and typhoid fever struck. The damage toll was at least $1 billion in Peru and Ecuador alone.

Of particular note is that right in Lima, the capital city of Peru, adequate urban water and sewage systems were not built in the 1980s, because the World Bank and International Monetary Fund refused to approve such construction. In 1991, cholera broke out in Lima. Over the subsequent months, it spread throughout South America; in 1993, cholera reached the Rio Grande River Basin, and is now found in Texas and border locations.

Australia. El Niño brings severe weather to Australia: drought and sudden storms. The 1982-83 episode was among the worst of the century. Huge dust storms rolled into towns, and over 75 people died, just from the bushfires whipped up by high winds; 8,000 people were made homeless. Herds suffered mass death. In February 1983, a giant storm struck Melbourne, depositing 11,000 tons of topsoil dust. Then, torrential rainstorms hit parts of eastern Australia, marooning people and livestock. Losses in agriculture alone were $2.5 billions.

Figure 1 shows just a transportation priority rail corridor, but the need for reliable water provision in Australia is well known, and also for emergency drainage systems. Less than 10% of the land area of this continent-nation has adequate rainfall. What is required is an "assembly-line" program of building and installing coastal nuclear-powered desalting facilities, to provide the man-made equivalent of "new rivers" to the dry continent. Also essential, is to build emergency systems for storms.

Southeast Asia. Indonesia, Malaysia, the Philippines, and other locations are periodically hard hit by drought under El Niño. Because of crop failures in 1982-83, Indonesia was drastically food-short; the official death toll from starvation was 340 people. Losses in Indonesia and the Philippines totalled at least $750 million in 1982-83. In these climates, provisions for strategic irrigation and "protected" agriculture infrastructure would avert such loss.

In Tahiti, and other islands of Polynesia, El Niño is associated with storms. In 1982-83, hurricanes left 25,000 homeless in Tahiti; Hawaii was also hit—an uncommon event. Damage totalled over $280 millions.

Africa. Across the Indian Ocean, the El Niño effect brings drought to southern Africa. Figure 1 shows a proposed canal to improve the southeastern watersheds—one of the many waterworks needed to increase and stabilize water supplies in the entire southern part of the continent. During the 1982-83 El Niño, for example, the Limpopo River Basin dried up. Lake Ngami dried up—one of the main watering spots for the many cattle in the region. The Okavango Delta shrank by one-third. Crop production was cut 40-70%; severe hunger and malnourishment spread. Losses way over $1 billion.

India, Sri Lanka. Drought can come with El Niño. In 1982-83, it caused significant crop damage, and a water shortage health emergency. Losses were an estimated $150 millions.

California's floods: no 'natural disaster'

Over the winter of 1996-97, northern and central California suffered severe flood damage, centered in the Sacramento River Valley and Delta, and in the Central Valley regions. While there was a specific coincidence of weather co-factors that caused the massive flooding—among them, early snowmelt, heavy rainfall, and warm temperatures—the damage toll resulted from the lack of provision and maintenance of infrastructure. In other words, a disaster of policy decisions, not nature. The systems needed to manage high run-off were not fully in place, nor maintained. In view of the target location of California for El Niño episodes, it is national insanity to continue this practice.

There are three kinds of projects needed to handle floods and droughts in California:

