EIR Feature

A plan to create new water supplies for North America

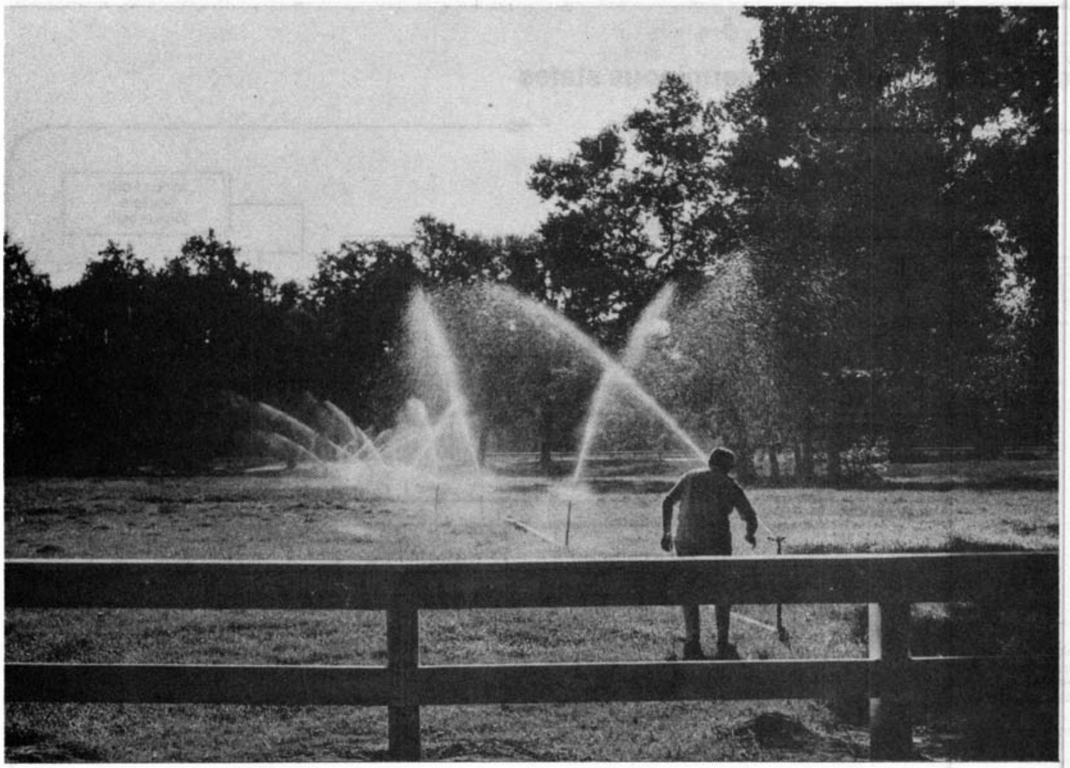
by Marcia Merry

The article begins an *EIR* series about how to reverse the physical collapse of the U.S. domestic economy, the problem the George Bush crowd (as well as its loyal opposition in Congress) is criminally evading. We begin our examination of the gaping U.S. infrastructure deficit with the water crisis now afflicting many states. The key is waterworks—not pennywise "conservation" schemes and other quack prescriptions dispensed by the austerity-mongers and their ecological fascist cohorts.

Most people think of rivers, lakes, aquifers, and water wells as resources fixed by nature, to be either conserved or consumed. On the contrary: The only relatively fixed feature of the water cycle in North America is the overall annual precipitation, which amounts to an average 4,200 billion gallons a day (bgd). Of that, about 1,200 bgd reaches the 48 coterminous states, where man's intervention over the past 200 years has directly affected what water engineers call the average dependable supply of runoff. Today, this totals about 515 bgd, and it is not a fixed figure, but the result of man's activities to clear channels, drain swamps, prevent evaporation, and create storage capacity.

The colonization of the 1600s saw local water improvements such as the Saugus Ironworks in Massachusetts, where water sluices powered giant waterwheels and bellows. In the 1700s, waterworks were constructed along the fall line of the eastern seaboard, to power grist mills and textile centers whose town names tell the tale today: e.g., Falls Church, Virginia. The nineteenth century saw the construction of vast waterworks: the Erie Canal, the Pennsylvania Canal, and the utilization of the great river systems of the continent. The early twentieth century surpassed even this, with the construction of the giant Hoover Dam, Grand Coulee Dam, the St. Lawrence Seaway, and other man-made wonders, and the model of resources development, the Tennessee Valley Authority.

