotal evidence suggests may have been the most extensive in the history of Southern California, the Los Angeles Star of 25 January commented that "the losses . . . on the whole . . . have been quite insignificant."

Like so much else in Southern California, the risk from floods changed dramatically after the Southern Pacific Railroad extended its line from San Francisco to Los Angeles in 1876 and a second cross-country line was built to the city a decade later. Newcomers descended upon Los Angeles, and the changes they made increased the flood threat. Urban development intensified beside the river, not only in Los Angeles but all along its length. Both Burbank and Glendale were founded near the river in the San Fernando Valley during the boom. Compton was established a mile west of the river as a station stop for the Los Angeles and San Pedro Railroad but grew more rapidly after

the Southern Pacific took over the line. Long Beach was founded east of the river's mouth in 1888 and by 1900 was the fourth largest city in the county. Efforts to create a deepwater port at San Pedro Bay grew in response to the greater trade the new population brought. Agricultural development, meanwhile, increased in the open country between the cities and towns.

The newcomers heightened the flood hazard by building homes and businesses not only on the floodplain, but sometimes directly in former channels of the rivers and streams. Willows and cottonwoods that had lined the river and anchored its banks were cut for fuel or to build fences. Scattered trees and shrubs that kept the soil in place and slowed the flow of water across the lowlands in time of flood were cleared to enable cultivation and to improve grazing. Plowing by farmers also removed the soil's natural grass cover, causing runoff to increase and heightening erosion, while irrigation canals dug directly from stream channels weakened riverbanks. Individual property owners built levees in an attempt to keep streams from overflowing, but these were often inadequate and only increased the threat elsewhere.¹¹ "Each man builds his levees as strong as he can and hopes and prays that his neighbor's levees will break," remarked one engineer at an early meeting about flood control. In downtown Los Angeles, the removal of sand and gravel from the bed of the Los Angeles River by construction crews lowered the riverbed by twenty feet. This forced runoff into a more narrow channel, which increased the velocity of flood flows and, therefore, their destructive power.¹²

But nothing exacerbated the flood danger more than the railroads. The most serious problem caused by the three national rail lines built across Los Angeles County during the last three decades of the nineteenth century was their use of trestle bridges, which often obstructed the free flow of water in the rivers and streams. Such bridges were typically built upon wood piles driven at close intervals into riverbeds (fig. 4.6). The bridge supports were so close together that they frequently acted as dams during heavy storms, when rain-swollen streams carried large quantities of trees, brush, and other debris. If enough material accumulated behind the trestles, water was forced out of stream channels and over nearby lands. Sometimes, when the pressure upon the trestles became great enough, the bridges themselves gave way, unleashing a torrent of water and debris that endangered bridges, buildings, and human lives downstream.

Even railroad bridges that did not rely on trestles for support often impeded the free flow of storm waters. The Los Angeles and San Gabriel Valley Railroad bridge over the Los Angeles River, for example, was built so low to the ground that it would seem to have been de-

Exactly what we have been saying.

signed by someone who had seen the river only in summer. It was clearly destined to fail. Railroads further heightened the flood danger by building their tracks across floodplains, thus confining floodwaters that would have formerly spread unimpeded over a wide area. Such tracks were often built on artificial embankments several feet high (fig. 4.7). Where natural stream banks were low, these embankments, in effect, became set-back levees and, by forcing floodwaters into an area smaller than the river's natural floodplain, increased the depth, speed, and cutting power of flood flows. The purpose of levees built for flood protection is to keep water away from development, but these embankments sometimes enclosed already settled areas.³⁴

The changes that occurred after the arrival of the Southern Pacific were greatest in Los Angeles. After 1876, urban development began to seriously encroach upon the floodplain. The first significant subdivision of agricultural lands had begun a few years earlier, when the Los Angeles and San Pedro Railroad had built its depot at the corner of Commercial and Alameda Streets. This had spurred a small property boom in the area. Businesses had begun to spring up along Commercial Street, and the Aliso Homestead Association had started to sell

Exactly what
we have been
saying
←←←

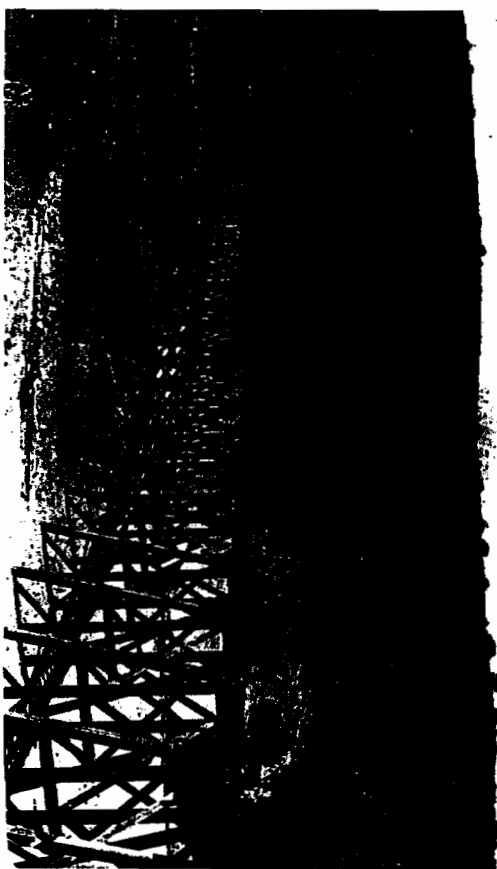


FIG. 4.6. Trestle railroad bridges, like this Los Angeles and San Gabriel Valley Railroad bridge built over the Arroyo Seco, often acted as dams during heavy storms, when stream-carried debris backed up behind bridge supports. Used with permission, The Huntington Library, San Marino, California.



