

A SHORT HISTORY OF THE ARIZONA WATERSHED PROGRAM

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The Arizona Watershed Program was formulated in the early 1960s as a joint initiative of the State Land Department and the Arizona Water Resources Committee to work with the USDA Forest Service and others to obtain and then extrapolate research findings related to integrated watershed management practices designed to increase water yields by manipulations of vegetative cover; to measure both the positive and negative effects of these vegetative manipulations on all natural resources; and to make economic evaluations of these manipulations. The Forest Service and other governmental agencies, with their cooperators, implemented a large number of research projects throughout the vegetative types within the Salt and Verde River basins and elsewhere in the state to attain these goals. The Arizona Watershed Program was planned as a solution to the age-old problem of conserving rainfall, putting every drop of moisture that falls to a beneficial use. A short history of this milestone program is presented in this paper.

Getting Started

The story begins with two events that were to become the stimulus for the creation of the Arizona Watershed Program—a meeting of a few ranchers concerned about the conditions of the state's watersheds, and a field trip to inspect the condition of some of these watersheds.

A Meeting at the Apache Maid Ranch

Kel Fox, a former newspaper reporter, a former state legislator, a long-time rancher in the state, and a man who was to become the leading light of the Arizona Watershed Program, was invited to a meeting with about 12 other people by Dave Wingfield, a long-time friend and neighbor, sometime in the summer of 1955. The purpose of this meeting, held in the shade of a big ponderosa pine tree on the Apache Maid Ranch, was to listen to a

novel idea introduced by Wingfield, Jake West, an employee of the Salt River Project, and Joe Arnold, a researcher with the Forest Service.

The idea presented at this meeting was that water, and many of the other products and uses of the state's watershed lands, could be increased if Arizona's watersheds were managed more intensively. Wingfield and West had arrived at this conclusion independently. Wingfield reached his conclusion from a diary he kept indicating that forage production had decreased significantly over the previous 50 years, and West based his deduction of a steady decline in water yields from a record of rainfall and runoff for the same 50 years.

The reasons for the declines in forage and water, the attendees at this meeting concluded, had to be the steady increase in woody vegetation on the watersheds. Useless trees and shrubs were crowding out Wingfield's forage and gobbling up West's water. The explanation was so simple that the attendees wondered why someone had not come up with it years before. Now, at least, someone had put a finger on the problem, and Fox, Wingfield, and the other ranchers left the meeting all steamed up to do something about it. Someone suggested that a field trip be held later in 1955 to which they would invite members of the U.S. Congress and the state legislature, representatives of land management agencies, and the media.

The 1955 Long Valley Field Trip

That field trip, to the Long Valley area near Clint's Well, was a resounding success. Among those attending were U.S. Senators Carl Hayden and Barry Goldwater, a young congressman named John Rhodes, several members of the Arizona State Legislature, the top management of the Salt River Project, and representatives of the media. The field trip generated so much support that it was decided to seek a full-fledged study of deteriorating conditions on the Salt and Verde watersheds.

The Salt River Project agreed to finance the study. The Arizona State Land Department and

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the University of Arizona agreed to provide the scientific leadership, the latter in the person of George W. Barr, an agricultural economist. With the assistance of Bob Humphrey, a range management specialist, and other members of the university's faculty, Barr began to assemble his team during the winter of 1955–56. Fox was at work on another front at the same time—the Arizona State Legislature. Looking toward the future, Fox saw the need for additional funds to carry out the hoped-for recommendations of Barr and his colleagues. Accordingly, he drafted a bill carrying \$25,000 in appropriations for the State Land Department. Fox had little trouble getting this bill passed by his former colleagues in the Senate, but it ran into trouble in the House. Only an urgent last-minute plea to the Speaker of the House, who had once been a protégé of Fox when the latter was Minority Leader of that body, did the trick.

Barr's Study

Barr and his team of experts spent most of the summer of 1956 touring around the Salt and Verde watersheds. While Barr's team was visiting the watersheds, State Land Commissioner Roger Ernst invited Fox to his office for a talk. Ernst was concerned about two critical questions—how should they introduce the Barr Report and how should they implement its recommendations?

The decision reached that day was to create a Watershed Management Division within Ernst's organization. Fox agreed to serve as its organizer, with Arnold as his assistant, and to head it up for a period of 6 months, after which it was planned that the job would be turned over to Arnold. Ernst rented space in the old Heard Building, across from the Adams Hotel, and Arnold and Fox reported for work there on September 1, 1956.

The Barr Report

Shortly thereafter, Barr handed Arnold and Fox his report, a massive document (Volume II) plus a shorter summary (Volume I), both going under the intriguing title "Recovering Rainfall—More Water for Irrigation." The report, to be made public in the fall of 1956, not only confirmed that Arizona's watersheds were in bad shape, but also proved to be a scientific base for the belief that their condition could possibly be improved by more intensive management practices, especially vegetative modifications. The task of Arnold and Fox was to make the report intelligible to the lay public.

A VIP dinner was held in September to hear Barr make his pitch. Jack Williams, soon to become

the mayor of Phoenix, introduced the topic of the report and the speaker, and it seems that the meeting went off well; however, the press reaction was mixed. The Arizona Republic, with columnist Ben Avery writing the story, was particularly critical, damning the proposal as a "tinroof concept," good for the farmers (more water) and for the ranchers (more grass), but damaging the timber and wildlife interests.

