Western Water

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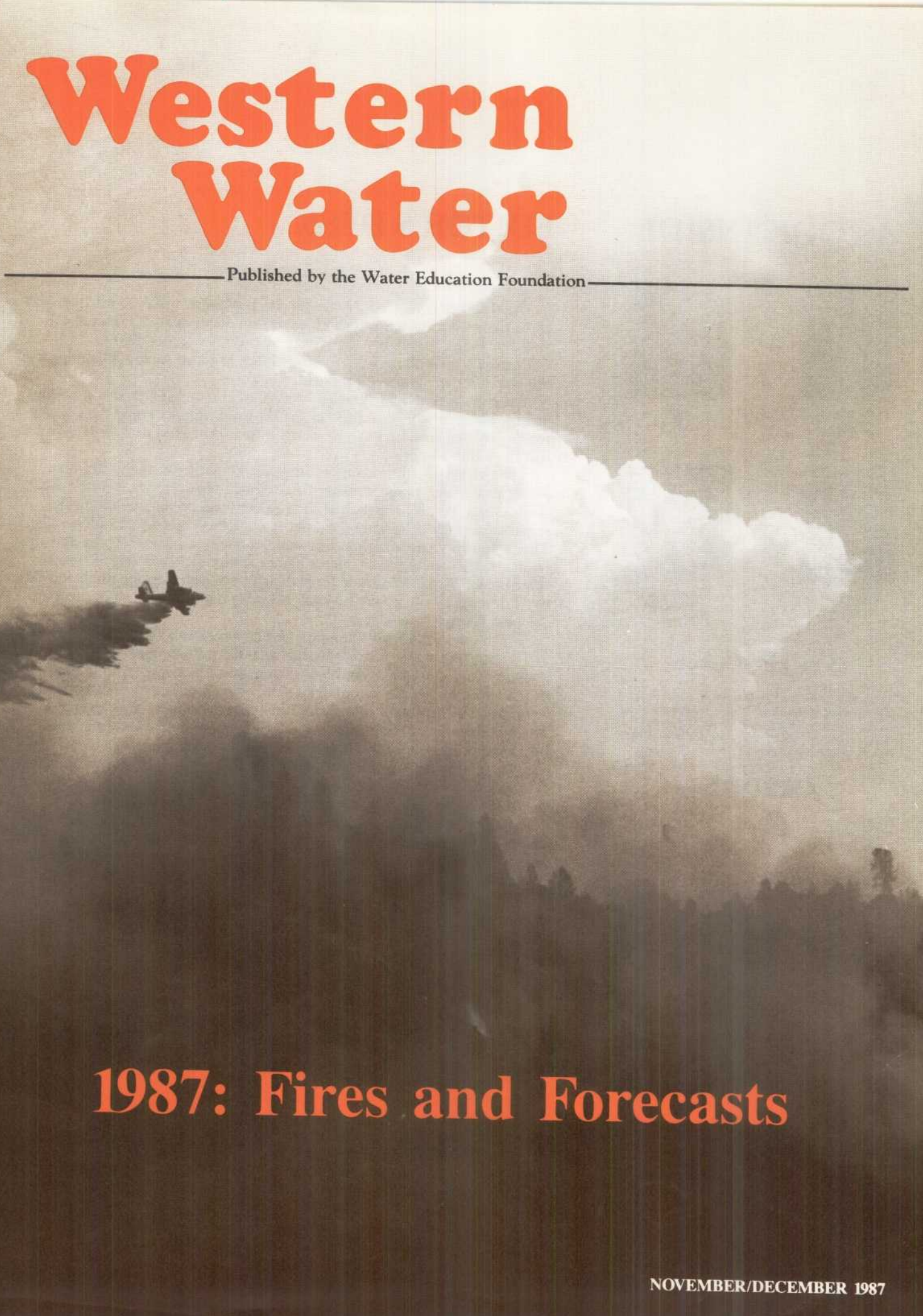

1987: Fires and Forecasts

NOVEMBER/DECEMBER 1987

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On The Cover

1987 was a critically dry year in which Californians saw hundreds of thousands of acres of National Forest land burn. Whether or not we face water quality problems because of erosion will depend on how the water year shapes up.

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The Water Education Foundation is a nonprofit, tax-exempt organization. Its mission is to broaden public understanding of current California water resources issues by fairly and accurately presenting information and the views of responsible persons and organizations.

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EDITOR'S DESK

Our "critically" dry state has been plagued with record fires and earthquakes and now we face an uncertain water year. This issue of *Western Water* highlights the effects of the fires on 800,000 of California's 20 million acres of forestland. We also look at the impact of the fires on the ecosystem and water quality.