Exactly what
urban purposes
is the
floodplain
→

FIG. 4.7. Railroad embankments, such as this one built across the river floodplain south of Los Angeles, confined floodwaters into a smaller area, which increased the intensity of flood flows and heightened their destructive power. Used with permission, Department of Special Collections, University of Southern California Library/Hearst Newspaper Collection.

home lots in the vicinity. Development intensified in the area when the Southern Pacific took over the Los Angeles and San Pedro and continued to use its depot. Warehouses and factories were constructed near the depot, and the area immediately surrounding the incipient industrial complex was subdivided for residences to provide homes for workers. Within a few years, much of the area between Macy and First Streets, from Alameda Street to the river, was occupied by small homes (fig. 4.8). By 1884, residential development had also begun to spread south of First Street, along Alameda, and between Main and San Pedro Streets sporadically all the way to the city's southern limits. Farther north, homes began to be built on the west side of the river near the Southern Pacific's freight yards, northeast of present-day Chinatown. Urban development also spread east of the river. Boyle Heights was subdivided in 1876 and became a streetcar suburb of Los Angeles after

a horsecar line was built across the river at Aliso Street. East Los Angeles (now Lincoln Heights) was developed at the same time.⁵⁵

As Los Angeles filled up with homes, few paid much attention to the river that flowed gingerly through the center of the city. One who did was J. J. Warner, the same man who in 1870 had urged city officials to strengthen the west bank of the river to prevent its overflow. As development moved closer to the river, he warned in a series of letters published in the *Los Angeles Times* in 1882 "of the risk to which many . . . are exposing themselves, their property and their families in the selection of places upon which to build their dwellings." Warner had arrived in Southern California in 1831 at the age of twenty-eight and had heard many firsthand accounts of the floods of 1815 and 1825 that had so altered the course of the river. He had himself witnessed the great floods of 1832, 1859, 1862, and 1868. "There are many now living in Los Angeles," he wrote, "who do not know the magnitude of the volume of water which flows through this city when the river is flooded." He castigated the "reckless and crafty" real estate agents who had sold property in the low-lying areas between Alameda Street and the river and cautioned that "the many obstructions" that had been placed in the river channel (the nature of which he did not specify) increased the likelihood of an overflow. If a flood of the magnitude of previous great floods occurred again, he said, "such a flood would destroy a large part of the property situated in that part of the city."⁵⁶

Such warnings did little to deter newcomers from buying lots in the Aliso, Johnston, Sanchez, and Alanis Vineyard Tracts—all south of Aliso Street and east of Alameda Street—some of whom scoffed at the idea that the harmless-looking river could possibly be a threat. The case of Alfred Moore is especially telling. Moore had arrived in Los Angeles in 1876, the same year as the Southern Pacific, and had bought a large lot on Lazard Street in the Aliso Tract, where he had built a house. An auctioneer by trade, Moore kept a few horses on his land and raised some chickens.⁵⁷ As he became more established, he bought several other lots in the neighborhood. Some he sold, but he built small homes on others and began renting them out. After Warner's letters were published, Moore responded with a letter of his own, thumbing his nose at the danger: "We need not, I think, feel at all alarmed about a flood," he said. "I have lived on the Aliso Tract the most central part, for the past eight years and never saw a flood yet." He boasted that he had recently sold six lots "within a few feet of the river" to a woman who was "plucky enough" to disregard the warnings of her soon-to-be neighbors about the possibility of an overflow. "I am selling bottom land lots, so-called, rapidly ever since," he wrote.⁵⁸



FIG. 4.8. This photograph, taken from a balloon in June 1887 and looking east across the Los Angeles River, shows that urban development had encroached on the west side of the river from Macy Street south to First Street. The plaza is the circular feature in the left center. Alameda Street roughly parallels the course of the river a mile west of its banks, running just east of (above) the plaza. The northernmost crossing on the river in the photo is Mission Street (far left). Moving south, the other crossings are at Macy Street, Aliso Street, and First Street. Used with permission, Sewer Center for Western History Research, Natural History Museum of Los Angeles County.

The arrogance of Alfred Moore is emblematic of the attitudes of many then and many more since, who have ignored dire predictions of floods, fires, landslides, and earthquakes and have built their homes in places that were ill-suited for them, later demanding that the government bail them out and protect them from future disasters. Although the storms Warner said would happen again, of course, did re-

Alfred Moore
=
vulcan

Only now,
vulcan with claim
that the federal
license built it
out of any
responsibility to
homeowners

occur, floods were still seen as an exception in a place where the sun shone nearly all the time, flowers bloomed year-round, and the worst cold was jacket weather. What people saw when they looked out their windows—mountains, beaches, palm trees—only cemented their resolve to stay where they were. The occasional flood or other disaster might scare off a few. Some in the more flood-prone areas would sell their land, perhaps to the railroads so they could build depots and freight yards or to industrialists for whom a foot of water was less a cause for alarm. Others would move to higher ground and rent their properties to people who could not afford to be so choosy. A few might even move back to Iowa or Indiana, perhaps deciding that paradise had too high a price. But they were clearly in the minority. Most probably laughed at the stream that ran through their city when they thought of the real rivers back home. A little stream like that, they assured themselves, could certainly be controlled.

Boom Years Are Flood Years

Contributing to the false sense of security of many of the newcomers was the fact that the late 1870s and early 1880s were relatively dry years in Los Angeles. Rainfall was below normal in five of seven winters, and from July 1879 to June 1883 precipitation averaged 30 percent below the mean. The winter of 1883-84 broke the spell, however, and the next seven winters still constitute one of the wettest stretches on record in Southern California. Abundant rainfall does not necessarily mean floods, if the storms are spread out and lack intensity, but the boom years were also one of the most flood-plagued periods in the region's history. As newcomers poured into Los Angeles, the city experienced six heavy floods, four moderate floods, and one light flood in seven years. The Los Angeles River overflowed five times, altering its course with each new storm and eventually breaking through its banks near Vernon, where it created an entirely new course two miles east of its former route.⁵⁹

The first heavy floods came in 1884, when three major storms in two months led to flooding that destroyed forty-three homes, severed railroad and telegraph lines, and washed away all bridges over the river except one.⁶⁰ Floodwaters stretched from downtown to Boyle Heights, with the river overflow again reaching Ballona Creek and its former outlet at Santa Monica Bay. Water was two feet deep on Main Street, and houses on Alameda Street were flooded to a depth of six feet. The cities of Compton, Downey, and Clearwater (now Paramount) and the San Fernando Valley from present-day Chatsworth to Glendale were also under water. Floodwaters mixed with ocean currents near the river's mouth, causing tides more than a mile inland.