Ernst, Arnold, and Fox were shocked at the lukewarm, often hostile reception accorded to the report. They had assumed, incorrectly it seemed, that any plan to augment the state's water supply by an estimated 235,000 acre-feet a year (Barr's prediction), while also improving collateral resources on watershed lands, such as forage and wildlife habitat, would be hailed and welcomed. They had to face up to the fact that the proposal to improve watershed conditions had formidable opposition along with its many supporters. Clearly, before the specific recommendations of Barr and his colleagues could be put into actual practice, they would have to undergo additional scrutiny.

Findings and Recommendations

Barr's team recognized the importance of the Salt and Verde watersheds for water, timber, grazing, wildlife, and outdoor recreation. Mining operations were considered not to be closely related to water use, and therefore the value of minerals was not considered. They also believed that obtaining the optimal economic use of the watershed meant assigning each segment of publicly controlled land to one specific use, or a specific combination of uses.

Barr's team believed that the greatest increase in water yields from vegetative manipulations would be obtained from the portions of the Salt and Verde watersheds at highest elevation, where precipitation is the greatest in the state. Much emphasis was placed on the high-elevation ponderosa pine and mixed conifer forests for this reason. Silvicultural treatments were also recommended by Barr's team for implementation in stream channels and along drainage ways, for poor timber-producing sites, and for good and intermediate timber sites.

It was thought that additional water could also be generated from the extensive pinyon-juniper woodlands by substituting grass and other forage plants, which use less water, for the non-useful woodland trees. Although less water would likely be realized than from the higher forests, Barr's

team concluded that the combined values of more water for irrigation, increased livestock carrying capacity, and reduced erosion would provide the economic grounds for the removal of much of the juniper and pinyon.

Barr's team believed that the chaparral shrublands had little water yield improvement potential. However, the hydrologic effects of controlling chaparral shrubs were somewhat speculative, because of the limited watershed research that had been done in the type. Removal of chaparral might reduce interception and transpiration losses, and might result in some increase in water yields. But, the low rainfall normally falling in the type would limit the amount of gain realized.

The team recognized that stream-side losses incurred during the passage of water from the point of production to the reservoirs could be large. Any reductions in these losses would mean substantial savings, not only of water that might result from a watershed modification program, but also of water that the watershed had already produced. They thought that replacement of deep-rooted trees and shrubs and establishment of a shallow-rooted herbaceous cover would greatly reduce evapotranspiration losses.

Barr and his team recommended that an extensive, well-coordinated action program be started to increase the yields of water from the watersheds in the state. They further believed that water could not be considered a by-product, unchangeable and inexhaustible, of a watershed devoted chiefly to growth of timber and forage. Therefore, the action program should be initiated first in areas where the greatest increase in water might be economically obtained, and where results of water yield improvement treatments, and costs of these treatments, can be adequately evaluated.

The Arizona Water Resources Committee

Ernst suggested the formation of a citizens committee to move ahead the programs recommended by Barr's team. Arnold and Fox agreed to this suggestion, and, with support from the State Land Department and the Salt River Project, they set about putting such a group together. Their nominees for committee membership reflected the thinking in that period of the state's history. With a significant exception, nominees were picked to represent the users of the lands and natural resources that, it was hoped, could be manipulated and rehabilitated to improve their condition.

That exception was Lewis W. Douglas, a Tucson banker, a former ambassador, and a one-

time U.S. Congressman. After a lot of cajoling, Douglas agreed to serve on the committee as its first president, provided that Arnold and Fox could come up with a vice-president who would take care of most of the leg work and paper shuffling, which was done. The Arizona Water Resources Committee therefore met for the first time in December of 1956, with Douglas at the helm and the other original members in attendance, three of whom remained aboard for 20 years.

The committee was ready for business on January 2, 1957, when Ernst publicly announced its creation, describing it as a policy-making group working with the Watershed Management Division. Over the next 20 years or so, this committee would be instrumental in raising more than \$17.5 million in federal, state, and private funds for watershed programs in Arizona. In later years, the committee was to expand its membership to include a wider variety of interests, among them environmental planning, education, and urbanization.

A Big Decision

No sooner was it organized than the committee was confronted by the need to make a major decision: whether to push for immediate implementation of Barr's recommendations on how to improve water yields from watershed lands, or to test these concepts through careful study before recommending their adoption. A decision had to be made on whether to actively pursue an action program or a research program. There seemed little point in renewing the battle with Barr's strident opponents, led by Avery. Better, it was believed, to pursue a waiting game, to enlist competent and respected researchers to put Barr's theories to the test, and then confront the critics with the time-tested facts. And so was born what was to be called the Arizona Watershed Program.

The Arizona Watershed Program

The focus of the Arizona Watershed Program, a joint initiative of the Arizona Water Resources Committee and the State Land Department, was to work with the Forest Service, their cooperators, and others to obtain and then extrapolate research findings on large-scale watershed management practices designed to increase water yields by manipulation of vegetative cover; to determine the costs of water yield improvement treatments; to encourage the development of improved methods and techniques for multiple-use management practices on the state's watershed lands; to meas-

ure both the positive and negative effects of vegetative manipulations on all natural resources; to make economic evaluations of these practices; and to support watershed management research.

The goals of the Arizona Watershed Program would be obtained largely through three closely linked programs—an action program, a research program, and a public relations (educational) program. The Arizona Water Resources Committee initially placed priority on the action program that the Barr Report had recommended. This early emphasis was later tempered, however, by the adverse publicity to the proposals for the immediate implementation of large-scale programs of vegetative manipulations to improve water yields from the state's watersheds. As a consequence, the committee acknowledged that proposed watershed treatments would need to be tested through research before their implementation.

