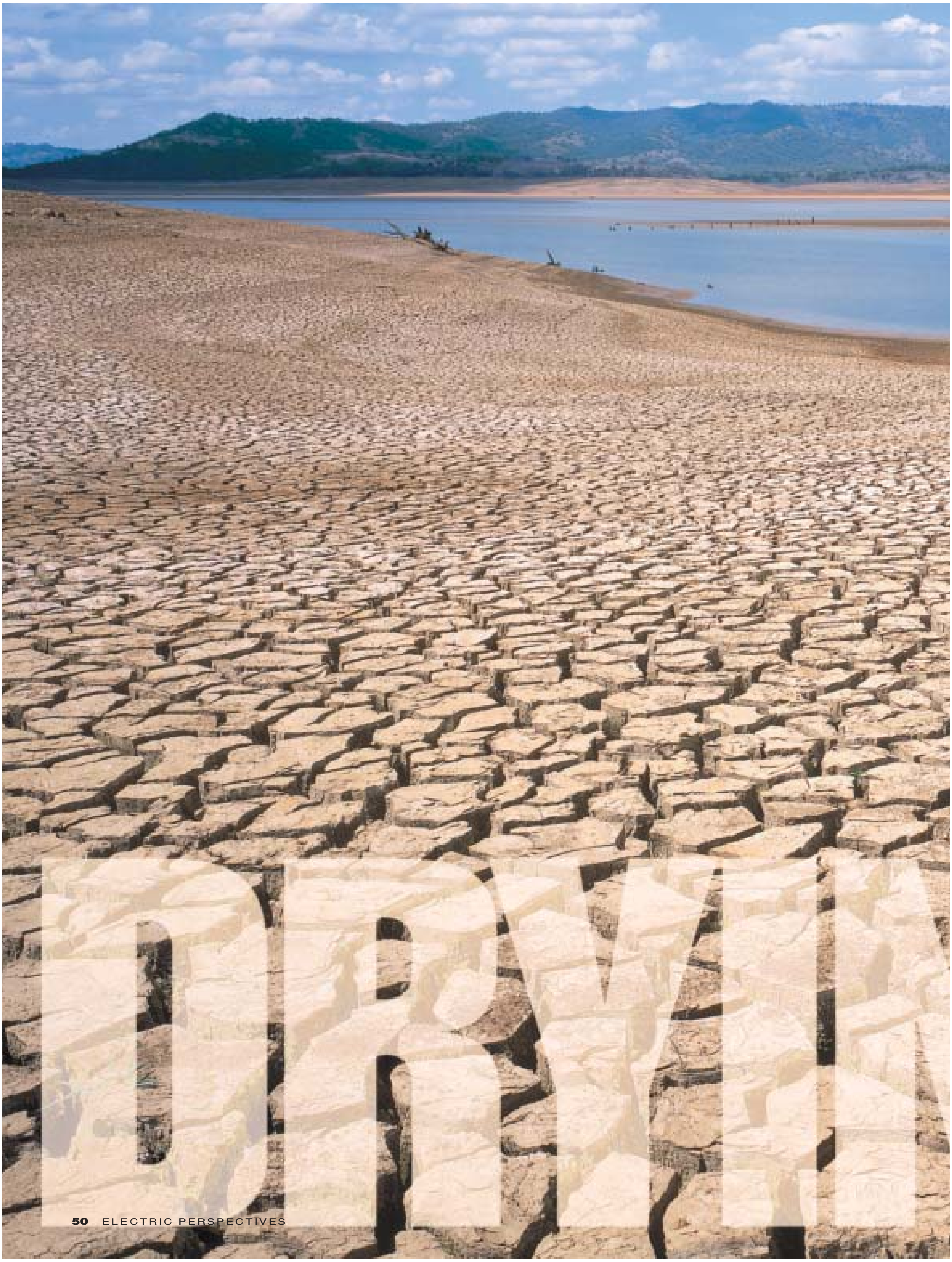

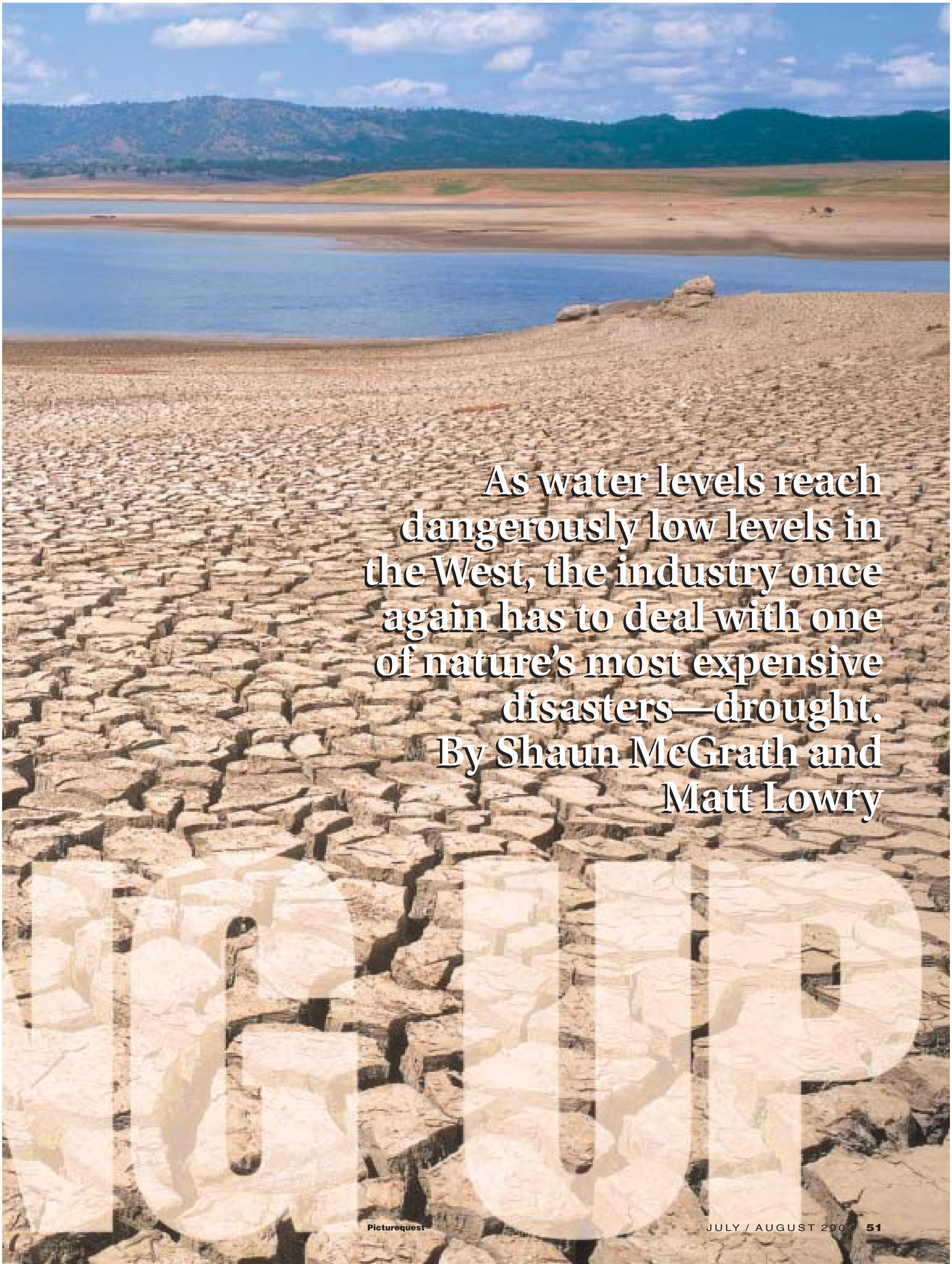

Picturequest

As water levels reach dangerously low levels in the West, the industry once again has to deal with one of nature's most expensive disasters—drought.

By Shaun McGrath and Matt Lowry

The drought of 2002 was one of the worst in the past century.