many of residents lived through flooding by crossing by

Estimates of damages from the floods ranged from about \$150,000 to \$1 million (\$2.4 to \$16.3 million in current figures). Rain fell in every month that year, with Los Angeles receiving more than thirty-eight inches in all. Climatologists now blame the above-normal precipitation on a cyclical phenomenon known as El Niño, which is caused by periodic changes in the direction of trade winds that result in the warming of sea temperatures in the Pacific Ocean. El Niño can spur unusual weather patterns worldwide.⁶¹

The Los Angeles River in flood washed barns, houses, household belongings, railroad cars, livestock, and even caskers downstream. Forty to fifty homes in Los Angeles were destroyed in 1884. Several people drowned. Forty-one horses were washed into the river when a stable near First Street was inundated. A winery at Ninth and Alameda Streets was also washed away. The power of flood flows was so great that, according to legend, a ten-gallon keg of brandy washed from the winery was found six years later buried in the soil several miles downstream by a farmer plowing his fields. The keg was reportedly still filled with brandy.⁶² Years later, Boyle Workman, a prominent Los Angeles banker and one-time city council president, remembered watching the floods as a boy from the back porch of his family's Boyle Heights home. "Day after day it rained in great sheets," he wrote in his memoirs. "The river became a boiling yellow lake. Houses, torn from their foundations, floated downstream with the smoke still escaping from their chimneys. Horses, cows, sheep, and now and then the ghastly form of a human being, were part of the strange driftwood. Sometimes the water came in waves fifteen feet in height."⁶³

The first storm began about 1:00 A.M. on 26 January 1884, and on 6 February the *Evening Express* reported that the city had received ten straight days of rain. Rail connections between Los Angeles and Santa Ana were cut off. The San Gabriel River overflowed its banks and inundated the town of Downey. A second storm began on 13 February. Two days later, the paper said that "Alameda Street is a veritable river."⁶⁴ The next morning, the steady showers turned into a down-pour. About noon, as debris backed up behind the bridges, the supports to a bridge at Aliso Street gave way and the bridge began to break up. A large section became lodged in the channel of the river, causing water to back up behind it and flow westward into the city. By 4:00 P.M., most of the residential neighborhood south of Macy Street and east of Alameda Street, the same area about which J. J. Warner had issued his warnings, was under water. A laundry on Weill Street was the first building to go, washing out into the center of the river and downstream. Three small homes that had stood neatly went soon after. Eventually, thirty-five houses in the Aliso Tract alone were washed

away. "House after house was gradually loosened from its foundation, and in many cases the occupants had barely time to get out before the building was afloat," the *Los Angeles Times* reported in an extra edition published on 18 February 1884. "The river rose all night and created a scene of destruction, at points close to its banks, which can hardly be pictured. Numbers of families lost everything they had. The destruction is immense."

Among the hardest hit was Alfred Moore, who had so cavalierly dismissed Warner's warnings two years before. Moore's home on Lazard Street was washed downstream with all its contents still inside. His son and brother-in-law living next door also lost everything, and a rental property Moore owned on Turner Street was destroyed. Two horses and several chickens he kept on his property were killed. Nearly as ironic was the case of J. P. Widney, a surgeon and local civic leader who had witnessed the flood of 1868 and in 1876 had co-written with Warner the first history of Los Angeles. Widney lost the most expensive house in the area, built fifteen months before at the foot of Sainsevain Street at a cost of \$2,000. Moore and Widney were hardly alone in their suffering; however, Joseph Mozet and his wife, for example, lost three houses they owned on Center Street. Another woman lost three new houses built, according to the *Times*, "right in the bed of the river."

Many of the victims were newcomers. Several French families living on Sainsevain Street were left homeless. A German who had recently relocated from New Mexico lost his house and most of his possessions. One of the dead was a twenty-eight-year-old milkman named George Stolz, who had moved to Los Angeles just three weeks before. He drowned when he tried to cross the river near the Arroyo Seco in a wagon drawn by two horses. "The swift current was too much for the strength of the animals and in a short time the wagon was overturned and Stolz then began a fierce struggle for his life," the *Times* said. "He was borne for a distance of nearly half a mile, still holding on the bridle reins of the animals, when, to the horror of the excited spectators who had lined the banks, he was seen to throw up his hands and sink beneath the waters. Nothing more was seen of the unfortunate man, and he is doubtless many miles from the spot where he came to his unfortunate end."

The levees built by the city in 1872, if they had been able to withstand the normal rains of the previous dozen years (and even that is not clear), were certainly no match for the floods of 1884. No mention of the work was made in news accounts of the floods and, within days of the first overflows, people began to demand more substantial levees. After the second overflow in mid-February, the *Los Angeles City*

Council erected a wing dam made of sandbags on the west side of the river, just downstream from the covered bridge at Macy Street, to protect the already devastated area west of the river. New storms a few days later, though, washed away the sandbags. The council then created a committee to study alternatives for preventing future floods and ordered a survey to delineate an "official" three-hundred-foot-wide channel for the river. Many in the hardest hit area seemed certain to abandon their properties until the city agreed to erect a more sizable levee on the west side of the channel. The council allocated \$10,000 for the work, and the new levee was completed in the summer of 1885. The *Los Angeles* and San Gabriel Valley Railroad, which built a line to Pasadena on the west side of the river that year (it was taken over by the Atchison, Topeka, & Santa Fe in 1886), increased the protections by lining the front of the levee in places with rocks, trees, and sand. Convinced that the new work provided adequate safety, many property owners west of the river, including Alfred Moore, decided to rebuild their homes. One-half mile of levees were also constructed on the east side of the river.⁶⁴