Therefore, the Forest Service and other governmental agencies, with their cooperators, implemented a large number of watershed research projects on sites that were scattered throughout the vegetative types within the Salt and Verde watersheds to attain these objectives. The research program was intended as a solution to the age-old problem of conserving rainfall, putting every drop of moisture that falls on the state to a beneficial use.

The State Land Department Link

Let's return to the Arizona State Land Department, where the idea to organize the committee was originally conceived. Important developments were taking place in that agency, developments without which the committee might not have survived. Ernst had resigned as commissioner, to accept appointment as Assistant Secretary of the Interior in President Eisenhower's Cabinet. As his successor, Governor Ernest McFarland appointed Obed Lassen, a Phoenix farmer and businessman who had already enjoyed a distinguished career in both the agricultural and political arenas.

Lassen was quick to recognize the critical role that the Watershed Management Division could play in the Arizona Watershed Program, and decided to throw the support of the State Land Department behind its efforts. Using earlier legislative actions for continuing the program in his organization, he appealed to the Legislature for an annual appropriation for watershed management, and got it.

With this commitment of funds, averaging around \$20,000 annually for the next 10 years,

Lassen moved the Watershed Management Division from the Heard Building to the main office in the Capital Annex Building, and into quarters directly across the hall from his own, so he could keep close tabs on its progress. Arnold was installed as the Division's director on April 1, 1957, with Fox continuing on as a part-time consultant and an all-important link with the committee.

Taking the Initiative

It was decided at the time to move the Arizona Watershed Program ahead on two fronts. First, a public relations effort would be mounted to offset the damage caused by the earlier attacks of Avery and others. To this end, the Arizona Water Resources Committee and the Watershed Management Division co-sponsored the first of what would become a long and important series of annual Arizona Watershed symposia in 1957. That first symposium was held in the chambers of the Arizona House of Representatives, with Fox presiding, as he was to do for several years, and with Arnold putting the program together. It attracted an audience of about 50 people, many of whom were antagonistic to the objectives of the Arizona Watershed Program. Later symposia, generally held at the Desert Hills Motel in downtown Phoenix, rarely failed to attract at least 150 persons, the bulk of whom were researchers, managers, and technicians interested in all phases of water conservation and watershed management.

The committee moved quickly on a second front in the winter of 1957, to implement a massive research effort to prove Barr's thesis—that water yields could be increased by vegetative modification. Two new actors now entered the drama at this point, and their contributions had a marked effect on the research front. Their names were Ray Price and Fred Kennedy.

Price and Kennedy

Price was the director of the Rocky Mountain Forest and Range Experiment Station of the Forest Service. This Experiment Station had long been known as a leader in watershed research in the central Rockies. Kennedy, the Regional Forester, was situated in Albuquerque, heading the administrative branch of the Southwestern Region of the Forest Service, which included Arizona and New Mexico. Together, these two men made a formidable team, and both were sold on the concept of vegetative modifications for the enhancement of the state's natural resources, including water and other multiple-use values.

At one of their first meetings with the committee, Kennedy announced his decision to set aside a 250,000-acre portion of the Coconino National Forest in north-central Arizona—an area destined to become the well-known Beaver Creek Project. Price not only indicated an eagerness to cooperate with Kennedy on the Beaver Creek Project, which was primarily located in the ponderosa pine forests and pinyon-juniper woodlands, but also pleaded for committee support for research in other vegetative types in the state, notably in the high-elevation, mixed-conifer forests, largely located on the Apache National Forest in eastern Arizona, and in the chaparral shrubland ecosystems, found scattered at lower elevations throughout the state.

Kennedy and Price gained the confidence of the Arizona Water Resources Committee at that first meeting, setting the stage for a close working relationship for the next decade or so. But, the mere decision to work together toward a common goal was not enough. This partnership would require money to flesh out the research that was envisioned by Kennedy and Price at Beaver Creek and in the mixed conifer forests and chaparral shrublands. And that leads us to one man without whose enthusiastic support there could have been no Arizona Watershed Program—U.S. Senator Carl Hayden.

Carl Hayden

Hayden was among the dignitaries who attended that first watershed field trip at Long Valley in 1955. He must have been impressed because, when Kennedy and Price recommended Beaver Creek as the site for the initial watershed experiments, Hayden got them the first appropriation—some \$200,000. The committee, in its first formal request for funds, added a second project to the list—in the chaparral shrublands—and sent Hayden a letter asking for an additional \$100,000. The Senator got the money, as he was to do on so many later occasions.

Encouraged by Hayden's support of Beaver Creek and the chaparral shrublands, the committee now began to expand its horizons. New projects were proposed to be implemented at regular intervals. And, importantly, agencies and groups of people other than the Forest Service were also brought into the picture.

Working with Native Americans

Hayden had told the Water Resources Committee that it would be a lot easier to get money from

Congress for Native Americans than for federal agencies. The committee took him at his word, and began sounding out the White Mountain Apache Tribe to see if they would be interested in a large-scale program of vegetative modification on their reservation. There were two reasons that the committee honed in on the Apaches rather than other tribes in the state. First, the Apaches had shown an earlier interest in prescribed burning, treating thousands of acres of their ponderosa pine forest with controlled burns long before it was popular to do so. Second, their reservation contained what was considered to be some of the finest watershed lands in Arizona.

The committee agreed to sponsor two large projects on the White Mountain Apache Reservation—one on Corduroy Ridge, the other on the Cibecue watershed—the first a pinyon-juniper woodland to grass conversion treatment, the second a combination of pinyon-juniper woodland and chaparral shrub conversion. The committee would obtain the money by means of an appeal to Senator Hayden, the Bureau of Indian Affairs would furnish the equipment to implement the project, the tribe would provide the necessary labor, and the U.S. Geological Survey would monitor the runoff.