With these high dams, the best barrier sites for maximum water capture were utilized, and new means of water improvements were required for moving into



Irrigation on the Russell Giffen Ranch in California, downstream from the Pine Flat Dam. Mr. Giffen is known locally as "the world's largest irrigated farmer." Reduced precipitation in California over a five-year period, plus the failure to develop new water projects, have resulted in a crisis for agriculture.

the twenty-first century. The average reservoir capacity produced per cubic yard of dam declined from 10.4 acre feet in the 1920s and earlier, down to 2.1 in the 1930s, 0.52 in the 1940s, and 0.29 in the 1960s, according to the U.S. Geological Survey (1984).

Following World War II, new means were at hand to create new water supplies. The grand, and obvious, plan was conceived to divert streamflow from the far north of the continent, which flows from the Yukon into the Arctic Ocean, southward. Atoms for Peace researchers were working on peaceful nuclear explosives capable of giant earthmoving tasks, as well as nuclear technologies to cheaply desalinate seawater.

However, these plans were all aborted. The U.S. water crises of today are the inevitable result—a situation which will only get worse, until we resume the geographic engineering required to "take care of nature," and expand usable water supplies.

The hydrologic cycle

Most of the United States has between 20 and 40 inches of rainfall a year, and only one-third of the nation's area gets less than 20 inches of annual precipitation. The limitations on water availability come from seasonality of precipitation, unreliability, difficult access, and similar factors, which vary greatly from place to place.

The overall hydrologic cycle for the 48 coterminous U.S. states is shown in **Figure 1.** This shows the U.S. "budget" of water flowing in (as snow or rainfall), and water going out (as evaporation, or streamflow return to the oceans). There is an estimated overall precipitation of 4,200 billion gallons a day coming in. (You can think of the size of 1 billion gallons as a column of water whose base is the size of a football field, and whose height is over four times that of the Washington Monument.)

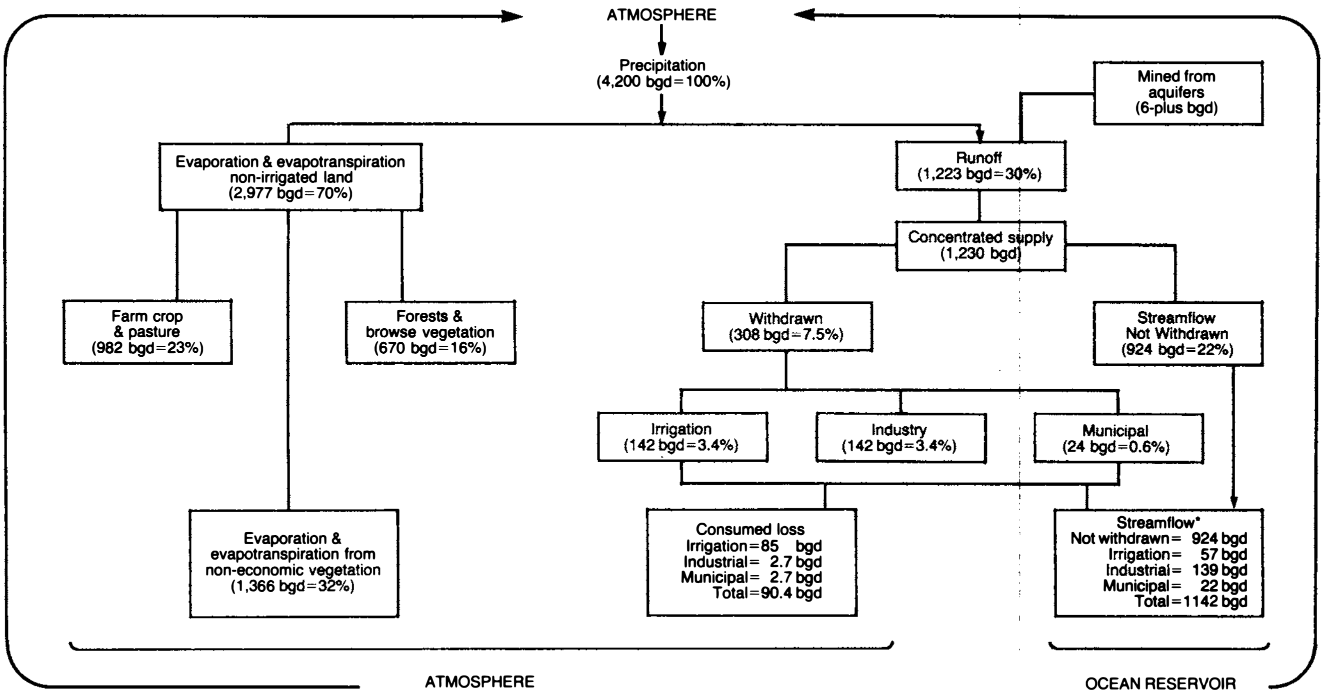
This amount, coming from weather patterns in the atmosphere, then breaks down into about 30%, or 1220 bgd, of runoff into streamflow and ground water, leaving 70%, or 2,977 bgd, to return as evaporation or evapotranspiration through plant life, to the atmosphere.