But the new levees proved no more capable at protecting the city than had earlier efforts. A storm in January 1886 caused the Los Angeles River to rise two feet higher than it had in 1884, and the new municipal levees were, in the words of the *Los Angeles Times* of 21 January, "washed away like so many playthings." Although flooding was not as severe or prolonged as it had been two years before, fifty families were nevertheless driven from their homes when the same neighborhoods so heavily damaged in that flood were inundated again. At least four people were killed, including an old Scotsman who had been living for more than a year in a tent in the riverbed and, according to the *Times*, "died from fright." Los Angeles was completely isolated for seven days, as telegraph, telephone, and railroad lines were washed out. Seven bridges over the river were destroyed. Published estimates of the damages ranged from \$58,000 to \$250,000 (\$688,000 to \$4.3 million in current figures).⁶⁶

The sequence of events in the flood demonstrated the effect of railroad development on flood risk. As the waters in the river rose, driftwood and other debris began to back up behind the Southern Pacific Railroad bridge, the northernmost bridge on the river, located just upstream from the Arroyo Seco. Just before dawn on 19 January 1886, the build-up of debris behind the bridge became so substantial that the river began to wash over the top of the tracks, and about 6:00 a.m. the bridge gave way, its wooden supports adding to the great load of material already carried by the river. This started a chain of events that caused the river to overflow. The swirling water and wood rushed to-

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ward the new bridge of the Los Angeles and San Gabriel Valley Railroad, built a few months earlier. Both approaches to the bridge were swept into the river, adding still more timbers to its load. The debris-laden river then washed out the approaches to the Downey Avenue (now North Broadway) bridge, causing a horse-drawn streetcar to fall into the river. The driver and a passenger inside had to be rescued by a sheriff's deputy, who rode his horse into the raging waters. Soon after, the depot of the Los Angeles and San Gabriel Valley Railroad, built just north of the Downey Avenue bridge on the west bank, toppled into the river. It floated downstream until it rammed into the Downey Avenue bridge, knocking out one hundred feet of its length (fig. 4-9). With the depot and the horse car lodged in the river channel, the river began to overflow.



FIG. 4-9. Remains of the Downey Avenue bridge, partially destroyed during the flood of 1886. It was in this area that the Los Angeles River first broke out of its channel and inundated the lowlands west of the river. Its normal path was partially blocked by a horse-drawn streetcar and a railroad depot that had toppled into its channel. Used with permission, Department of Special Collections, University of Southern California Library/Tide Insurance & Trust Company Collection (USC 1-1-1-31).

Note that the live approaches the former bridge are on the bank.

Floodwaters poured south and broadened as they spread across the lowlands, stretching two-thirds of a mile wide by the time they reached Seventh Street. Once again, the greatest damage was experienced between Aliso and First Streets adjacent to the river, an area that, according to the Los Angeles Times of 20 January, "was occupied mainly by small frame houses which had sprung up since the flood of 1884." Most of the residents were able to evacuate, but at least two people in the area were killed. One was a young child who drowned during a rescue attempt by a sheriff's deputy (the same man who had saved the two passengers stranded in the horse car) after the deputy fell from his horse. The other was a woman who lived at the corner of Center and First Streets in the Aliso Tract, a block from the river. Trying to escape her house, she immediately found herself waist deep in water and had to hang on to a small tree to keep from being pulled under by the current. She was about to be rescued by a mounted police officer, when, the Times wrote, "a small house came floating down and struck the unfortunate woman. She was knocked over, and was seen no more."

As before, numerous homes were swept away. Alfred Moore, who had rebuilt after losing three houses in the flood of 1884, lost five houses this time and estimated his losses at \$3,000. Two of his houses were washed completely downstream. The other three were knocked from their foundations and seriously damaged. All that was left where his home had once stood was a steam laundry deposited there by floodwaters. The same man who had, four years earlier, dismissed warnings about the river now demanded that the city take immediate action to control it. "He was emphatic in his declaration," the Times said, "that the city ought to build a substantial bulkhead along the riverfront, first widening the official channel to 600 feet." The lesson of two disastrous floods in three winters was not lost on others, either. "This last flood is another warning to the people of Los Angeles," the Times wrote. "The river, though a small stream ninety-nine hundredths of the time is still capable of foaming freaks when maddened by the Storm God's lashings. It is a treacherous stream and cannot be trusted. It needs to be restrained within its banks. It pays no attention to the 'official' riverbed, but breaks out just where it pleases, each time doing damage which, aggregated, would soon pay the cost of necessary levees to keep it within its bounds."

Unable to protect its citizens from floods, the city responded the same as it had two decades before, when the establishment of a domestic water system had proven so difficult—it sought assistance from private parties. In December 1886, the Los Angeles City Council agreed to give the Atchison, Topeka, & Santa Fe Railroad, through its

Volunteer will ask for public \$, but they will be denied/for the levee to deny public claims

will the city have to agreed at Volcan's feet

subsidiary the Southern California Railway, a fifty-foot right of way on the west bank of the river on the condition that it build and maintain a levee from Mission Street south to First Street. The city also agreed to pay the railroad \$12,000 for its work. As it turned out, the Santa Fe did even more than was required. It erected a levee from Downey Avenue (now North Broadway) all the way to the city's southern boundary, a distance of 3.7 miles, protecting its front with piling and wood planks. The levee was completed in March 1888. Realizing that a levee on only one side of the river would mean certain flooding on the opposite side of its channel, the city itself built one mile of new levees on the east side of the river at a cost of \$31,389.⁶⁸