Experts think the fire-caused erosion of the major federal, state and local watershed will have little effect on water quality. But, they note, we really can't be sure because we don't know what kind of a water year we will have this winter.

That brings us to a common question we get from many of you. What about long range weather forecasting? How accurate is it? Gala Argent, our Writer, researched long range forecasting and found the overall accuracy of long-range forecasters is between 55 and 65 percent. That's not very encouraging, but some forecasters, in particular Scripps Institute of Oceanography, get a higher rating for their skill in winter forecasting. While its winter forecast isn't out yet, Scripps predicted our dry fall marked by more of a high pressure dry situation than some of the past four or five years.

You'll note an ad for landscape design brochures in this magazine. With uncertain water conditions facing Californians, now is the best time to plan water conserving and low maintenance landscapes. Our first brochure on this topic will address new home landscapes. The second brochure will deal with renovating existing landscapes. Your agency, home builder or nursery can place its own name on the cover of this brochure produced by the Foundation. It's an exciting project.

Also in this magazine is a fascinating discussion with former Governor Edmund G. "Pat" Brown. While interviewing Brown, a highly secretive 60 Minutes crew was filming in the same hotel. Brown played investigator, met the crew and charmed out of them the story they were doing. Seems the producer went to school with his son Jerry and worked for Brown Sr.'s son-in-law at CBS. When you've been a governor and your son has been governor, it seems you have a lot of connections.

Our first Water Awareness Week held October 19-24, was a successful event. More than 200 water agencies and interest groups provided information and sponsored events to raise the level of knowledge about water issues. I hope many of you saw our TV spot and heard our radio spot. Our radio spot featured Governor Deukmejian and Assemblyman Speaker Willie Brown agreeing to support Water Awareness Week. Special thanks to the state Department of Water Resources and the Association of Water Agencies for helping us co-sponsor the Water Awareness campaign. Hopefully, now more of us can tell people where our water comes from and how it gets to our homes and farms.

Rita Schmidt Sudman

Rita Schmidt Sudman and Gala Argent analyze information for this issue of WESTERN WATER.

Interview with a former governor

Edmund G. "Pat" Brown

He's been called the father of the State Water Project but at 81 Edmund G. "Pat" Brown still is most known as the man who beat Richard Nixon in the 1962 race for governor of California and also known as the incumbent governor defeated by Ronald Reagan. When we met recently in Sacramento he was long retired from politics but still active in issues—especially water. A genial and enjoyable man to interview, Brown was elected District Attorney of San Francisco in 1943 and state Attorney General in 1950. He participated in several major water cases as Attorney General.

When Brown was elected governor, by almost a million votes, he was determined to build the State Water Project. The California Water Plan had been released in 1957 and adopted by the legislature. Part of that plan called for the state to build the proposed Feather River and Delta Diversion Project, to bring water to Central and Southern California and prevent northern flooding. However, California's last governor, Goodwin Knight, had failed to get a state water project approved and the legislature was deadlocked on the issue.

Governor Brown put together a legislative package sponsored by Senator Hugh Burns and Assemblyman Carley Porter proposing a $1.75 billion general obligation bond measure which had to be approved by the legislature and the voters.

Foundation president William Gianelli, who worked with Governor Brown before becoming Director of Department of Water Resources recently told me, "I give Brown all the credit for getting this bill through the legislature. No governor had done it before nor has any governor passed such a significant water bill since that time." The bond issue narrowly passed in the 1960 election.

Today Brown travels extensively, is active in his Los Angeles law firm, and heads the Edmund G. "Pat" Brown Institute of Government Affairs and still swims several laps a day.

Before his son, Jerry, left his office, the California Water Commission named the aqueduct carrying water from the Delta to Southern California the Edmund G. "Pat" Brown California Aqueduct. Brown recently sent me a note asking if the name had been changed back since writers often refer to the aqueduct as the California Aqueduct. Sorry, Governor, that's just water shorthand.

Sudman: Can you paint a picture for us of the kind of growth and the problems that were facing California at the time you became Governor in 1958.

Brown: Well, we were growing at the rate of about 300,000 people a year. Our population was around 18 million and we were the second largest state in the union. I had been District Attorney of San Francisco and then I'd been state Attorney General and represented every agency of state government, so I was well aware of the needs of the state. I was born here along with my father and mother and I was very interested in every phase of California development.

Sudman: Did you have a natural interest in water or was it something that developed as you saw the state grow?

Brown: Well, my mother used to tell me about her father. They lived in a little ranch in a town 14 miles west of Williams in the foothills of the coast range mountains. She told me about water and how her father would ask all the children—and there were nine of them—to get down on their knees and pray for rain. So during my law school days I took a course in water law and mining.