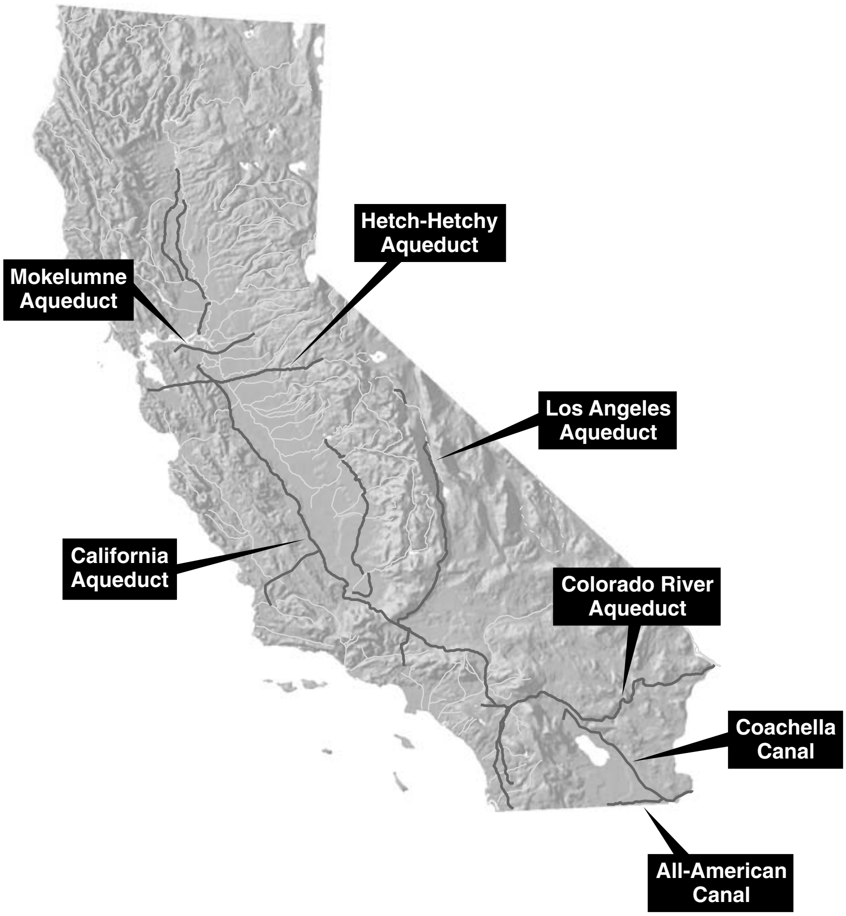
1. Continental-scale "geo-engineering," involving interbasin water transfers, to maximize the availability of water for the benefit of the economy, and the natural resources environment in the mutual interest of Canada, the United States, Mexico, and Central America. In western North America, this can be accomplished by the NAWAPA project, shown in Figure 2.

In Mexico, there are sister projects, known as the Hydraulic Project for the Northwest (Plhino) and the Hydraulic Project for the Gulf of the Northeast (Plhigon). These latter designs, worked up by the College of Civil Engineers, would move water through canals and existing dry river beds draining the slopes of the Sierra Madres, to the dry northern states of Sonora, Sinaloa, and Tamaulipas. NAWAPA, and Plhino and Plhigon, were ready to go in the 1960s, but over the last 30 years, the plans were shelved, during the era of the anti-development policies of the last decades of the failing International Monetary Fund system.

2. Full implementation of regional water management programs—construction and maintenance. Since 1957, California has had a master Water Plan, for an integrated state and regional water supply and management, which, however, was only partially implemented as of 1970, and then stalled. **Figure 3** shows some of the completed projects in California. **Figures 4-6** show aspects of the unfinished waterworks in the northern California watersheds, which set the stage for the vast damage of 1997.

3. Nuclear-powered desalination of seawater. California is well situated to enjoy guaranteed plentiful water supplies, even in the worst El Niño drought periods, if high-technology desalination facilities were built to desalt Pacific waters. Such facilities were proposed for the giant Metropolitan Water District for Los Angeles and sothern California, from San Diego-

FIGURE 3
Major man-made canals and diversion channels



Over the course of the twentieth century, systems of aqueducts and canals were built to provide expanded freshwater supplies, flood control, storage, and distribution throughout the state. Many of the projects shown were started during the 1930s Depression; others were done following World War II. In 1957, the California Water Plan laid out projects to provide water for a growing population into the next century. Over the last 30 years, however, these were stalled, partially completed, or scrapped altogether. The result is water shortages and flood damage.

based General Atomics, using their proposed gas-turbine modular helium-cooled reactor. But because of opposition, it was shelved in the early 1990s.