The new railroad- and city-constructed levees were almost immediately put to a test. Los Angeles was hit by four major storms in 1889, one in the spring and three in the weeks before Christmas. As the rainy season began in December, City Engineer Fred Eaton reported that storms the previous winter had left the Santa Fe levee in "dangerous condition at many points north of First Street."⁶⁹ Rainfall was greatest between 21 December and 27 December; on Christmas night the Los Angeles River rose at a rate of eighteen inches an hour. "Eastern thrush [sic]," remarked the *Evening Express* on 26 December, "are complaining." Once again, storm-induced damage to the railroad bridges precipitated destruction and contributed to flooding farther downstream. Half of the Santa Fe bridge was washed out, and the debris from it weakened the piers and badly damaged the Buena Vista (now North Broadway) Street bridge, just downstream. Swelled by ever-increasing debris from the bridges, the river then washed away the approaches to a bridge at Kuhns Street (now North Main Street). The Southern Pacific bridge at Mission Road was also carried off. By this time, the river was a swirling mess of timbers, rocks, sand, and other debris, and its current cut away at the new levees. The wooden bulkhead built by the Santa Fe to protect its levee was broken in places, and fifteen hundred feet of the city-built levee on the east side of the river was washed away. Where the levees were destroyed, water spread over the low-lying areas, damaging houses and streets. "The scene along the river," commented the *Evening Express*, "was a melancholy one." This latest flood finally persuaded some riverfront residents, including Alfred Moore, to move to higher ground. A few years later, Moore was living on Workman Street in the new suburbs of East Los Angeles (now Lincoln Heights), well above the floodplain on the east side of the river.⁷⁰

Still, news reports suggest that the damage incurred at Los Angeles was not as severe as in the previous two floods. The new levees, although undermined in places, still prevented flooding in large parts of

the city. Other areas were not so fortunate; in fact, the city's levees heightened the flooding elsewhere. The floods came as Southern California was experiencing the most intense growth in its history. The population of Los Angeles County tripled between 1880 and 1890, with much of that increase coming in 1887, after completion of the Santa Fe line to Los Angeles instigated a fare war that reduced the cost of a one-way ticket from Chicago to Los Angeles to pocket change. The total assessed value of property in the county rose from \$40 million in 1886 to \$102 million in 1888.⁷¹ During the two years before the floods, the cities of Burbank, Compton, and Long Beach had been founded. The number of farms in Los Angeles County, meanwhile, more than doubled during the boom decade.

Because so much of the settlement was new, few outside Los Angeles were prepared for the great quantity of water that the river carried during the storms. Only sporadic levees had been constructed south of the city. The Santa Fe levee, meanwhile, ended abruptly at the city limits. The city-constructed levee did not extend even that far. Thus, when the river emerged from the partially confined channel south of Los Angeles, it again widened, which caused its velocity to diminish and its ability to carry debris and sediment to decline. As a result, the river dropped much of the sediment it carried. Sand slowly built up in the riverbed until, during the flood, its channel was blocked entirely, causing the river to break through its banks two miles south of the city. The river swerved sharply southeast, digging a new channel as much as a quarter of a mile wide and twelve feet deep. One man in the Fruitland section south of Los Angeles lost fifty acres of grapevines, walnut trees, and fruit trees when the rampaging river left his farm a wash of sand and debris. The shift dramatically altered the future course of the river. From then on it flowed southeast instead of south after leaving the city of Los Angeles, before turning more directly south near the present city of Maywood, its channel meeting with the Rio Hondo four miles farther upstream.⁷²

Near Downey, the river overflow joined with floodwaters from the San Gabriel River and the Rio Hondo to form a waterway five miles wide that swept away everything in its path, emptying into the sea through both Alamitos Bay and San Pedro Bay. "The country between the city and the sea is in places covered with water," the *Evening Express* reported on 26 December 1889. "Many ranchers will lose heavily." Residents around Compton and Downey were forced to use boats to obtain food and supplies.⁷³ Farther downstream, the infant city of Long Beach was completely surrounded by water. All communication with the outside world was cut off, and many of its new homes were inundated. "A dismal wail comes up from Long Beach," wrote the *Even-*

ning Experts on 27 December. County officials later estimated that the peak flood discharge of the Los Angeles River during the 1889 floods, based on observations of stream velocity, was between 38,000 and 54,000 cubic feet per second—more than five hundred times its normal dry season flow.⁷⁴ Damages from the floods were estimated by one newspaper at \$398,700 (\$6.9 million in current figures).⁷⁵

Soon after the floods, the Los Angeles County Board of Supervisors commissioned a group of engineers to make recommendations for curbing the flood risk throughout the county. The Santa Fe Railroad, meanwhile, spent \$15,000 to repair and strengthen the levee on the west bank of the river through the city of Los Angeles. Railroads also improved the levees on the east side of the river. In 1891, the Los Angeles Terminal Railroad, a subsidiary of the Union Pacific, built a line from the city to San Pedro to compete with the Southern Pacific for harbor traffic and built its tracks through Los Angeles on the east side of the river. It spent \$93,000 to construct a levee from near the Arroyo Seco to the city's southern boundary. A photograph taken a year after the levee was completed shows that the railroad built a wooden bulwark in front of the levee to increase its strength along at least part of its length (fig. 4.10). In 1903, the successor to the Terminal Railroad, known as the San Pedro, Los Angeles and Salt Lake Railroad, agreed to build a levee protected by rock riprap north of the existing levee on the east side of the river. The city gave the Salt Lake a triangular plot of land beside the river, north of Mission Road, as payment for its work. The railroad built its station and freight yard there. To reduce obstructions to the free flow of the river, meanwhile, the Los Angeles City Council began regularly to use chain gangs from the city jail to remove trees and brush from the bed of the river.⁷⁶

As is so typical of the climate of Southern California, the wet years of the 1880s were followed by an extended dry spell. Seasonal rainfall was below normal eight out of the next ten winters. Although poorly drained streets regularly flooded during cloudbursts and high water on the river occasionally knocked out bridges or overflowed agricultural lands, no major floods were recorded in Los Angeles County for the next twenty-one years.⁷⁷ Persuaded that the string of floods during the boom years might have been a fluke, the county put off plans to initiate any large-scale flood control program of its own. The proposals of the engineers it hired after the 1889 flood were set aside. Money was diverted to more pressing needs, like the building of highways to connect the rapidly expanding metropolitan area. While the rains slowed, the migration to Southern California most definitely did not. Few of the new arrivals recognized the flood risk any more than their predecessors had during the Boom of the Eighties. Even if they heard