Former Governor "Pat" Brown and Foundation Executive Director Rita Schmidt Sudman discuss the future of the State Water Project.

Then I got by the bar examinations and I never even had to touch a case involving either water law or mining law, but when I was running for Attorney General in 1950, people would ask me questions: "How do you stand on the acreage limitation?" "Should there be more water development?" The day I was elected Attorney General, the University of California Law School put out an issue devoted completely to water. I took a vacation. I read that book backwards and forwards and it refreshed my recollection on my course in water law.

Sudman: After you became governor, were you approached about developing a state water project?

Brown: When I became Governor I knew that one of the great needs of California was water. And someone told me that you'll never be as popular as the day that you take your oath of office. And they said, whatever you want to do, do it right away. So I immediately proposed the development of the California Water Program, and I worked for it and finally in the election two years later (1960) we passed a water bond issue of $1.75 billion (to build the State Water Project) which is the largest bond issue of any state in the union.

Sudman: It's been reported at the time your administration proposed the $1.75 billion bond issue, the amount was closer to $2 billion. But to get the people to pass the bond issue, you stayed under the $2 million mark. Was there any truth to that?

Brown: No, none whatsoever. We hadn't completely engineered the project, but we had estimates as to the cost of the project and we had to pass this bond issue and it didn't have to be exact. But as a matter of fact I wanted to have a small bond issue. I was afraid a bond issue of $1.75 million dollars would be too much.

Sudman: You were a Northern Californian and as Governor you saw there was opposition between Northern and Southern California and still is to this day over water. Do you see water as strictly a north-south issue?

Brown: No, it's not...California did need water north and south and I as a northerner—they felt that I was a traitor to build a water project that would take water from Northern California and give it to Southern California. But, I didn't want all those people from Mississippi and Alabama to come up here to Northern California; I wanted them to go down and live in Los Angeles. I wanted Northern California to be a little freer, not so many people. So I was guilty, but it was not pro-South, it was pro-North even though there were more votes down there.

"When I became Governor I knew that one of the great needs of California was water."

Sudman: Since the 1960 bond issue passed, no additional major water bond issue has passed and the State Water Project is not complete as proposed. Do you think we're at a stalemate now?

Brown: We are unquestionably at a stalemate, but it will be resolved because in 12 short years California's going to have 31 million people and they're going to need water, and if we have a dry year this year which we have, and a dry year next year which we may have, you won't be able to water your garden.

Sudman: After the drought of 1977, it would seem that the people would have looked more favorably on water development proposals, but the 1982 proposal (SB200) to build the Peripheral Canal (and other projects) was defeated. Why do you think the voters defeated the Peripheral Canal package?

Brown: Well, in Northern California they voted against it 8 and 9 to 1 because they were afraid that this would facilitate the stealing of Northern California water. The Peripheral Canal is also a storage dam for about 700,000 acre feet of water and you can regulate the flow which you cannot do (now) when you pour the water in the Delta. The real reason we wanted to build the Peripheral Canal was to save the fish. When they use those great big pumps to pump the water out of the Delta, it kills the fish and the Fish and Game people were the ones that suggested it, so I don't think that Northern California fully understands it... the Peripheral Canal.

Sudman: Since that time another governor - George Deukmejian - wanted to enlarge some of the channels in the Delta, and he, like previous governors, including your son, Jerry Brown, all felt they had to go to the legislature, when under the Burns-Porter Act they probably had the authority to go ahead. Why did they feel they had to go back to the legislature to get support?

Brown: Well, under the Burns-Porter Act we gave the Governor plenary power to build the California Water Project, dependent only upon the ability to finance it. But neither my son, nor Governor Deukmejian wanted to risk the wrath of the people and build it because of the vote against the Canal.

Sudman: As you know, the situation in the Delta is presently deteriorating. What do you think about the long-term future of the Delta?

Brown: It's hard to say. They're going to have to rebuild a great many of those levees. I mean, every year they're flooded and the water pours into this rich agricultural land. I don't know whether economically it will be supportable to continue to rebuild these levees because they all should be done completely over again and that would be a tremendous cost.

Sudman: There's a concern today more than ever about the quality of drinking water and this seems to be polarizing the urban people and the agricultural people. The Delta supplies 40% of California's drinking water. Do you think drinking water eventually will be isolated in a channel through the Delta?

Brown: Whenever farmers irrigate, the wastewater must go someplace. It just doesn't sink into the ground, and it goes into the Bay and that does deteriorate the quality of the water.

Sudman: The State Water Resources Control Board is holding hearings on the Bay and Delta, and they may find there is a need for more fresh water to flow into San Francisco Bay. Opponents of increasing fresh water releases in San Francisco Bay say these fresh water amounts are so small compared to the huge tidal action that affects San Francisco Bay daily, and if you increase the fresh water many, many times, it would still not freshen up San Francisco Bay; it would mostly go out the Golden Gate and little would reach the South Bay. What's your opinion?