Unbuilt projects mean flood damage

Figure 4 shows how the Flood of '97 ruptured 46 inadequate levees on the Sacramento and San Joaquin river systems (which rise in the highlands of central and northern California, meet, and flow out to sea at the San Francisco Delta). *Hundreds of miles of local levees along these rivers and tributaries were substandard,* according to the Army Corps of Engineers specifications. So, when the floodwaters rose, the system gave way at weak spots. There are about 6,000 miles of levees in these basins, some of which originated in the nineteenth century, and programs to update and maintain them have not been carried to completion.

In addition to the levee question, the other flood control system weakness is the lack of completion of dams, spillways, and similar systems to hold back, or divert high floodwaters, and to control the rate of run-off in order to protect downstream towns and farms. Figure 5 shows the location of the centerpiece project—the proposed Auburn Dam. The site is upriver from the existing Folsom Reservoir on the American River, above Sacramento, the state capital city, on the Sacramento River.

For over 30 years, Army Corps of Engineers and other specialists have proposed a dam at Auburn, to capture and store run-off, to relieve the pressure on the Folsom Reservoir, and to prevent the possibility of its waters overflowing into Sacramento. The proposed Auburn reservoir could store 2.3 million acre-feet, placing it among the large reservoirs in the state, thus adding greatly to the water supply. (An acre-foot is the volume of water covering 1 acre to the depth of 1 foot.)

However, time and again, the Auburn Dam proposal was rejected. In 1992, enabling legislation was introduced into Congress to help fund the project. (The Federal government usually funds 50-75% of the construction cost of public water works and flood-control projects.) The bill lost by a vote of 273-140 in the House of Representatives, during the Conservative Revolution mania. In 1996, it was introduced again, and once again, defeated by those opposing the costs and "environmental" impact. The dam was defeated 35-28 in the House Committee on Transportation and Infrastructure. Heavy lobbying against the dam was done by the Friends of the River, Sierra Club, Environmental Defense Fund, Friends of the Earth, and National Wildlife Federation. Opposition over costliness was led by Taxpayers for Common Sense, and Gingrich-follower Rep. Thomas Petri (R-Wisc.).

Fortunately, this time around, the Folsom reservoir system held, and Sacramento was not inundated. Fortuitously, somewhat less rain fell on the American River watershed,

Red River Floodway protects Winnipeg

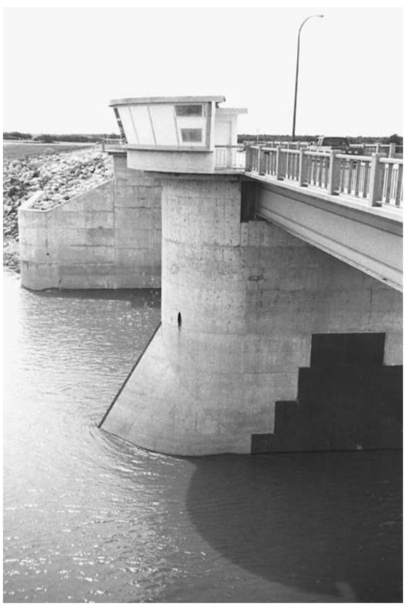
Shown here are views of the Red River Floodway, the 29-mile diversion channel, running east around Winnipeg, the capital of Manitoba, Canada. The Floodway (and related structures including Shellmouth Dam, Portage Diversion, Z Dike) kept the 600,000 residents safe during this year's century flood of the Red River of the North. It is popularly known as Duff's Ditch, named after Manitoba Premier Duff Roblin, who pushed it through to completion, in 1968. In 1950, Red River floodwaters devastated Winnipeg; 100,000 people had to flee, and 10,000 homes were destroyed. Roblin and other leaders pledged to build anything required to prevent this ever happening again. The "Ditch" has been used 18 times since 1968, successful every time. This year, the Red's flood crest at Winnipeg would have been 1.6 meters higher than in the disastrous 1950 flood. But the floodgates were opened on April 21, and the city saved.