According to the National Drought Mitigation Center, 53 percent of the United States experienced "moderate" or worse drought conditions in areas covering 32 states. The National Oceanic and Atmospheric Administration (NOAA) reported that the average temperature during the summer season was 73.9 degrees, which is the third-warmest on record and surpassed only by the Dust Bowl years (1936 and 1934). At the same time, 29 states recorded significantly below-average precipitation. Six states (NC, VA, CO, UT, AZ, and NV) had their driest 12-month period on record, and five states (SC, GA, MD, DE, and WY) had their second-driest. Furthermore, for a number of southeastern and western states, the abnormally hot and dry conditions came in addition to a drought that began in 1998.

The 2002 wildfire season was the most costly and second most devastating season on the books, costing more than $1.4 billion to suppress and burning more than 7.1 million acres across the country—an area larger than New Hampshire and Delaware combined.

Low municipal water supplies led many localities to request voluntary or issue mandatory water restrictions. In Colorado (just one state example), five communities experienced water supply emergencies and 19 reached "critical" designations. The Missouri River fell 9 to 15 feet below its normal average depth, threatening barge traffic and the ecology of the river. The Colorado River, which depends on snowpack run-off, flowed at 25 percent of its historic average; the Salt River ran at one-sixth its average.

Shaun McGrath is a program manager with the Western Governors Association and Matt Lowry is a policy analyst with the Western Interstate Energy Board.

Corbis

Low water levels on the Colorado and other Western rivers affect electric utilities, which require water to operate hydro and thermal plants.

The National Drought Mitigation Center estimated the drought's cost at $11.2 billion, though the total cost is difficult to ascertain because some states were not coordinated in tracking all the impacts, and some did not provide estimates at all.

Although the 2002 drought wreaked havoc on (particularly) western agriculture, ranching, and the recreation and tourism industry—it had far-reaching effects in the utility industry, too—it was by no means a new phenomenon. According to NOAA, there have been 12 different drought events since 1980 that resulted in damages and costs exceeding $1 billion each. The most devastating of these was the 1988 drought in the central and eastern United States, which caused severe losses to agriculture and related industries, totaling $40 billion.

Drought visits some area of the country every single year—several states will have drought conditions this year. The National Drought Mitigation Center estimates that the federal government spends $6 billion-$8 billion per year on drought compared to $2.5 billion on floods and $1 billion-$5 billion on hurricanes. There is some planning in anticipation of these costs: In February, for example, Congress passed an omnibus appropriations bill that included $3.1 billion for drought aid to farmers and ranchers and $825 million for wildfire suppression.

Yet, despite drought's recurrence and tremendous associated costs, there still does not exist a permanent national policy to prepare for and respond to drought disasters. This lack of a coordinated, integrated federal plan of action causes confusion at the state and local levels and results mainly in special legislation and ad hoc measures rather than a systematic and permanent solution.

It's time to create that solution.

Thirsty Dams

The 2002 drought also significantly affected U.S. energy markets. The specific economic effects are difficult to gauge, however. "There are many factors that influence the market, and there is no simple or easy way to isolate the effect of less-than-average rainfall," says Marlon Walker, spokesperson for Southern California Edison.

Still, the Western energy crisis of 2000-01 is an illuminating example of drought's effects on electricity. Inadequate generation resources, volatile natural gas prices, questionable business practices, California's unsuccessful attempt at deregulation, high temperatures, and low streamflows conspired to make the Western region an energy flashpoint. Markets went haywire, and electricity prices rose from $15-$30 per megawatt-hour (MWH) to as high as $1,400 per MWH at certain distribution hubs in California.

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Dry conditions kept boat-owners ashore at Lake Arrowhead, CA. Similar low water levels in the Pacific Northwest exacerbated California's 2001 energy crisis.

Among the main factors in the meltdown were reduced power exports from the Northwest. Hydropower provides roughly three quarters of the electricity in the Northwest. Streamflow and snowpack levels were one-half to two-thirds of their normal levels. When federal hydro production on the Columbia went from a five-year average of 17,900 aMW (aMW—an average MW is the energy produced by the continuous operation of one megawatt of capacity over a period of one year, equal to 8,760 MWH) to 10,900 aMW, the region was forced to purchase additional power for its own use.

The Energy Information Administration (EIA) reports that the United States derives roughly 7 percent of its electricity from hydroelectric generation, primarily from dams in the Northwest. The link between water supply and hydroelectric generation is apparent: Water is fuel. The more there is, the more power you can produce.