Everything worked out fine, except for the most important part—the results of the treatments were not what the committee expected. Hayden got the money, close to a million dollars, and the Bureau of Indian Affairs and the tribe did their jobs. Unfortunately, the results of the conversion treatments proved inconclusive in terms of increasing water yields.

U.S. Geological Survey

The two White River Apache projects were not the only studies that the committee got going with the U.S. Geological Survey. There were others, two of which are worthy of mention. The earliest contact that the committee had with the Geological Survey was through the Survey's state director. The committee members were interested in finding out how much water was transpired, and therefore lost, to runoff in a heavy stand of cottonwoods. These trees, along with alders, willows, and sycamore, made up the higher elevation riparian ecosystems mentioned in the Barr Report as having a great potential for increased water yields. The area chosen for the cottonwood study was a 3-mile reach of Cottonwood Wash, a perennial stream in Mohave County near the Yavapai County line. The Geological Survey agreed to build the necessary

gauging stations, treat the vegetation, and monitor the results as its contribution to the effort. The Salt River Project and the State Land Department assumed the other costs.

This study was a success from a scientific standpoint, producing benchmark estimates on transpiration losses from riparian plant communities—approximately 2 acre-feet of water for every acre treated. The Salt River Project used the results from this experiment in later years as the basis for a proposal for treating a hundred acres of cottonwoods along the Verde River, near Camp Verde, to reduce water consumption by the riparian ecosystem.

Another effort with the Geological Survey, for which the committee obtained funding through Hayden's efforts, was the so-called Middle Gila Project, located on a reach of the Gila River just above San Carlos Dam. This project involved the measurement of transpiration losses in connection with salt cedar, an introduced tree species growing extensively within the state's riparian ecosystems.

It concluded that substantial savings in water could be accomplished through controlling the salt cedar. However, the results of this research effort were never implemented operationally, largely because of the subsequent opposition by sportsmen and other wildlife advocates who were concerned about destruction of wildlife habitat from the clearing process.

Agricultural Research Service

Over the years, the committee became involved in programs administered by the Agricultural Research Service, the research branch of the U.S. Department of Agriculture. One of these efforts was construction of a Soil and Water Conservation Research Laboratory, which had been authorized by the U.S. Congress to be established in the Southwest. Through the efforts of Senator Hayden, the committee was successful in getting this lab located in Phoenix.

USDA Forest Service

The main effort of the Arizona Watershed Program was centered within the USDA Forest Service. That interest had manifested itself by the middle 1970s in both research and action programs throughout the national forests of Arizona. By far the largest of these projects in terms of money invested in research infrastructures, cultural practices, and scientist support, and the most widely known, was the Beaver Creek Project south of Flagstaff.

The Beaver Creek Project

This project covered an area of approximately 250,000 acres, with ponderosa pine forests and pinyon-juniper woodlands the dominant vegetation. The project area had two main watercourses, Wet Beaver, a perennial stream, and Dry Beaver, an ephemeral stream but a heavy yielder of runoff from snow melt in the spring. Twenty permanent gauging stations were established to measure the runoff from selected watersheds. Of the 20, 18 ranged from about 65 to more than 2000 acres in size—3 in the lower pinyon-Utah juniper woodlands, 3 in the upper pinyon-alligator juniper woodlands, and 12 in the ponderosa pine forests. The other two watersheds—12,000 and 16,500 acres of ponderosa pine forests—were set aside to demonstrate the effects of a composite of management practices on areas of the size that managers work with operationally.

Beginning in 1957 and continuing into the early 1980s, various vegetative manipulations were applied to watersheds in the pinyon-juniper woodlands and ponderosa pine forests on Beaver Creek. These treatments were monitored to evaluate the treatment effects on water yields and other multiple use values. Monitoring responsibilities fell largely to personnel of the Experiment Station and to personnel from the Coconino National Forest, the area on which Beaver Creek was located.

Results

With a single exception, results from the treated pinyon-juniper woodland watersheds on Beaver Creek indicated insignificant effects on subsequent water yields. This finding was disappointing to the committee, but it was not entirely unexpected. Barr's team had predicted only a modest increase in water yields from this vegetation type. The only exception to the insignificant changes in water yields was a watershed where the overstory trees were killed by an aerial application of herbicides used to defoliate woody plants. However, because these chemicals were subsequently withdrawn for general use as a tool in land management due to concerns about their environmental effects, prospects for increasing water yields from the approximately 15 million acres of pinyon-juniper woodlands in Arizona did not appear encouraging.

The results were more promising in the case of the treated ponderosa pine forest watersheds. The committee members were pleased that almost all of the treatment prescriptions applied to ponderosa pine forests—thinning, strip-cutting, and clearing—provided increases in water yields in the

years immediately following implementation of the treatments. It also appeared that the treatments tested would be beneficial to some of the other multiple-use values. However, the duration of these treatment effects on water yields, and on the other watershed resources, were unknown.

From a strictly water yield improvement project, Beaver Creek became a full-fledged multiple-use evaluation effort in the early 1970s, with water resources sharing the concern of planners and managers with timber, livestock forage, wildlife, and recreation, and even amenities such as scenic beauty. These multiple-use, multidisciplinary orientations on Beaver Creek were largely in keeping with a policy that had been adopted by the committee of endorsing the Multiple Use and Sustained Yield Act of 1964, which the committee strongly supported by word and deed.