Brown: Well, some of the zealots would stop the storage of any water in the state of California just to keep San Francisco Bay clear of any wastewater. But it's not an easy question. I know these people. I know them to be sincere and I argued with them 20 years ago when I was Governor. The tidal action really protects the quality of the water in San Francisco Bay. But it's a delicate question and we have to supply domestic water and irrigation water to all the people of this state.

Sudman: During the development of the State Water Project, you chose not to institute any acreage limitation (limiting acres for farmers and allow a subsidy for water) in the project. Why?

Brown: As Attorney General I defended acreage limitation in the federal (CVP) project. But in the California Water Project I was afraid that if we put in acreage limitation, that we would lose the support of the large agricultural interests. They would put money in to defeat it. And I felt it was more important to build the project and maybe let them get a big break on the cost of water than not to build the project at all. They had to pay a whole lot more for the water than they did under the federal project...And I'm glad that I did it. I know I've been accused of abandoning it for the big agricultural interests. That's absolutely not true. I had just been elected Governor and I didn't give a damn about any interest. I wasn't thinking of defeat. I was thinking of building the water project.

Sudman: At the time you probably realized that this would make a lot of people rich, those who went into farming in the San Joaquin Valley near the California Aqueduct.

Brown: I would be very happy if we made them rich. If the project developed and they had that land and were willing to pay the cost of the water which was far more than federal water, it was perfectly all right with me. They paid it in income taxes over the years and developed the great San Joaquin Valley. I'm a Democrat and I'm more liberal than I was when I started in politics, but I have no regrets about that at all and if some of those big farmers made money, so be it.

Sudman: What did the State Water Project do for Southern California below the Tehachapi mountains?

Brown: It provided water and development for this great big state all the way to San Diego. I hate to think of what it would be if we didn't have it, and it's going to get more useful as the population grows.

Sudman: Do you think public support can be mobilized to complete the State Water Project?

Brown: I'm sure that it can. We won't win the support of Northern California, but they're going to need water, too,... and the Project will be just as helpful to the north as it was to the south. You're going to have to enlarge Shasta Dam or you're going to have to build more reservoirs unquestionably, not on the wild rivers, but on the rivers that have already been developed. When I think of California with 31 million people, that's an awful lot of human beings. Ride around in an automobile and see how crowded the state is right now.

1987: FIRES AND FORECASTS

By Gala Argent

As of press time, close to 800,000 of California's 20 million acres of National Forest have burned, and the end finally appears to be in sight. Incited by the year's "critically dry" water status, ignited by summer thunderstorms, and propelled by fierce winds, 1987 proved the worst fire season on record in terms of acres burned. Eleven firefighters and 114 homes were lost to the blaze along with enough timber to build homes for a city the size of San Francisco. Long term resource recovery costs, according to the U. S. Forest Service, are expected to exceed $150 million.

As the winter weather cycle approaches, those concerned with water issues are faced with a dilemma of conflicting needs. While reservoir storage remains relatively high, a repeat of 1987's critically dry status could cause water supply problems; we need the rains. On the other hand, an extremely rainy winter could exacerbate erosion caused by the fires and lead to increased flooding around the burned areas.

1987 has thus far been a year of nature's extremes: fire, drought, earthquakes, and now, with the winter rains approaching, the possibility of floods. What follows is a discussion of the chain of events affecting California's water this year—the impact of the fires on the ecosystem and water quality, some specific areas affected, and resource reclamation efforts. We'll also look at the process of weather and water forecasting and some predictions for the coming water year.

Effects of Fire on the Ecosystem

Fire is one of the most pervasive of all natural disasters, impacting every aspect of the environment. The damage runs deeper than the obvious loss of surface vegetation and wildlife, affecting both the physical and chemical makeup of the soil in the burn area—and ultimately the water. Fire throws nature's system out of whack and initiates a cycle that can take years, decades, and even centuries to complete.

Erosion problems begin almost immediately. On steep slopes, "dry creep" occurs when gravity pulls ash, soil, and debris into drainages, choking channels and threatening the area's ability to adequately disperse runoff.

With the arrival of the winter rains come more difficulties. High temperature fire sometimes forms "hydrophobic soil," a powdery layer that virtually repels water, much the same way talcum powder does. When the inevitable winter rains fall on the burned area there is no organic matter normally present on the soil surface to absorb moisture, and surface runoff is increased. The increased runoff travels more quickly over the barren ground, generating increased erosive energy which in turn accelerates erosion. The more intense the rainfall, the more compounded the erosion.