A dam depends on precipitation over more than one season. The longer the season that affects precipitation and water levels, the greater the implications of temperature, snowpack, precipitation, soil moisture, runoff, and streamflow, all of which can combine to affect dramatically the availability of water resources. The driest June on record in a river basin with adequate storage capacity might be inconsequential if there were above-average snowfall during the preceding winter. However, a negligible decrease in precipitation over the course of a decade also could be disastrous for generators in a low storage basin.

Reduced water levels intensify competition among groups that include irrigators, recreational users, fish and wildlife, and households and industries that rely on water and the electricity it generates. The allocation of water is subject to the strictures of water law and certain state constitutional provisions or legislation. In some cases, the rights and responsibilities of individual stakeholders are codified, as in the Colorado River Compact which apportions water among seven Western states. Organizations have also been formed to ensure broad-based input into river basin operations. One example is the Northwest Power Planning Council which strives to balance the environmental and energy needs of the Columbia River Basin.

Hydroelectric operators cannot make it rain, but they do have several options for coping with lower generation levels due to drought. The Bonneville Power Administration, for example, devised a comprehensive drought management strategy that features load reduction, reliability enhancements, acquisition of additional resources, and flexibility regarding fishery regulations. Load reduction can be achieved through promoting conservation efforts and buy-downs in which a utility offers rebates to customers who reduce their energy demand. The enhancements to reliability include allowing customers temporarily to switch providers when appropriate and securing increased water storage upstream. Additional resources are typically procured in the open market. Hydro facilities can also invoke emergency provisions allowing them to operate outside fishery regulations to ensure that the financial integrity and reliability of the electrical system is preserved.

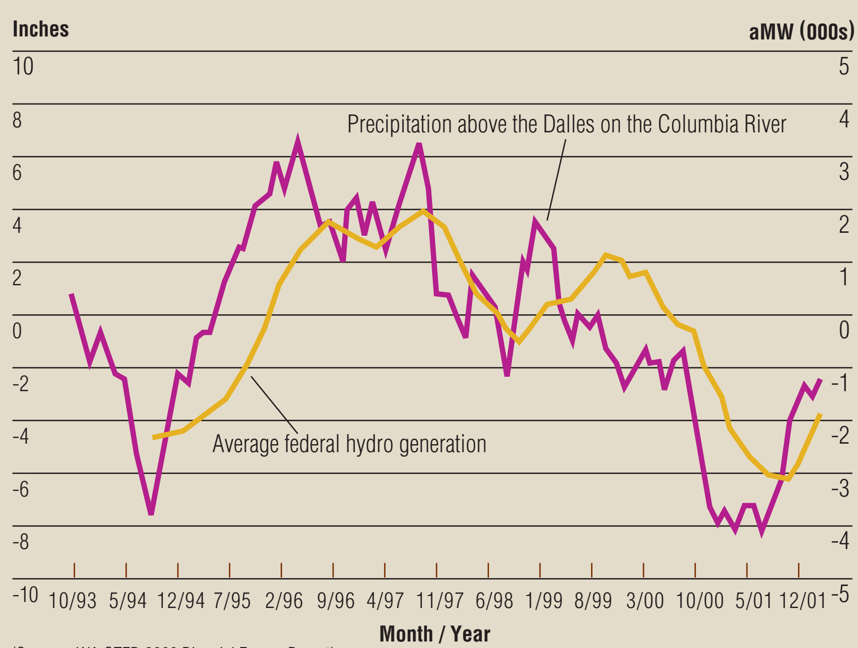
Cooling

According to the U.S. Geological Survey, roughly 40 percent of the freshwater used in the United States runs through thermoelectric plants, fossil-fueled or nuclear—they take in between 190 billion and 277 billion gallons each day, most of it for cooling purposes. This is by far the largest freshwater use in the East. Most of the water is returned to waterways to continue its journey through the hydrologic cycle.