Other Forest Service Research Efforts

The committee took pride in the fame achieved by Beaver Creek. However, it also took pride in some of the perhaps lesser known, but equally important collaborative efforts with personnel of the Rocky Mountain Forest and Range Experiment Station. Chaparral shrublands, which had been largely written off by Barr's team, became the shining ornament of the Arizona Watershed Program. That first \$100,000 investment yielded rich dividends—spectacular water yield increases, well in excess of those reported from the ponderosa pine forests. Many of these unexpectedly high water yields were observed on the Three-Bar Experimental Watersheds, located near Roosevelt Lake, following the conversion of chaparral shrubs to a cover of herbaceous plants.

The Experiment Station also addressed another committee interest—vegetative manipulations for water yield improvement in the mixed conifer forests. Research in the mixed conifer forests, with its high precipitation, held promise for results that were as good, and perhaps even better, than those being obtained on the chaparral shrublands, making it another good investment in committee research-sponsored dollars.

John J. Rhodes

When Hayden retired from Congress, the committee turned to another Congressman from the Phoenix area, John Rhodes of Mesa. Like Hayden, Rhodes had made appropriations his specialty. Hayden, a Democrat, had risen to the chairmanship of the Appropriations Committee in the Senate. Rhodes, a Republican, never made it to the

top spot because his party never gained power in the Lower House while he was in Congress. However, Rhodes had become the ranking Minority Member by the time Hayden retired, and therefore held a position of power and influence when the committee needed him the most. How well he wielded that power is shown by the following incident.

Carl Wenger and Bill Hurst, who replaced Price and Kennedy as Experiment Station Director and Regional Forester, respectively, came to the committee in the early 1970s with a sad story. Between increasing inflation and the ever-expanding work at Beaver Creek and throughout the Arizona Watershed Program research locations, they were running out of money. The committee did not want to see the research on Beaver Creek or elsewhere in the Arizona Watershed Program curtailed any more than Hurst and Wenger. So, the committee wrote Rhodes a letter, in which they explained the situation in some detail and requested a modest increase in the annual appropriation.

The committee had asked that Forest Service research funding be raised to \$400,000 a year. However, Rhodes got \$600,000. The committee had also requested an additional \$178,000 for Forest Service administration. Prior to this time, Forest Service administration had been funding the efforts at Beaver Creek at the regional rather than national level. Rhodes got that too—and as a line item in the budget.

The Arizona Water Commission

When Lassen completed the second of his two 5-year terms as State Land Commissioner, he was succeeded by Andrew Bettwy. A lawyer with experience in land and water matters, Bettwy took a long look at the language contained in earlier legislation and felt it was lacking in justification for continued annual appropriations to maintain the Watershed Management Division within his organization. He therefore terminated the Watershed Management Division and its connection with the State Land Department. Some months before this termination occurred, however, the state legislature was considering a bill to create what was to be known as the Arizona Water Commission.

The committee voted to endorse the Arizona Water Commission Bill, provided it included reference to the role of watershed management. Fox carried this message to the hearing on the bill, and was gratified to see the necessary language inserted. In 1971, therefore, the state legislature

expanded and reorganized the Arizona Interstate Stream Committee, restructuring the latter as the Arizona Water Commission. It was intended that the membership, powers, and duties of the Interstate Stream Commission would be transferred *en bloc* to this new commission, the former then to pass out of existence.

The Arizona Water Resources Committee terminated its relationship with the State Land Department as far as watershed management issues were concerned at this time, and assumed a new relationship with the Arizona Water Commission. However, its transition to the Arizona Water Commission modified the policy-making role of the committee, along with the quasi-public position that the committee had assumed to this time. In essence, the commission, rather than the committee, began to officially prosecute the state's role in watershed management programs.

A Setback

An agreement had been signed between the Salt River Project and the Forest Service in 1964 to rehabilitate the Salt and Verde watersheds. The ink was hardly dry on the agreement when the first projects were begun to convert pinyon-juniper woodlands and chaparral shrublands to herbaceous plant covers, hoping to improve forage production and water yields. Then in 1969 came a setback to the Arizona Watershed Program, leaving scars that remain largely unhealed to the present time. This setback later became known as the "Globe incident."

The Incident

A helicopter hired by the Forest Service was spraying herbicides on a stand of chaparral shrubs on the foothills of the Pinal Mountains at the outskirts of the town of Globe. It was scheduled to be a routine operation, using a chemical mixture dominated by the herbicide commonly known as 2,4,5-T. The same operation had been performed countless times at different locations on the Tonto National Forest since 1965, as part of a rehabilitative program to reduce the densities of the chaparral stands in the foothills of the Pinals. However, this time it was different.

The incident began on Sunday morning, June 8, 1969, when Mrs. Willard (Billee) Shoecraft, a long-time Globe resident and the wife of the local radio station owner, said she "stepped outside [her] bedroom door ... and was covered with a spray mist from a helicopter flying over [her house] located at the foot of the Pinal Mountains." At

about the same time that Mrs. Shoecraft thought she felt the chemical spray, a man named Robert McKusick, a resident of nearby Kellner Canyon, saw (or thought he saw) a sudden gust of wind carry droplets of 2,4,5-T (and the other chemicals) into his yard, where the droplets fell on his chickens and ducks. And so the stories went.