Water flowing across the surface of the scorched land picks up large debris which can clog stream channels, creating unstable dams. Problems can occur when enough water builds up behind these dams to break through and send an eruption of water and debris down the stream channel, tearing out banks, fisheries habitats, bridges, and campgrounds.

Impact on Water Quality

Just as the water affects the burned areas, the burned areas affect the water. "Any time you have a wildfire under uncontrolled circumstances you are going to have impacts to water quality," says John Rector, Group Leader for Water Resources and Watershed Planning with the U. S. Forest Service.

At the molecular level fire releases organic nitrates, phosphates, and potassium that were bound in the plant material into the water. This "nutrient loading" causes an imbalance in the natural aquatic ecosystem, sometimes to the extent that the system cannot stabilize. These organic compounds can concentrate in downstream reservoirs and act as fertilizer to certain types of organisms, causing algae blooms which in turn affect other aquatic flora and fauna.

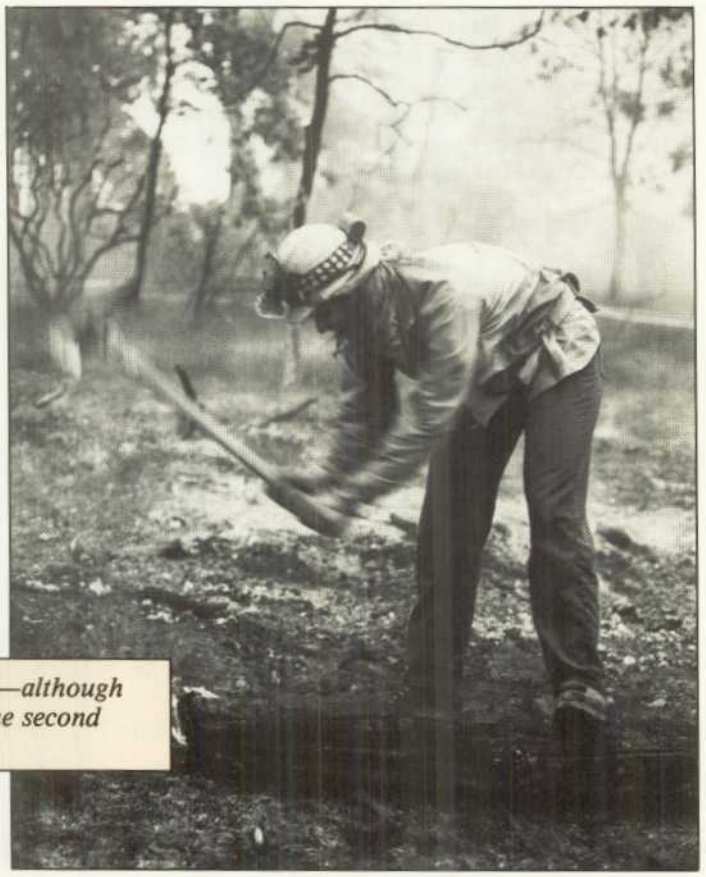
Nutrient loading has the potential to act as a fertilizer in irrigation water as well. Also, sluggish, turbid water laden with debris can pose problems to pumping and irrigation systems, but since most of the irrigation water supply is in the Central Valley or is taken below the large reservoirs, the effects this year should be minimal.

When fire burns a mere fraction of the watershed area, increased sediment and debris don't usually pose a water quality problem for agricultural or domestic water users. By the time the debris and ash combine with the total water output for a watershed it is usually greatly reduced by dilution. "The rule-of-thumb is that if less than five percent of the area burns, the results are hardly noticeable," says Ken Turner, Watershed Management Specialist with the Department of Water Resources.

Sedimentation problems do arise when large portions of the watershed burn or when the watershed supports a domestic water supply reservoir right downstream from it. Water with increased turbidity, sediment, and organic matter requires more treatment to reach drinking water standards, and more treatment translates to more expense. While the quality of water coming out of the tap remains unchanged, the cost of increased treatment may filter down to the consumer.

Additionally, increased sedimentation can cause storage capacity problems. "If you fill a bathtub half full of mud, it'll only hold half as much water," explains Rector.

Specific areas that can expect water quality problems because of this year's fires include the watersheds above Lake Pillsbury in the Mendocino National Forest, areas around the Stanislaus complex fires feeding into the Tuolumne, and the Palomar fire in San Diego County, which is already resulting in increased sediment in Lake Henshaw. A different type of problem is materializing on the Klamath and Salmon Rivers in the North, where sediment is being deposited on salmon and steelhead spawning areas.



One-on-one firefighting efforts prove effective—although more acreage burned this year than in 1970, the second largest fire season, fewer homes were lost.