The photographs, taken in July, when floodwaters had waned, show views of the signpost, the Red in its natural riverbed, the receded floodstream remaining in the Floodway, and the floodgates, control tower, and walkway. Though modest-looking here, the 29-mile long ditch was visible to the astronauts on the Moon in the 1960s.

"Duff's Ditch" took three years of planning, and six years of building. The chief hydraulic engineer was Ed Kuiper, from Holland, who remained in the area as an engineer at the University of Manitoba. At the height of the project, in summer 1965, some 1,000 people were working on construction. Building the Floodway required moving more earth than was moved to construct the Panama Canal.

The cost of the Floodway project was $63.2 million (Canadian dollars); it was paid for in cash, with the Federal share being 58.5%, and the rest paid by Manitoba Province. Officials put the value of damage prevented by the Floodway, in the 18 times it has been used between 1969 and 1997, as high as many billions of dollars—far more than the cost of the "Ditch."

The Red River is a relatively young river (less than 10,000 years old), about 545 miles long (844 km), whose basin is mostly the level plane of the former Glacial Lake Agassiz, making flood protection difficult in such flat terrain. This year the Red River turned into the "Red Sea," covering 1,000 square miles, or 640,000 acres, but the Floodway shows that infrastructure works.—*Marcia Merry Baker*



Counter-clockwise from top left: Floodway signpost; floodgate structure with control tower; Red River running in its own channel; Duff's Ditch.

FIGURE 4

Flood of '97 ruptured 46 inadequate levees on the Sacramento and San Joaquin River system

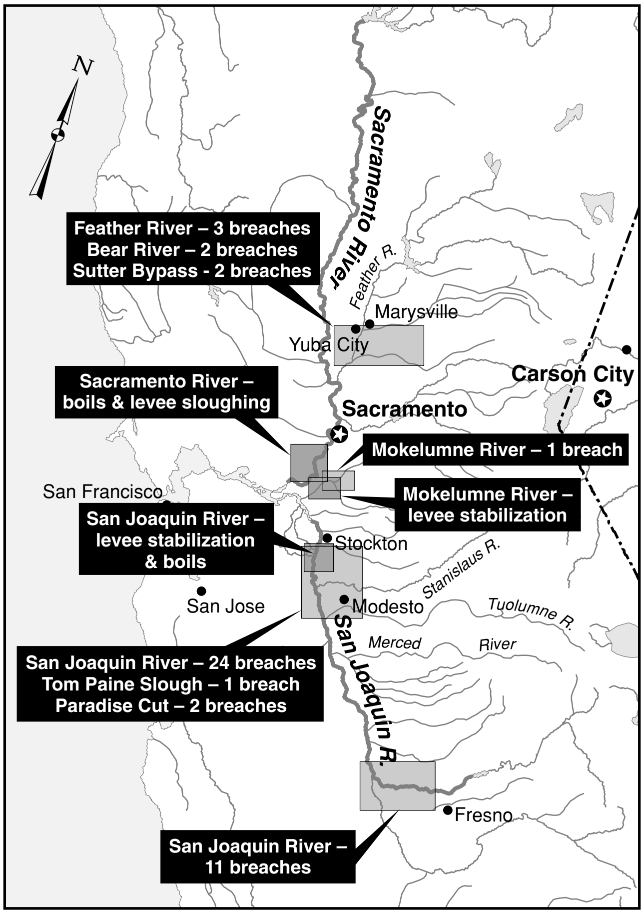
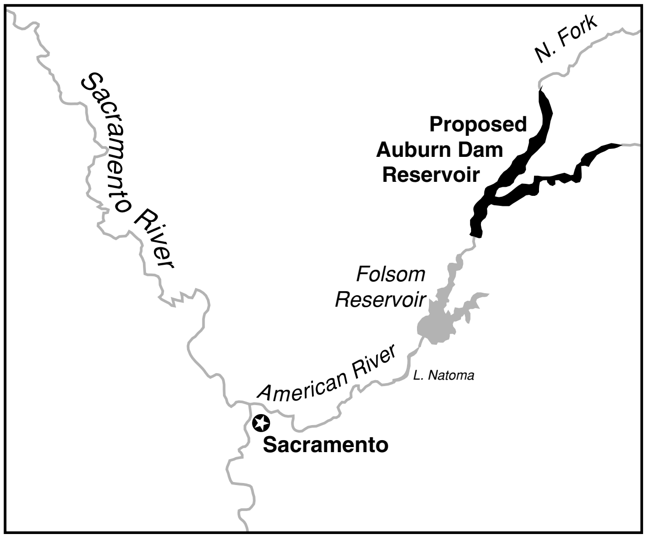