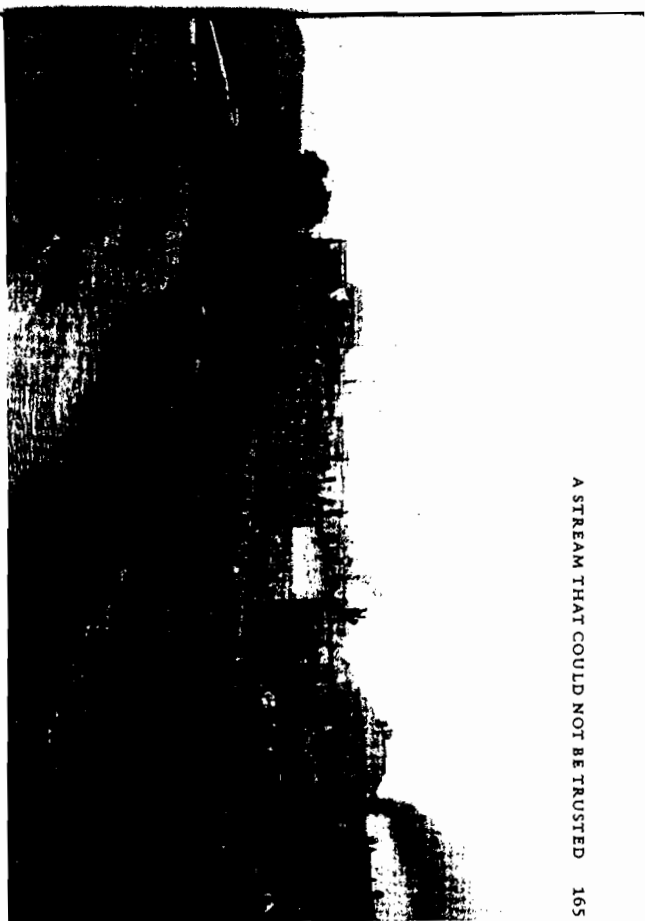


FIG. 4.10. Wooden bulwark built in 1891 by the Los Angeles Terminal Railroad to protect the levee on the east side of the river. Employees of the Southern California Packing Company, which occupied land to the east of the levee, stand atop the train. The banner on the first boxcar reads: "This entire train loaded with canned fruit." Used with permission, The Huntington Library, San Marino, California.

stories, the appearance of the river—drained by drought and diversions of its flow—made it easy for them to ignore what they heard. As demand for land grew, building intensified beside the river, not only near downtown, where the riverfront lands became the center of the city's first industrial district, but all along its course.

Over the next two decades, the population of Los Angeles County increased fivefold to more than 500,000 and the city of Los Angeles grew from what was still basically a small city into the sixteenth most populous municipality in the United States. Other cities in Southern California grew even faster than Los Angeles. Henry Huntington, nephew of Southern Pacific magnate Collis P. Huntington, built the first line of his Pacific Electric commuter railroad from Los Angeles to Long Beach in 1902. The line became an immediate success and helped Long Beach grow from a small town with about 2,000 residents to the third largest city in the county by the end of the decade, with a population of nearly 18,000. Numerous other towns also developed along the line, including Vernon, which would become the most

important industrial city in Southern California, and Huntington Park. Indicative of the amnesia Angelinos had about their river was the fact that parts of both Vernon and Huntington Park were platted directly in the former channel of the river, as it had existed until the flood of 1889 (fig. 4.11). Within a few years, a General Petroleum Corporation plant was built right in the old bed of the river, just south of the point where its channel had shifted sharply east in 1889.⁷⁸ Near Elysian Park, meanwhile, some 250 "Mexican" families were by 1913 living in shacks "mostly in the river bottom," according to a prominent local attorney and Progressive politician.⁷⁹

Much of the San Fernando Valley, meanwhile, was cut up into small farms and even smaller residential-sized lots in anticipation of all the

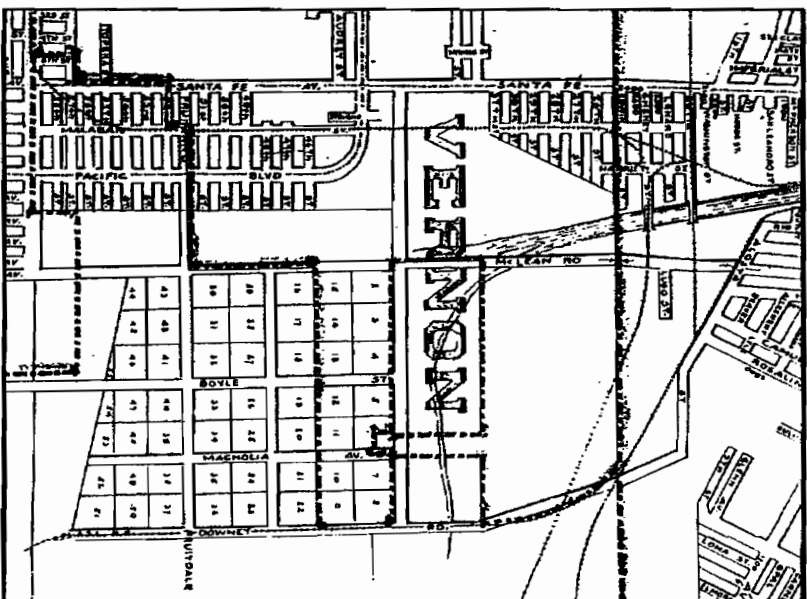


FIG. 4.11. Early twentieth-century map shows industry-sized lots platted in the former channel of the Los Angeles River in Vernon. Note the riverbed running under McLean Road in the center. Excerpted from Felix Viole, "Map of Los Angeles and Surroundings," 1916.

water the Los Angeles-Owens River Aqueduct would bring. The Pacific Electric extended its tracks to Glendale in 1904. A year later the town got its first newspaper, and by 1910 it had a population of 2,742. Perhaps 10,000 people lived in the surrounding area, including the town of Burbank, which had a population of about 500. The Pacific Electric extended its tracks to Burbank in 1911, and that city began to grow steadily as a result. The same year, the railroad built a new line through Cahuenga Pass to the San Fernando Valley to serve the new residential subdivisions that would become North Hollywood, Van Nuys, and Canoga Park.⁸⁰ Amid all this new development, however, almost no attention seems to have been paid to the possibility that the river could overflow. That quickly changed, however, in 1914.