Watershed Reclamation

If left to nature's own timetable a brush field will rejuvenate in about five years, while forested areas can take up to 100 years to return to normal. But we humans operate on a much tighter schedule. Because over 90 percent of the lands burned this year were multi-use National Forest lands, reclamation efforts began immediately to evaluate and ultimately restore the valuable water, wildlife, timber, range and recreational resources lost to the fires.

Before the embers have cooled emergency rehabilitation teams unite to formulate the reclamation effort. Depending upon the size of the fire, the teams may include local, regional, and/or national experts. All disturbed ground, from the smallest fireline to the largest burn, is evaluated. Many factors come into play in the decisions the teams reach, and special consideration is given to riparian vegetation areas around streams.

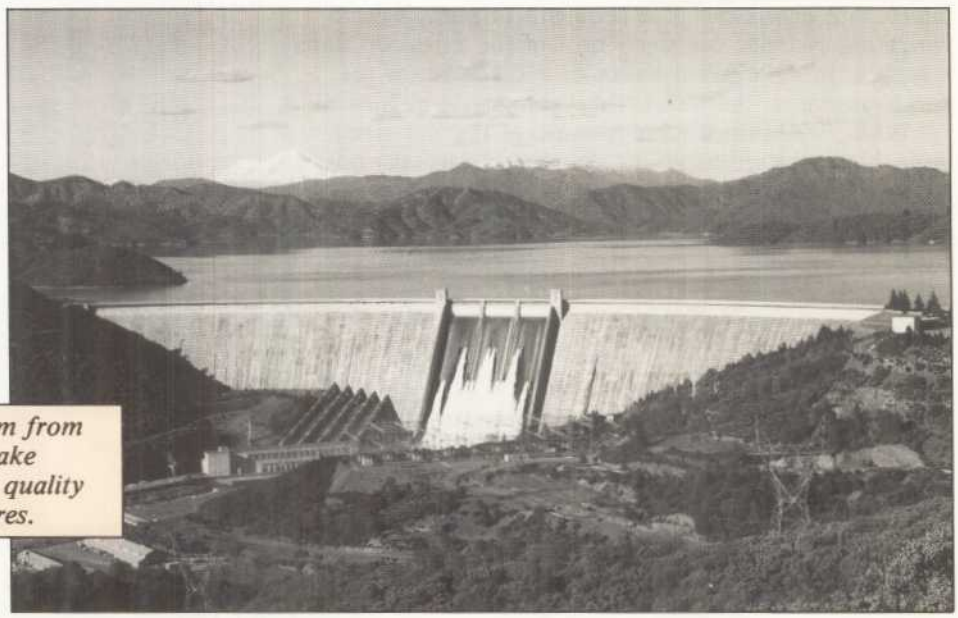
The most immediate concern is erosion control. Grasses are the plants of choice for rapid germination and soil holding, but experts like to try to avoid reseeding areas ultimately destined for timberland with grass because grass competes with young seedlings. Sometimes, though, they have no choice. "Where we look for damage is close to the fire and immediately downstream from it," said Dennis Orrick, Vegetation Management Program Coordinator with the California Department of Forestry and Fire Protection. "If, for example, the watershed supports a domestic water supply, then we have a problem and we may very well go in and sow some grass species that would give the soil some kind of holding capacity." In this scenario, the immediate erosion control effect is achieved, but competition from the grass will have to be dealt with when the area is replanted with seedlings.

Reforestation of National Forest land begins within weeks. Because of the tremendous area of timberland burned this year actual replanting will proceed slowly. "We just don't have enough seedlings or seed to attempt to go out and do that in one year," states Orrick. "We're looking at probably a four to five year period of just replanting." Short-term reclamation may include not only revegetation efforts, but clearing blocked stream channels and building check-dams to counter potential drainage and flood problems as well, and can cost anywhere from $20 per acre for grass seeding to thousands of dollars per acre for channel clearing or structural work.