A group of area residents, attending a meeting to protest the use of herbicidal sprays, held at the Globe Chamber of Commerce in July 1969, endorsed a proposal drafted largely by McKusick and Mrs. Shoecraft, which was to be sent to the Forest Service and the Salt River Project on the subject of spraying herbicides in the Pinal Mountains near Globe. This proposal called for all spraying of plants on the Pinal Mountains to cease immediately, the Forest Service no longer having immunity from the controls set forth by the Board of Herbicides and Pesticides, and the Salt River Project was to be restrained from further destruction of the Pinals for any reason whatsoever.

McKusick was to file lawsuits about a year after the spraying incident, alleging that the herbicides sprayed in the Pinal Mountains caused malformations in the chicks and ducklings born after the mist flowed across his property. He and his neighbors followed with complaints of unexplained human illnesses attributable to the chemical. All of these complaints culminated in the filing of a lawsuit, in which Dow Chemical, the primary manufacturer of the herbicide, and the Salt River Project, Arizona Helicopters, Inc., who were accused of negligence, and the Forest Service were named as co-defendants. Three other chemical companies were also included in the lawsuits, which claimed that these companies were also allegedly negligent in allowing the herbicides to be marketed without proper testing or labeling.

"Sue the Bastards"

Attempting to publicize the incident, Mrs. Shoecraft wrote a book in 1971 about the Globe incident titled "Sue the Bastards." The book recounts the many contacts that Mrs. Shoecraft had with local representatives of the Forest Service, employees of the Salt River Project, U.S. Senators and Congressmen, the Governor of Arizona, who was Jack Williams at the time, and Clifford Hardin, the Secretary of Agriculture. She detailed her often unproductive (in her opinion) communications and other exchanges with researchers and other experts within and outside of the Forest Service on their thoughts relative to the use of herbicides.

Mrs. Shoecraft's impressions of the effective-

ness of the task forces brought in to investigate the incident are described from her perspective of these encounters. Formal and informal correspondence from and to Mrs. Shoecraft in relation to the use of 2,4,5-T and other herbicides in the Globe-Miami area, and their use in general, is also presented in the book to reinforce the points made by the author.

Bob Moore

In one of his last acts before retiring, Jake West had recruited an agricultural engineer, Robert E. "Bob" Moore, then completing his education on the University of Arizona campus, as his heir-designate. The committee, seeing a rising light in Moore, had made him its secretary-treasurer, succeeding Fox, who then moved up to president of the committee and watched with pride and approval as Moore pushed through the chaparral control effort in the Pinal Mountains, the first operational water yield improvement program based on the state's research findings. The committee, therefore, was bitterly disappointed when the Forest Service, knuckling under to the threats resulting from the Globe incident, ordered the planned chaparral conversion project to be shelved.

The Thorud-Ffolliott Report

Some months later, representatives of the Arizona Water Resources Committee met Dave Thorud, the head of the Department of Watershed Management, University of Arizona, at his office on the Tucson campus to discuss a project of vital importance to the committee. It was time, the committee thought, to assemble, collate, refine, and analyze all of the information gleaned by watershed researchers over the decade and a half that the committee and the Arizona Watershed Program had been in business. The committee also felt that it was time to move the Arizona Water Program from one of research to one of action. The Department of Watershed Management at the University of Arizona was asked to do the job. Thorud agreed. Thus was set in motion what became known as the Thorud-Ffolliott Report (for Peter Ffolliott, a member of Thorud's faculty) or, to give the report its formal title—"Vegetation Modification for Increased Water Yields in Arizona."

Release of the Report

It took Thorud, Ffolliott, and their associates about a year to prepare the report, a massive document that came off the press in 1975. However, a shorter

summary, titled "More Water for Arizona," prepared by the committee and the Arizona Water Commission, was made available to the public on September 24, 1974, at a dinner meeting in Phoenix. The Westward Ho hotel was chosen as the site for this dinner, to be held to release the Thorud-Ffolliott Report to the public—as it was on the night that Barr made his report available.

Among those in attendance were the governor of Arizona, Jack Williams; representatives of the Arizona Water Resources Committee, the Salt River Project, the Forest Service, and the Arizona Water Commission; and the president and a number of faculty members of the University of Arizona. Committee spokesmen said that "they expected opposition from conservation groups" the following day, when the Thorud-Ffolliott Report would be formally presented to the public at the annual Arizona Watershed symposium. However, the committee and others were surprised by the intensity of opposition. As it turned out, history was to repeat itself in another sense as well.

Another Setback

The next day started off well enough. That day, September 25, 1974, Fox, Thorud, Ffolliott, a number of Forest Service researchers, and Bill Hurst, the Southwestern Regional Forester, all of whom had been invited to speak at the 18th Annual Watershed Symposium, faced some 250 researchers, managers, technicians, and water specialists who had been invited to attend the symposium. The symposium presentations came off exceptionally well. Expert after expert, all respected leaders in their respective fields, attested to the generally favorable conclusions drawn from the nearly 18 years of watershed research since issuance of the Barr Report.

Bill Hurst was the luncheon speaker at the symposium, with his talk focusing on the application of water yield research to watersheds on the national forests in the state—a further discussion of this talk is presented below.

Ffolliott reported in the afternoon session that the water yield improvement opportunities on the state's grassland and desert shrub ranges were limited. He also presented a paper in which estimates of the potentials for increasing water yield by vegetation management practices were given. Thorud, who was Master of Ceremony for the symposium, concluded the day with a presentation on the Arizona Watershed Program in review, in which he summarized the relevant conclusions

and recommendations contained in the Thorud-Ffolliott Report.