In the 1960s, the U.S. Geological Survey, part of the Department of the Interior, began a survey process to assay water resources—the volumes available, the quality, and all other necessary features. The purpose was to provide analysis for the ongoing process of making infrastructure improvements to supply water for future generations in the amounts, purity and locations necessary.

The Geological Survey established 21 hydrologic resource regions, 18 of which are shown in **Figure 2** and listed in **Table 1.** There are 18 regions in the 48 coterminous states, and one region each for Alaska, Hawaii, and the Caribbean. The regions were delineated based on the coherent runoff and ground water patterns that occur in the various watersheds across the country. For example, the region called "Southeastern-Gulf" includes the river systems draining eastward into the Atlantic Ocean and the Gulf, which mostly originate on the southern and eastern

FIGURE 1

U.S. hydrologic cycle and water use, 48 coterminous states



*The same water may be reused at points spaced along a single stream.

Source: Abel Wolman, Publication 1000-B, National Research Council, 1962.

slopes of the Appalachian range.

The runoff varies greatly across the hydrologic regions. Table 1 shows total runoff for each region, the the "estimated dependable supply," and per capita supply and use in 1985.

How much can be utilized?

The key issue, as shown in the central area of the hydrologic cycle diagram marked "Withdrawn," is how much water can be effectively utilized in the cycle, for the support of the economic development of the population and improvement of our ecology. The diagram gives statistics for water use in the United States in about 1960, when the total water withdrawn was 308 bgd. This is only 7.5% of the annual 4,200 bgd precipitation, and still only 25% of the runoff of 1,223 bgd a day.

However, relative to the estimated daily readily available supply—515 billion gallons—the 308 bgd use was 60% of readily available supply. This showed clearly the necessity for a program of water infrastructure projects to be implemented over the last 30 years. Already in the 1960s, some regions were running short of water, and others were approaching their supply limit.

The urgency of the issue is further shown by the fact that per capita water use in 1960 was 1,506 bgd, and that increasing numbers of people, combined with increases in needed per capita water withdrawals, would inevitably cause severe shortfalls unless available supplies were increased.

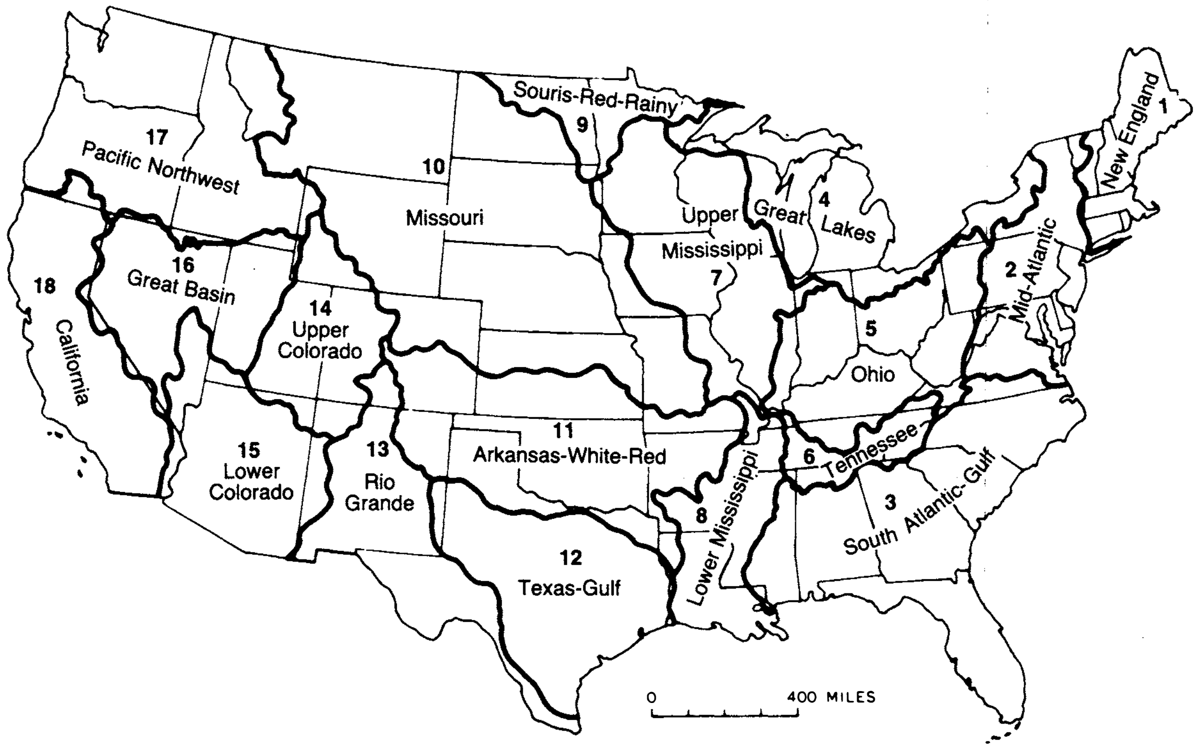
In the absence of man-made water projects to augment natural water supplies, increasing use has been made of ground water. Today, ground water supplies up to one-fifth of all fresh water withdrawals for use nationally.