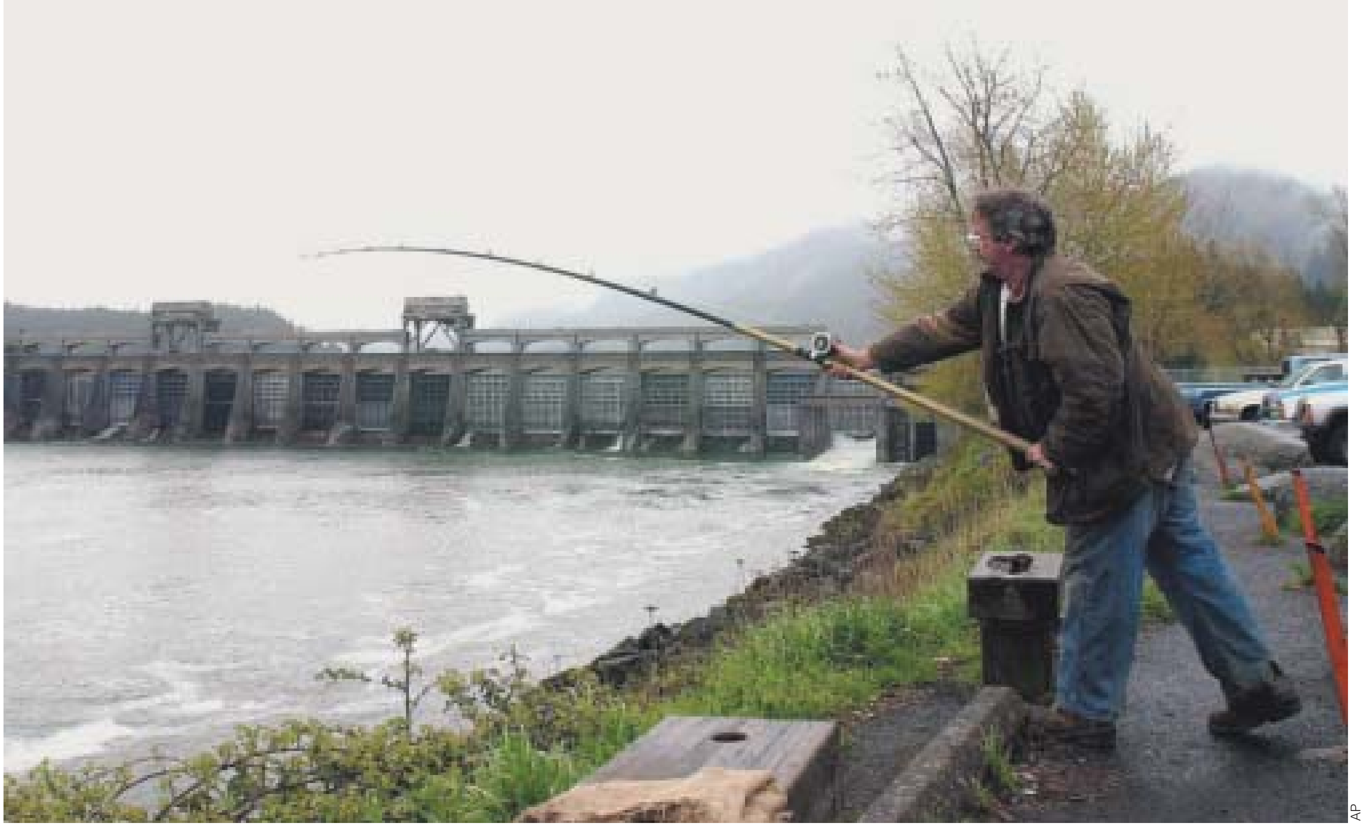
The type of cooling system in thermoelectric plants affects water use. Once-through cooling, the most widespread technology, passes water through a condenser to absorb heat

FIGURE 1

NORTHWESTERN PRECIPITATION AND HYDRO GENERATION



(Source - WA OTED 2003 Biennial Energy Report)



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Balancing the water rights of recreational and industrial users becomes increasingly challenging as drought conditions worsen and water levels fall.

before it is discharged. In a closed-cycle recirculating system, water travels through a condenser where it heats up and is then sent through a cooling tower or cooling ponds and then back to the condenser. Closed-cycle cooling requires less water than once-through but typically consumes more water per kilowatt-hour through evaporation. In general, the more efficient generator is the one that condenses steam the most rapidly, and once-through systems are generally thought to be the most efficient.