"There was only one sour note," Fox would later say, "the luncheon talk by Regional Forester Hurst, in which some of the points made in the Thorud-Ffolliott Report were challenged. Eager to pour more coals on the fire, the same newspaper men who had written the earlier stories about the conclusions of the Barr Report seized on Hurst's reservations to the Thorud-Ffolliott Report, blithely ignoring the overwhelming testimony presented in its favor."

Members of the committee were thunderstruck at the reception that the Thorud-Ffolliott Report received. To many of them, it seemed that Hurst, who had been a member of the steering committee that had aided in the preparation of the report, was out to knife both its authors and some of the committee members.

The controversy smoldered for more than a month, until there could be a reconvening of the committee with Hurst in attendance. This meeting, which took place in Phoenix and lasted most of the day, resulted in a compromise acceptable to both parties—that is, to Hurst and the committee members. Fox would write, and Hurst agreed to sign, a letter to John Rhodes stating that he had, in effect, been misquoted by the press, and that he and the agency he represented (the Forest Service) were ready to support the concept of vegetative modification for the purpose of increasing water yields and improving related resources. The pact was duly inked by the principals about a month later. Peace, it was thought, had been restored. It was believed that the Arizona Watershed Program could move ahead, and that the Arizona Water Resources Committee would continue to play a key role in the program.

In Retrospect

Much of the perceived problem that Hurst seemed to have with the Thorud-Ffolliott Report was probably the result of a case of miscommunication among the parties to the debate on the nature of the report's conclusions. To a large extent, the Thorud-Ffolliott Report contained two parts—a summary of the knowledge obtained from the Arizona Watershed Program up to that time, and a statement of a theoretical maximum in water yield improvement potential that might be obtained through implementation of hypothetical vegetation management practices. The latter was presented within the framework of a set of necessary and, it was thought, carefully stated assumptions.

Hurst had little problem with the first part of the Thorud-Ffolliott Report. In fact, he commented in his aforementioned luncheon talk at the symposium that it "constitutes an excellent summary of the knowledge available on water yield possibilities from the major vegetative types in Arizona." Furthermore, he continued, "this information will be extremely helpful to land managers in developing management objectives for specific areas of land during the planning process." His problem with the report, it seemed, was with its second part ... However, by placing these two perspectives side by side, it can be seen in retrospect that there was relatively little disagreement between the two.

Compounding the controversy was the time lag between the release of Hurst's remarks at the symposium and the published presentations of Thorud and Ffolliott. A copy of the paper that Hurst presented at the luncheon was made available to all in attendance, including the media, at the time of its presentation. However, the papers authored by Thorud and Ffolliott, along with those of the other speakers, were not published for several months thereafter, when the symposium's proceedings, which included the full text of Hurst's paper, became available to the public. As a consequence, it was difficult for people to draw their own conclusions relative to what side to take in the controversy, if any side was to be taken, in the time immediately following the symposium.

Battle Flat

A need for testing and, if necessary, refinement in the management of chaparral ecosystems as shrubland-grassland mosaics for increased multi-resource outputs had become a critical issue by the middle 1970s. Earlier research on the Three-Bar Experimental Watersheds indicated that significant improvements in water yield could be achieved through conversion of chaparral shrublands into less water consuming herbaceous plant covers. It was largely for this reason that what became known as the "Battle Flat Pilot Application Program" was initiated as a prototype chaparral management area in 1977.

The Battle Flat Program

The Battle Flat study site, an area of about 3780 acres, was representative of a dense chaparral cover found on a mixture of volcanic, granite, and alluvial soils. The site chosen was grazed by live-stock, home for a variety of wildlife species, and used for hunting, hiking, and horseback riding by

local people. Battle Flat was not quite as steep as the average chaparral shrubland in the state, although its terrain was considered suitable for testing the conversion treatments being proposed and then demonstrating the results of these treatments to the public.

Forest Service researchers and their cooperators developed the necessary baseline data sets and predictive models for future treatment evaluations during the pre-treatment calibration period. It was originally intended that—following the required calibration—treatments would be imposed on smaller watersheds, treatment responses would be predicted by the models, and a larger scaled treatment involving an optimal shrubland-grassland mosaic pattern would be prescribed and placed on the ground.

Still Another Setback

Although extensive inventories and research studies were conducted as prescribed, the mosaic treatment of the entire watershed on Battle Flat Creek was delayed, and ultimately the treatment was never implemented, largely because of political and legal constraints to implementation of the treatment and controversies surrounding the widespread use of herbicides for treating watersheds. Only one of the smaller watersheds was ever treated in the Battle Flat Pilot Application Program. The shrub cover on this watershed was only temporarily reduced by prescribed burning, however. Therefore, it was generally felt that prescribed burning was not necessarily a feasible alternative to the use of herbicides in converting chaparral shrublands, because of the need to subsequently control the vigorous post-fire sprouting of chaparral shrubs.

A Winding Down

In the early 1980s, the Rocky Mountain Forest and Range Experiment Station carefully examined the status and resulting benefits of the existing experimental watershed studies in relation to their general contributions to watershed-related research in the state—this examination occurred during a comprehensive review of its watershed research program. As a result of this review, the Experiment Station decided to consolidate all aspects of its watershed-related research in Arizona into a newly formed research project to be located in its Tempe office.

The assigned tasks of this project were to study the effects of fire on soil nutrients in representative ecosystems of the pinyon-juniper woodlands and

chaparral shrublands of the state, to further the knowledge of basic erosional processes and rates in these ecosystems, and to investigate the effects of manipulating high-density chaparral shrublands on water quantity and water quality in areas of high precipitation. Project personnel would also be responsible for overseeing the Battle Flat study. Concurrent with these tasks was a need for the project personnel to continue evaluating the effects of vegetative manipulations on water yields from the state's watersheds. Issues to be addressed included monitoring and evaluating the effects of timber harvesting and thinning, conversions of pinyon-juniper woodlands, and chaparral shrub removals on streamflow responses.