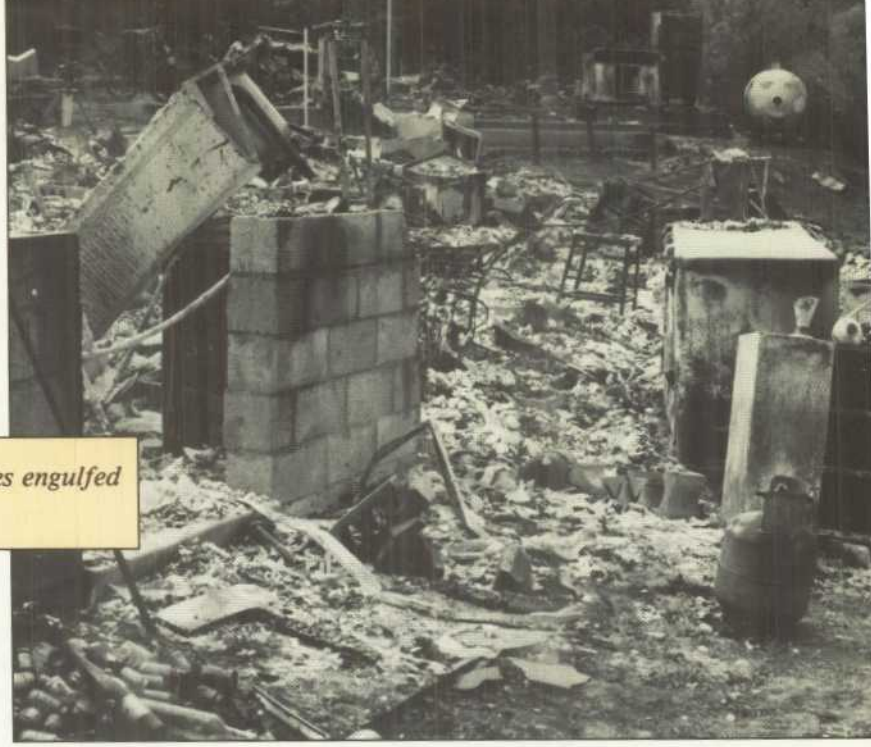
"Any time you have a wildfire under uncontrolled circumstances you are going to have impacts to water quality."

John Rector
US Forest Service

Long-term reclamation efforts continue to focus on soil erosion control. "When you lose the soil, you lose the productivity of the land, and you can't grow grass, trees, or brush and forage for wildlife," Rector states. In terms of the watershed, detailed surveys and inventories identify those areas subject to accelerated erosion. Treatment may include breaking up hydrophobic soils, laying jute matting or straw crimping, and stabilizing slopes and channels.



Reservoirs directly downstream from large burned areas, such as Lake Shasta, may experience water quality problems due to this year's fires.



The worst fire season on record, 1987's flames engulfed 114 homes.

But water isn't the only concern in the development of a long-term restoration plan. According to Rector, rehabilitation takes on a multiple-resource perspective. "We assemble an interdisciplinary team of specialists—wildlife biologists, hydrologists, soil scientists, engineering folks who have lost roads, recreation people who have lost campgrounds—all of whom have resource objectives that need to be met," he states. The number and type of experts depend on the resources damaged by the fire. From this group of experts comes a negotiated plan of long-term reclamation designed to meliorate the situation and maximize the areas resources.

Like ants mending a hill, workers guided by these reclamation plans are hurriedly attempting to establish grass and stabilize slopes before the winter rains arrive and erosion and drainage problems begin. "There is no rest. We just move from one season to the next," Rector points out. "With the advent of the fires we've had this fall we fully expect to have flood damage occurring as we move into the winter months."

A lot depends on the amount and type of rainfall we get this winter. While most years start with smaller storms, flood-producing downpours are also possible in the early part of the season and could hinder restoration efforts and cause more damage. "Speaking strictly from a water quality and watershed stabilization standpoint, it would be nice if we had, not necessarily a drought, but a moderate, slow water year," continues Rector. Unfortunately what we may want and what nature ultimately delivers are often at odds. With the configuration of events that have thus far troubled California this year, the ability to glean what the winter months hold in store would better enable water officials to plan for future flood or water shortage contingencies.

The Process of Prediction

Humans, since the dawn of time, have sought ways to explain, predict, and ultimately control their environment. In the past we have gazed at stars, and consulted everything from oracles to tea leaves to crystal balls trying to understand the inconsistencies of nature. In this technological age, the ubiquitous and irrevocable effects of weather make it a prime, and important, target for more scientific prediction. Although we've come a long way from a fireside toss of the old mammoth bones, weather prediction still deals in probabilities rather than certainty.

The Department of Water Resources is one agency that evaluates and utilizes prediction programs in the quest for reliable ways to plan water contingencies. Maurice Roos, Chief of the DWR's flood hydrology and water supply branch, says, "Our policy is to support research in this area to see what can be done, so we like to encourage people to develop and improve whatever skills they can."

However, Roos, whose job includes evaluating forecasting programs and their results, is guarded in his discussion of forecasting. "Our standard forecasting assumptions are that we have no reliable way of predicting what the precipitation is going to be in this coming year, so we look over the historical record and say then that next year could be statistically like any one of the past 60 years on record," he explains. If you think this sounds vague, you're not alone. Those with wet fingers to the wind are the first to admit that while long-range forecasting has come far in the past few years, it still has a long way to go.