There are an estimated 150,000 billion gallons of water (about 450 million acre feet) stored in large (50 acre feet or more) surface and ground water reservoirs, and an amount estimated to be 200 times this stored in aquifers up to 2,500 feet below the surface. However, there is great variability in the rate at which aquifers recharge, the quality of water available, the structural consequences of heavy drawdown of aquifers, and other factors. Most of the areas of the West have been heavily dependent on ground water use.

Short water supplies, ground water crisis

Table 1 shows that there are many hydrological regions where dependable runoff is far under the 2,200 gallons per day per person benchmark requirement level (discussed in the next section), either because of little water, large population concentrations relative to available runoff, or both. The two areas with the reverse situation—large water runoff and small

FIGURE 2
U.S. hydrologic regions in the 48 coterminous states



Source: U.S. Geological Survey

populations—stand out dramatically: the Great Basin and the Upper Colorado. In fact, the waterworks of earlier this century tapped off this water for use downstream by the populations in southern California and the Southwest.

Table 1 gives the per capita water withdrawals in 1985, that is, water used per person in that hydrological region in 1985. Since in many hydrological regions, the per capita water withdrawn for use figure exceeds the runoff per capita, this makes clear the role of ground water supplies, and interbasin transfers of runoff through water diversion programs. This also makes clear that if water diversion flows and/or ground water sources are diminished, much of the nation's economic activity is jeopardized.

The pattern of use shows that though the western states receive precipitation at about one-quarter the amount per acre as the East, their withdrawals are nearly double. The daily per capita use of water ranges from 596 gallons a day in the Mid-Atlantic region to 11,800 in the Upper Colorado. On a state level, the extremes range from 152 gallons in Rhode Island to 22,200 gallons in Idaho, of daily per capita fresh water withdrawals.

This extreme variance reflects broader regional differences in irrigation and similar types of water use. In the 17 western states, per capita fresh water withdrawals in 1985 averaged 2,214 gallons per day, which is more than twice the average for the 31 eastern states where irrigation is not the rule.

The problem areas

Given the inherited patterns of water use, and the 25-year hiatus in developing new water supply infrastructure, the water supply problems are showing up most acutely in the western regions, but also in a few other key parts of the country.

Several successive years of low precipitation have markedly reduced water supplies in California and the Missouri regions. In 34 states, saline water intrusion has resulted from years of pumping ground water for amounts exceeding the rate of recharge.