A meeting was convened to discuss the future of watershed research in the state, and especially the status of the experimental watersheds, and to hopefully find a resolution to the dilemma on hand. This crucial meeting was held in the library of the Experiment Station's Forest Hydrology Laboratory in Tempe, on November 2, 1983.

The Tempe Meeting

At the meeting were key members of the Arizona Water Resources Committee, researchers from the Experiment Station, and representatives of the Salt River Project and the state's universities. After a lengthy discussion on the status of experimental watershed studies in the state, and the objectives of the Forest Service's pilot applications programs, those in attendance at the meeting agreed that a number of actions in relation to the Arizona Watershed Program should be taken.

The Beaver Creek Project

One of the smaller watersheds located in the ponderosa pine forests on Beaver Creek, Watershed 13, would continue to be monitored by the U.S. Geological Survey, largely because this watershed was at the time being considered as a possible "research natural area." However, with the exception of the large watersheds that had been set aside for pilot applications—Woods and Bar M canyons—the remaining Beaver Creek watersheds in both the ponderosa pine forests and pinyon-juniper woodlands would be "mothballed"—in other words, collection of streamflow and precipitation data by Forest Service personnel would be discontinued, although the stream gauging structures on these watersheds would remain in place for possible future activation. These actions marked the end of nearly 25 years of research on the Beaver Creek Project, although the project had

officially been terminated earlier by the Experiment Station, on October 1, 1983.

Shortly after the meeting, Peter Ffolliott, one of the authors of the earlier Thorud-Ffolliott Report, indicated that there was interest on the part of the School of Renewable Natural Resources at the University of Arizona in continuing the measurements of streamflow and precipitation on two of the Beaver Creek watersheds in the pinyon-juniper woodlands. Ffolliott and his colleagues felt that a longer post-treatment evaluation period of these watersheds would be helpful in planning for future management of the pinyon-juniper woodlands in the state—the herbicide application on the treated watershed was the only water yield improvement tested in the Arizona Watershed Program that had resulted in a water yield increase in the pinyon-juniper woodlands. The School of Renewable Natural Resources continued to take streamflow and precipitation measurements on these two pinyon-juniper watersheds until October 1, 1986.

Streamflow and precipitation measurements continued on Watershed 13 through October 1, 1992, at which time the U.S. Geological Survey terminated these measurements. However, streamflow and precipitation continue to this time to be measured in Woods Canyon and the adjacent Bar M Canyon, the control to Woods Canyon, by personnel from the School of Forestry at Northern Arizona University, who had entered into an agreement with the Forest Service to monitor these larger watersheds following the Tempe meeting.

Other Forest Service Research Efforts

Research efforts on other watersheds in the state were also affected greatly by the decisions reached at the Tempe meeting. The Three-Bar Experimental Watersheds were immediately mothballed. However, the Whitespar watersheds, located in the chaparral shrublands near Prescott, were maintained to help evaluate the effects of a brush-grass mosaic on water. It was anticipated that the additional measurements to be obtained from Whitespar would assist the Forest Service in testing such a mosaic treatment on a larger scale as part of the Battle Flat Pilot Application Program. Streamflow and precipitation measurements continued on the Whitespar watersheds until October 1, 1988. All of the other watersheds in the state's chaparral shrublands—with the exception of those located on Battle Flat—were immediately mothballed. Streamflow and precipitation measurements on Battle Flat were ultimately termi-

nated on October 1, 1989.

The Workman Creek watersheds in the mostly mixed conifer forests on the Sierra Ancha Experimental Forest were immediately mothballed as a result of actions taken in the Tempe meeting. However, precipitation and other meteorological measurements were continued at the Sierra Ancha headquarters by Experiment Station personnel until the middle 1990s, at which time personnel from Arizona State University assumed this responsibility.

Streamflow and precipitation measurements on the Castle Creek watersheds, in the ponderosa pine forests of the White Mountains, would be continued by personnel of the Apache-Sitgreaves National Forest, Springerville. These measurements were analyzed by personnel of the Experiment Station for a period of time. However, the watersheds themselves were to be released as experimental areas to the Apache-Sitgreaves National Forest, to be then incorporated into their long-term forest management plans. Full responsibility for making and analyzing the measurements on Castle Creek now rests with personnel of the Apache-Sitgreaves National Forest. Disposition of the Thomas Creek and Willow Creek watersheds in the higher elevation mixed conifer forests on the Apache-Sitgreaves National Forest, near Hannigan Meadows, was largely the same as that of the Castle Creek watersheds.

A Final Comment

Much of the action program put forth in the Arizona Watershed Program has not, and will likely never be, carried out as it was intended. Society's values have changed greatly since this program was presented to the public in 1956, precluding full-fledged adoption of the proposed management practices as a matter of land-use policy. However, it is also true that a research base was established to better "refine" the proposed management program offered by Barr's team of experts, although hydrologic limitations and multiple-use concerns have constrained operational implementation of these findings.

Other limitations placed on management activities of the state's watersheds in general—such as limitations on timber harvesting and grazing of livestock—further constrained watershed management activities by the middle 1990s. In effect, therefore, the earlier lofty goal of the Arizona Watershed Program of increasing yields of water from watershed lands has been tempered, to a large extent, and placed into a proper perspective.