"The overall accuracy of long-range forecasting is about 55 percent which doesn't show a great deal of skill since you get about 50 percent reliability by tossing a coin," admits Glenn Trapp, Meteorologist in charge of the Weather Service's San Francisco forecasting office. Yet still researchers pursue the key methodology and factors that will unlock the mysteries of the weather; the stakes are so high they can't afford not to.

For long-term water forecasting (usually no further than 90 days in advance), Roos analyzes information from three groups: the National Weather Service, Scripps Institution of Oceanography, and Entropy Limited.

Using primarily wind flow patterns in the upper 10,000 to 30,000 feet of the atmosphere, the U. S. Weather Service issues regional 30, 60, and 90 day temperature and precipitation forecasts in either the "above" or "below" normal categories. By defining what patterns exist, meteorologists are able to project the direction and magnitude of the weather coming our way.

Although short-range projections (up to five days) have improved greatly in the past few years due to more detailed models showing more layers of the atmosphere, long-range forecasting remains somewhat iffy. The further in advance meteorologists try to forecast, the iffier the accuracy becomes.

But NWS's Trapp sees increasing reliability of the long-range predictions. European methods of foretelling global weather have proved more accurate because they have been using larger mainframe computers longer. "One of the things that's helping us increase our accuracy is the advent of these large computers that can go through many equations in a shorter period of time," he explains.

The Climate Research Group of Scripps Institution of Oceanography in La Jolla issues quarterly national precipitation forecasts in three categories: wet, middle, and dry. Says Dan Cayan, a researcher with the group, "Our forecast is painted with a broad brush. We forecast average conditions, not details such as frontal passages and particular storms. That detail is lost beyond about a week or two."

"The odds are eight out of ten there will be enough water for everyone next year."

Maurice Roos
Department of Water Resources

The Scripps group examines 40 years' worth of information on winds aloft, temperature and precipitation over the continents, and ocean surface temperatures measured by ships and satellites, looking for patterns in the present situation that mimic what has happened in the past. According to Roos, who has been evaluating their data for nine years, the Scripps group "shows little skill in the fall and summer, but significant skill in the winter forecast—around 65 percent accuracy."

Another promising approach was developed by Entropy Limited, using a statistical pattern search trying to find worldwide factors that have predictive value for California and Northern Sierra precipitation. The computer program, which boasts a 65 percent accuracy rate, combs through massive amounts of raw data looking for patterns that can be used to make predictions over time, and, like the Scripps group, utilizes primarily three types of information: historical recordings of rainfall and water from various sites in Northern California which basically begin with the Gold Rush; worldwide historical sea surface temperatures for the Pacific Ocean over the past century; and worldwide weather reports.

"Patterns that are very important (in predicting Northern California's precipitation) turn out to be across a lot of regions of the Pacific Ocean because that's where the weather is coming from. Sometimes the regions are close by, and sometimes they're offshore, and sometimes they're over by Hawaii, and sometimes, lo and behold, they're way down by the equator because things that are swirling down there and building up may be seen months later in their statistical effect," explains Ron Christensen, President of Entropy Limited.

While the foretelling of weather remains still very much in the realm of conjecture, it is, nonetheless, educated conjecture. Forecasting experts remain optimistic and point out that the advances made in short- and medium-range forecasting in the past decade indicate an increasing accuracy in long-range prediction as well. For now, though, 55 to 65 percent accuracy still stands better than a flip of a coin.

Predictions for the Coming Year

Beyond the immediate concerns of flood control after this year's fires lies the issue of the water supply for the coming year. With one dry year behind us, the issue looms larger, and comparisons are being made between 1987 and 1976, the first year of the last drought.

In terms of water, the recent Dry Year Report issued by the DWR states that statewide precipitation this year was about 65 percent of average. In 1976 the total was 60 percent of average. This year's runoff was 10 percent better than 1976, and storage in state reservoirs this year is higher than 1976, with 4.7 million more acre-feet in the state's 150 large reservoirs, partly due to the carry over from a wet 1986. According to Roos, "The odds are eight out of ten there will be enough water for everyone next year."

In terms of weather, Roos, who is trying the experimental Entropy procedures at DWR, says so far the method predicts wet this year. On the other hand, the Weather Service's October through December forecast reads somewhat dry, with below normal precipitation on the northern coast and near or below normal for the Central Valley. Although the Scripps winter forecast doesn't come out until December, Cayan says, "The fall has so far been marked by more of a high pressure dry situation than some of the past four or five years." While we're at it we might as well throw in the *Old Farmer's Almanac*, whose "secret weather-forecasting formula" portends a wetter than normal fall and winter.

After all is said and done, who really knows? The weather remains irresolute; the forests burn and the waters flow—or don't—on timetables of their own, timetables as yet beyond our cognition.