The Flood of February 1914

The winter of 1913-14 was an El Niño season, as the flood year of 1884 had been. Had the relationship between the periodic warming of ocean currents and weather patterns been more widely recognized at the time, floods in Texas, which left 177 people dead in December 1913, might have been considered a preview of coming attractions.⁸¹ In Los Angeles, rain fell heavily in November and throughout January. Shortly after midnight on 18 February 1914, the ground already saturated from a month of regular showers, rain again began to fall. This time it did not stop for three days. Even as the rain came down, however, some in Los Angeles remained in denial about the potential for the river to overflow. The first day of the storm, officials of the city water department said that "there is positively no danger of a flood."⁸²

By the time the storm ended, however, some locations in the San Gabriel Mountains had received more than nineteen inches of precipitation, and every major river and stream in Los Angeles County had overflowed. The city of Los Angeles got just over seven inches of rain, including an inch and a half in a single hour. Floodwaters from Tujunga Wash, Pacoima Creek, and Verdugo Creek spread over much of the San Fernando Valley. The peak discharge of the Los Angeles River was 37,400 cubic feet per second, equal to the normal flow of the mighty Colorado River and far more than its small channel could contain. Long Beach again became an island. Nearly twelve thousand acres in Los Angeles County were flooded (fig. 4.12). Given all the new development since the great floods of the 1880s, it is hardly surprising that the flood of 1914, while not the most intense in terms of rainfall or the land area inundated, was the most damaging in history. Miraculously, no humans were killed.⁸³

Nearly all the flooding occurred outside the city of Los Angeles. Railroad-constructed levees on both sides of the river from the Arroyo

Seco south to the city limits for the most part kept the Los Angeles River in its channel, though the levees themselves were seriously damaged, numerous bridges were washed out, and some property losses occurred near the river. A pigeon farm across from Elysian Park was swept into the raging waters, and many of the estimated 500,000 birds housed there were killed. The river also threatened the Los Angeles city gas supply, and the cutting away of levees near several giant gas tanks that had been built west of its channel gave hint of the potential for even greater disaster. Elsewhere, damages were more severe. An entire street of houses along the Arroyo Seco toppled into that stream when its banks gave way. South of Los Angeles, the Los Angeles River overflowed its banks and inundated large areas between the city and the sea (fig. 4.13). East of Watts, according to news accounts, "the river became a great lake, encompassing in its broad expanse hundreds of ranches."⁸⁴

Shifts in the river's channel again wreaked havoc. Relatively minor changes nevertheless left bridges high and dry near Vernon. East of Compton, a sheet of water a mile across covered the area; when floodwaters finally receded, the main channel of the river had moved a mile west. Long Beach was the hardest hit. Hundreds of houses there were inundated. All railroads, highways, and telephone lines into the city were washed out. Even as the storm toll mounted, however, some remained ignorant that such a flood certainly had historical precedence and continued to judge the river by its dry season appearance. "The flood was wholly unexpected," the *Los Angeles Times* wrote. "Even those most familiar with the rainfall and topography of the country never had reason to think that so destructive a torrent could come rolling down from the hills and through the gully that has been lightly termed the Los Angeles River."⁸⁵

The public and private infrastructure of the county suffered the greatest financial losses. Floodwaters from the river dumped four million cubic yards of silt into Los Angeles and Long Beach Harbors, which had been transformed into one of the busiest port complexes on the Pacific Coast after the arrival of the railroads. The silt significantly raised the bottom of channels in the harbor area, stranding ships and rendering some channels unnavigable. Transportation lines throughout Southern California were also damaged. Thirty-five bridges were washed out. More than one hundred roads and highways were destroyed. Railroad service was suspended, and communication with the outside world was cut off for nearly a week. Total damages from the flood were initially estimated at \$10.1 million (\$162.1 million in current figures). County assessors later calculated that flooding had reduced the aggregate value of property in the county by another \$20 million.⁸⁶