FIGURE 5

Auburn Dam would provide flood control protection on American River against even 200-year flood



than on surrounding areas; but the next 100-year flood may not be so lucky for Sacramento.

Overall there are about 60 surface water storage projects proposed that could be built for flood control to protect California against 100-year floods, or, in some locations, "200-year" floods; and in the meantime, to add to the water supply system. Figure 6 shows 11 out of the 60 proposed projects, located on the Sacramento and San Joaquin Rivers systems.

If all these 60-some projects were built—some of which were proposed in the 1957 California Water Plan—the state would gain a combined storage capacity of 39.1 million acre-feet, which is almost equal to the existing storage capacity of California's water system.

As a consequence of the lack of such necessary infrastructure, the damage toll of the Flood of '97 in California, was enormous. In California, and the adjacent five-state region hit by floods, 26 people died as a direct result, and hundreds more as an indirect result; close to 50,000 livestock died; 2-3,000 homes and business establishments were damaged or destroyed; roads were destroyed; prime agriculture land was flooded. The dollar damage figure is way above $3.5 billion.

The '500-year flood' in central Europe

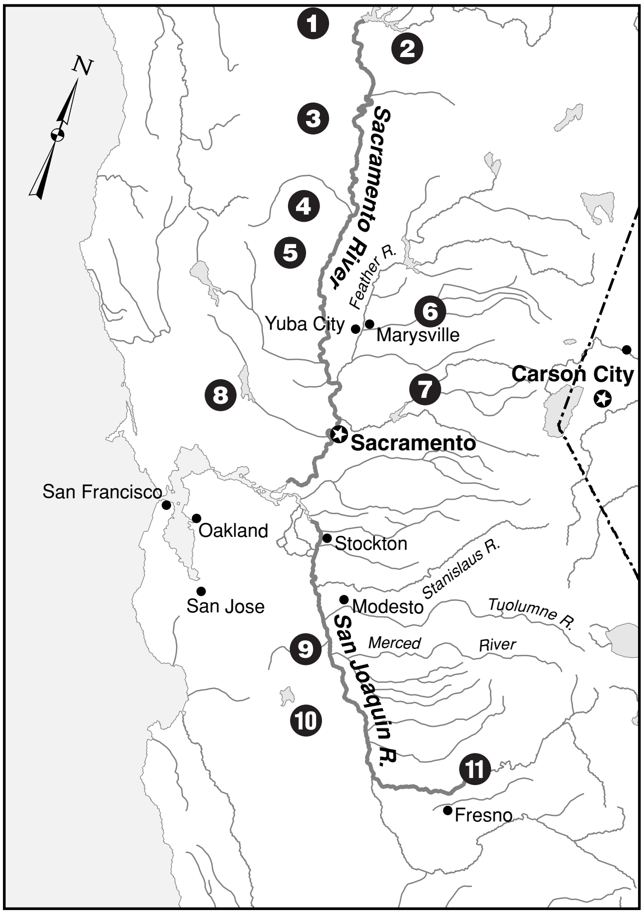
Dramatic demonstration of the urgency to build infrastructure geared for "century floods" is the disastrous situation in central and northern Europe, hit by what engineers call a "500-year flood." The Oder and Neisse River systems and adjacent watersheds were pelted this summer with prolonged, torrential rains. The result, wherever infrastructure was absent, or in a state of substandard repair, was massive flooding and devastation. Directly hit were the Czech Republic, Slovakia, Poland, and eastern Germany.