Dry cooling, on the other hand, relies on air blown over tubes to cool the steam inside, much like a radiator. Water requirements for dry cooling are quite low, but dry cooling is expensive and the least efficient of cooling technologies. Still, thermal plant operators in regions prone to drought can opt to install such systems.

Overall, thermoelectric plants are less susceptible than their hydropower counterparts to variability in water supplies. For one, they use less water. Also, some draw water from the ocean, which is less prone to the effects of drought. Nonetheless, drought can limit access to water supplies if a plant possesses junior water rights (that is, if other users are higher up in terms of priority) or its withdrawals substantially affect downstream users. Generation also might have to be curtailed due to reduced cooling capacity. In 2002, for example, the intake-water temperatures at several Southeast plants were too high to cool the boiler steam effectively—when the water is low, it warms up quickly—and the plants had to reduce output. South Carolina Electric & Gas, for example, had to keep an eye on its Canadys Station on the Edisto River in 2002, where water levels reached one foot, almost low enough that the intake would have sucked air.

Thermal plants also have more resources at their disposal for mitigating drought. Since thermal plants often hold water rights, they can seek to enforce them if their allotment is not met. Additionally, water efficiency upgrades could enable a plant to continue normal operations in the face of dwindling water supplies.

A good example of utility response to drought can be found in Public Service Company of New Mexico's (PNM) actions last year. The company's primary concern was that the drought would restrict access to water for its major generation source, the San Juan Generating Station—the coal-fired plant serves 58 percent of PNM's customer needs. PNM has a contract with the Bureau of Reclamation for water from the Navajo Reservoir and another contract with BHP Billiton for water from the San Juan River. Last November, PNM representatives met with those from Arizona Public Service, BHP Billiton, the Navajo Nation, and other major San Juan users to address drought issues facing the region. The group developed a shortage sharing agreement based on a worst-case scenario for 2003, which was estimated at approximately a 30-percent shortage. As part of this agreement, the Navajos would be paid above-market water rates for irrigation forbearance. Thus, powerplants in the region, including the San Juan generating station, could continue to operate at full capacity throughout the year.

A continued drought, pushing PNM into a worst-case scenario, would definitely affect the company's profits. "A worst-case scenario would not affect our customers, but it would affect our bottom line," according to Amy Miller, external communications manager at PNM. "We are in a rate freeze until 2008, and if PNM had to curtail generation at San Juan, we would have to purchase power on the wholesale market and rely on natural gas-fired peaking plants in southern New Mexico."

Breaking the cycle. Preparing for the effects of recurring drought in Colorado—which experienced its fifth-worst drought in 110 years in 2002—is what the state's Drought Task Force hopes to do with its mitigation and response plan.

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A Recurring—and Predictable—Disaster

Drought puts the squeeze on all water users, with increasing effects on the economy—in terms of energy prices, food costs, and more. But despite significant government spending, a coherent, national policy to prepare for and respond to drought disasters still does not exist. This is due in part to the fact that drought sneaks up on regions—unlike a tornado or hurricane, which have sudden and apparent impacts that make good headlines. It's also because of what the National Drought Mitigation Center dubs the "hydro-illogical cycle": Our approach to drought is characterized by the way we ignore water shortages until the situation becomes dire. Then we cry out to Congress for emergency funding. But as soon as it rains, we forget there was ever a problem—and the cycle starts all over again.

Although some areas affected by last year's drought have recovered (along the Eastern seaboard, for example), much of the West and Midwest continues to be hampered by drought conditions. According to the May 27, 2003, "U.S. Drought Monitor," 18 states across the country currently show conditions of "moderate" or worse drought. Despite some very beneficial rains and snow in some dry areas, problems still persist. Dry, windy, increasingly warm weather across the Plains, Midwestern, and Great Lakes states is drying out topsoils. Record warmth reached the high Plains by April 13, including a new earliest high temperature of 92 degrees in Bismarck, ND. In mid-April, state pasture condition reports indicated that at least 50 percent of ranges and pastures were in very poor to poor condition—states reporting this include Colorado (with 72 percent of pasture in poor condition), Nebraska (62 percent), South Dakota (59 percent), Wyoming (55 percent), New Mexico (52 percent), and Kansas (50 percent). Colorado, which has suffered six years of below-normal snowpack—it was 52 percent of normal last year—has drawn down many of its reservoirs. In the South Platte River basin, reservoirs are at just 56 percent of average, and in the Arkansas River Basin they're at 43 percent of capacity.