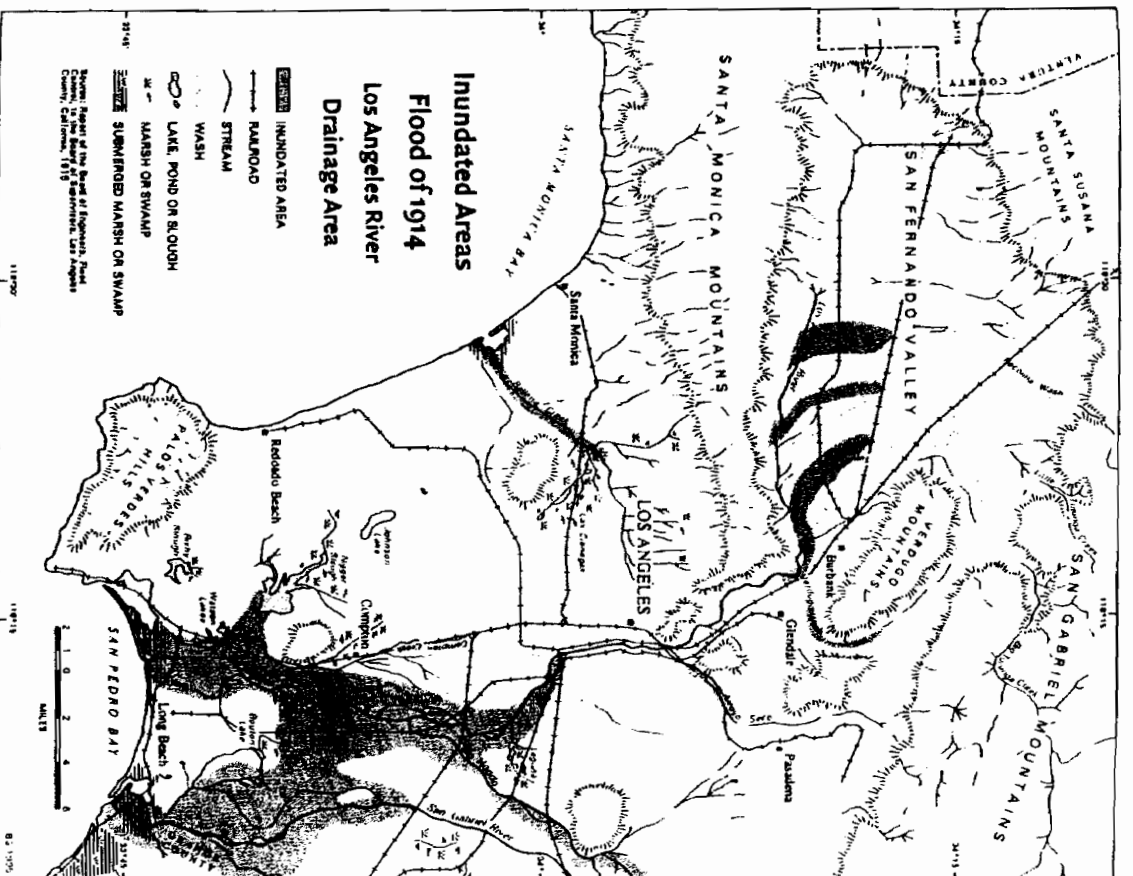


FIG. 4.12. Nearly twelve thousand acres in Los Angeles County were inundated during the flood of 1914. This map is based on a 1915 map produced by a county flood control board, which was more approximate in its delineation of the flooded area than similar maps produced for later floods. As a result, the flooded area appears larger than statistical estimates issued by the same board would indicate. Still, the map provides a good sense of the geographic dimensions of the flood. Map by the author.



FIG. 4.13. The Los Angeles River inundated large areas south of Los Angeles during the flood of 1914. In this photograph, floodwaters from the river wash over the tracks of the Pacific Electric Railway south-east of Lynwood. The main channel of the river is visible in the background, running horizontally between two lines of trees. Courtesy U.S. Army Corps of Engineers, Los Angeles District.

More than ever before, the railroads were a factor in the flooding. By this time, three major railroads and an extensive network of commuter rail lines crisscrossed Los Angeles County. In the years since the last major flood in 1889, the Pacific Electric Railway had built hundreds of miles of commuter tracks that radiated in every direction from Los Angeles. The Los Angeles River was crossed in sixteen places by railroad bridges, many of them trestle bridges, which slowed and sometimes blocked debris-laden flood flows. After the flood, county flood control officials received "a large number" of letters from residents critical of the railroads for their continued use of trestle bridges.⁷⁷ Within days of the flood, furthermore, the Los Angeles County Board of Supervisors passed a resolution calling on the railroads to replace their pile bridges with more permanent span structures that would allow stream flows to pass more freely. Railroad representatives expressed a willingness to cooperate. An official of the Santa Fe Railroad said, "The Santa Fe follows the policy of erecting permanent bridges wherever possible. But it is handicapped in this country by the fact that the stream bed of today may be a mile from the stream of tomorrow."⁷⁸

A map of the areas inundated in the 1914 flood, replicated in figure 4.12, gives some suggestion of the impact of the railroads. In seven different places, floods began very near where railroads crossed stream channels. This is especially noticeable in the San Fernando Valley, where three tributary channels of the Los Angeles River flooded. All three breakouts began near Southern Pacific Railroad crossings. The Los Angeles River, meanwhile, overflowed its channel south of downtown Los Angeles in a location where railroad-constructed levees confined floodwaters to a narrow course and two railroad bridges crossed the river within a mile. In addition, three other

"Lessons learned" nearly a century ago. Urban has no such incentive or willingness to cooperate

river made cause and cumulative impact. either way, exactly what we have been saying.

waterways—the San Gabriel River, Ballona Creek, and the Arroyo Seco—all first flooded near where their channels were crossed by railroads.⁷⁹ Although the exact role of the railroads in these outbreaks is not known, the impediments caused by the railroad bridges and embankments were clearly a contributing factor.

Silting of Los Angeles Harbor was also caused in part by the inadequacy of railroad bridges. The east approach to a Southern Pacific bridge between Wilmington and Long Beach, built in the 1880s before human activity forced much of the flow of the upper San Gabriel River into the Rio Hondo and out to sea via the Los Angeles River, was too short to allow debris-filled floodwaters to pass freely. Consequently, most of the flow of the river during the flood of 1914 was forced west over higher ground and into Los Angeles Harbor via Dominguez Creek. One channel in Los Angeles Harbor was rendered unnavigable when floodwaters deposited silt to a depth of eighteen feet. Another channel, newly dredged to a depth of twenty feet, was only two to four feet deep after the flood. Harbor officials said it would cost at least \$580,000 to restore the port, which had seen its trade volume increase 800 percent since the federal government had agreed to erect a breakwater and the city of Los Angeles had annexed the surrounding area, promising to spend \$10 million on port improvements.⁸⁰ The damage to the reputation of the harbor, said one engineer after the flood, "cannot be computed."⁸¹

Although floods were certainly nothing new in Southern California, the flood of 1914 clearly demonstrated to even the most skeptical that something had to be done to prevent the Los Angeles River from regularly overflowing its banks and occasionally carving entirely new courses across the increasingly developed landscape. Much of the city of Los Angeles by this time was reasonably well protected by railroad-constructed levees, but coordinated flood protections north and south of the city were nonexistent. The river, meanwhile, had become more dangerous because of changes made by humans, and the rapid growth of the region meant that the risk to life and property was greater than ever before. Los Angeles was fast becoming a sprawling metropolis and an industrial giant, which meant that even small storms now did more damage than the great floods of years past. Each new building and highway that was built, furthermore, increased the potential for flooding by reducing the area available to absorb rainfall and runoff, so as Southern California expanded, the flood danger grew with it. No longer the chief source of water for the largest city in the region, with most of its natural supply intercepted before it even reached its channel and its dry bed filling up with trash, the Los Angeles River was now merely an occasional hazard that had to be controlled.