The consequences are typified by the situation as of September, in the Czech Republic. The school year could not start this fall for thousands of students in Moravia and eastern Bohemia, because either the school buildings were heavily damaged, or those that are sound are in use as homes for the 8,000 Czechs made homeless by the floods. Thousands of citizens in the immediate disaster zones will have no regular freshwater and electricity supplies before 1998; they live in emergency conditions.

The overall extent and devastation from the summer floods resemble that caused by war. As of August, there was immense damage to housing and industrial infrastructure, energy and medical facilities, and transport and telecommu-

FIGURE 6

Eleven needed surface water dam/reservoirs



Key

Shown here are 11 out of 60 surface storage projects that could be built for flood control to protect against "100-year" and, in many locations, "200-year" floods. The dam/reservoirs would also add to the fresh water supply. Many of these projects were drawn up as far back as California's 1957 Water Plan. Engineering and other studies required for their construction have already been completed.

Listed are their storage capacity, and cost, where known. Their combined storage capacity would be 39.1 million acre-feet (maf), almost equal to the current storage capacity of California's system. An acre-foot is equal to 325,851 gallons (the amount of water that could cover one acre to the depth of one foot).

1 **Clair Engle Lake:** enlargement to 5 maf

2 **Shasta Reservoir:** enlarge from 4.55 maf to 14 maf
cost: $4-6 billion

3 **Cottonwood Creek:** 1.6 maf
1987 cost in 1995 dollars: $760 million

4 **Glenn Reservoir:** 8 maf
1980 cost indexed to 1996 dollars: $3.4 billion

5 **Sites Colusa Reservoir:** 3 maf
cost: 1.5 billion

6 **Marysville Reservoir:** 900,000 acre-feet
cost: $1 billion

7 **Auburn Dam:** 2.3 maf
1987 cost, expressed in 1996 dollars: $1.5 billion

8 **Lake Berryessa:** enlargement from 1 maf to 13 maf
cost: $2.9 billion

9 **Orestimba Reservoir:** 1.1 maf
cost: $1.8 billion

10 **Los Banos Grandes:** 2 maf
cost: $1.1 billion

11 **Millerton-Friant Dam:** enlargement from 0.6 maf to 1.4 maf

nications grids.

Czech Republic: 42% of the national territory has been affected, including areas in the northeast and northwest, with traditionally high concentrations of manufacturing and transport infrastructure, and densities of population. About 10,000 households have lost everything, another 110,000 report heavy or considerable damage. At least 23,000 homes have to be rebuilt or significantly refurbished. At least 100,000 hectares of arable land suffered damage. Unofficial estimates from Prague speak of a damage toll in the range of $4-6 billion.

Poland: Close to 500,000 hectares of arable land, are contaminated and destroyed. Nearly 600 kilometers of rail tracks, which suffered varying degrees of damage, have to be restored; 600 schools and numerous hospitals have to be made functional again. All in all, 85 cities and 875 villages have to be partially rebuilt, as well as about 3,000 kilometers of river dikes and other water-management infrastructure—of which 2,000 kilometers of levees were proposed for overhaul by the National Accounting Office in 1994.

Some 15,000 Polish households have lost everything, and another quarter of a million households report considerable material losses. Unofficial estimates speak of between $5-7 billion as being required for the economic reconstruction, of which at least $1 billion will be for the farm sector.

Germany: The damage along the Oder River is in the range of 2 billion deutschemarks (about $1.25 billion). German engineers speak of a "250-year flood," and stress the need for dam-building, and other water-management improvements.

The estimated cost of required infrastructure projects for the three nations combined—Germany, Poland, and the Czech Republic—is in the range of $20-30 billion, to guarantee an effective protection against another catastrophe of this scope. It is evident that such sums cannot be assigned out of existing International Monetary Fund- or Maastricht-approved austerity budgets, but have to come from classic methods of state-guaranteed generation of reconstruction credits, as has traditionally been done in reconstruction periods immediately after a war.