California. Reduced precipitation for the past five years, plus years of heavy net withdrawals from ground water sources, have resulted in short supplies, salt water intrusion, and related problems. The water levels in the state's reservoir system continue at only 65% of average, and in Nevada, storage is even lower. Mining of ground water has resulted in seawater intrusion at many points in the central and southern coastal towns. The state has been obtaining 40% of annual water needs from pumping ground water, which in 11 of 50 major aquifers has led to an overdraft crisis. Thousands of

TABLE 1

Water resources, by standard hydrologic regions, for the 48 coterminous states

Region	Total average runoff -(bgd)-	Estimated dependable runoff	—Per capita— dependable runoff —(gal daily)—	Use, 1985
1. New England	67	22	1,790	746
2. Mid-Atlantic	84	36	900	596
3. South Atlantic-Gulf	197	75	2,310	973
4. Great Lakes	75	69	3,240	1,300
5. Ohio	125	48	2,190	1,420
6. Tennessee	41	14	3,640	2,390
7. Upper Mississippi	65	31	1,480	807
8. Lower Mississippi	79	25	3,450	2,350
9. Souris-Red-Rainy	6.2	3	4,170	389
10. Missouri	54	30	3,222	3,370
11. Arkansas-White-Red	73	20	2,360	1,800
12. Texas-Gulf	32	17	1,160	934
13. Rio Grande	5	3	1,430	2,670
14. Upper Colorado	13	13	20,340	11,800
15. Lower Colorado	3.2	3	760	1,880
16. Great Basin	7.5	9	45,460	4,090
17. Pacific Northwest	210	70	8,510	4,310
18. California	62	28	1,060	1,432
Total	1,200	515		

square miles of agricultural land in the San Joaquin Valley have sunk. Over 36 years, much of the town of San Jose slumped up to 12 feet. In the Central Valley, the nation's most productive agricultural region, saline water is threatening to seep into the underlying fresh water aquifer, which has been heavily pumped.

New York. The drinking water supplies for millions of residents on Long Island are threatened because the underlying aquifer has been mined to the point that sea water is moving in.

Florida. The water supplies for Miami, Tampa, Jacksonville, and many other population centers are threatened by the saline intrusion into ground water sources, because of heavy pumping.

Texas. Land subsidence as a result of ground water pumping has occurred in the Houston and Galveston areas, causing costly damage. The effects of land subsidence due to overpumping ground water can include not only loss of storage capacity, but also structural damage to bridges, buildings, roads, and underground utilities.

Rio Grande, Lower Colorado. In these hydrologic regions, plus southern California, the U.S.-Mexican border zone of *maquiladoras*—slave labor assembly plants—has become a biological breakdown zone because of the lack of safe water supplies. Hundreds of thousands of people have migrated there for cheap labor in the past five years, when as of the 1970s, the per capita and per hectare water supplies were unsafe for increased population, and hydrologists warned that improvements were necessary.

Nawapa and contingency plans

The plan for a North American Water and Power Alliance (Nawapa) would ultimately provide at least 135 bgd to the United States, and additional supplies to Canada and Mexico. But during the 20 years required for its completion, priority regional projects should be implemented to fill local water deficits:

Western projects. California water supplies can be greatly augmented by lifting the arbitrary bans on utilizing the runoff of the rivers in the far north of the state, now flowing unused into the Pacific. Plans exist for a "Peripheral Canal" project to effectively harness this flow. There are other projects in Colorado, the Dakotas, and throughout the West that can be "unblocked."

On a larger scale, the vast runoff available in the Columbia River watershed, in the Northwest hydrological region, can be utilized. Engineering plans exist to draw off water through the Snake River system, and channel the flow southward to Nevada, California and other points south.

Desalination. The Atlantic and Pacific Oceans, and the Gulf of Mexico, constitute "reservoirs" of virtually limitless storage capacity, given the installation of advanced technology nuclear desalination facilities—the modular high-temperature gas-cooled reactor (MHTGR) design. If these plants were sited at key points along the Pacific, Gulf, and Atlantic coastline, their sweet water output could reduce the dangers of land subsidence and salt water incursion now threatening the water supplies for millions of people.

A string of California coastal towns, including Santa Barbara and the island of Catalina, are now building desalination plants. But they are using fossil fuel, retrograde technologies that do not point to a regional solution.

Economic location. The water supply figures in Table 1 show several hydrologic regions which offer plentiful supplies of reliable "surplus" water, notably the Great Lakes, the Ohio, and the Tennessee regions. Here, coordinated federal and local intervention could provide conducive circumstances for agriculture, manufacturing, and residential buildup. The power and transport potential of this region is great, and the proximity to pre-exisitng population concentration.

This would be an economically sound approach to building the nation, as opposed to backing for such economic hoaxes as the "Sunbelt" trend of the 1970s, or the "free trade " Mexican-U.S. border zone, where the water crisis has reached the point of an impending cholera outbreak and biological holocaust.