The fact that drought would visit areas of the country two years in a row, and in some places persist for three and four years should come as no surprise. On average, about 18 percent of

TABLE 1

DROUGHT IS A NORMAL FEATURE OF U.S. CLIMATE

Percent area of basin/region	>0%	>10%	>25%	>33%	>50%	>66%	>75%	>90%	100%
United States	100	72	27	13	1	0	0	0	0
Upper Mississippi	77	55	43	30	19	12	9	3	1
Ohio	67	51	34	28	16	12	9	4	3
Missouri	90	70	43	33	17	10	4	3	0
Pacific Northwest	86	61	42	33	23	14	9	1	0
California	53	45	40	30	14	9	5	3	3
Great Basin	71	65	43	37	19	6	3	1	1
Lower Colorado	56	54	35	28	16	11	10	4	3
Upper Colorado	50	50	42	34	27	25	16	9	8
Rio Grande	58	47	32	24	15	8	5	2	2
Texas Gulf Coast	49	48	38	26	22	13	10	9	7
Souris–Red–Rainy	66	57	38	29	19	10	8	5	2
Great Lakes	73	58	32	23	9	3	2	2	0
Tennessee	31	31	27	24	21	16	13	5	5

*The table lists the number of years that the United States has had severe or extreme drought in the 100 years from 1896 to 1995, based on the Palmer Drought Severity Index. The data is further divided and analyzed based on NOAA "river basins," which do not always correspond to geographical river basins. The table reflects only those basins that have experienced greater than 90 percent drought.

the nation experiences drought each year, according to the National Drought Mitigation Center. And, over the last 100 years, severe to extreme drought has occurred in some area of the country every year. (See Table 1.)

The National Drought Preparedness Act

In this time when state and federal budgets are greatly strained, we can ill-afford to pay for billion-dollar drought disasters year after year. Without a coordinated, integrated national drought policy, this kind of drain on budgets will continue as the norm, as evidenced once again by last year's drought response.

There is a better way to do business. In their 1996 report "Drought Response Action Plan," the Western governors recommended developing "a national drought policy or framework that integrates actions and responsibilities among all levels of government." This recommendation has been repeated in other reports since, most recently in the Congressionally mandated report by the National Drought Policy Commission issued in 2000, "Preparing for Drought in the 21st Century."

During the 107th Congress, the "National Drought Preparedness Act of 2002" was introduced in both the U.S. Senate and House by Senators Pete Domenici (R-NM) and Max Baucus (D-MT), and Representatives Alcee Hastings (D-FL) and Dennis Rehberg (R-MT). The bill would establish a comprehensive national policy that statutorily authorizes a lead federal agency for drought and delineates the roles and responsibilities for coordinating and integrating federal assistance for droughts. Drought preparedness planning would be encouraged and funded under the bill at all levels. As droughts emerge, federal and state efforts would focus on implementing the plans to mitigate the drought's impacts.

For example, in a basin highly dependent on agriculture, the preparedness plan might contemplate the planting of alternative crops that require less water. As state and local drought managers recognize the emergence of a drought based on improved drought monitoring established by the bill, federal, state, and local governments might then work with the farmers to plant drought-resistant crops and advise implement and seed dealers to stock their inventories accordingly. If there is a known endangered species that could become threatened, the plan might also ensure adequate stream levels through water transfers, water banking, the buying of temporary water rights from willing sellers, or other such tools.

It is high time for our nation to move to a national policy that recognizes and prepares for the always possible threat of drought, and which encourages and facilitates the implementation of measures that will mitigate droughts' costly impacts. The Western governors have urged Congress and the President to enact the legislation this year. The drought preparedness bill would invest our public resources in preparedness activities that will result in greater efficiencies, more win-win solutions that 'share the shortage,' and less overall impact from drought. ◆