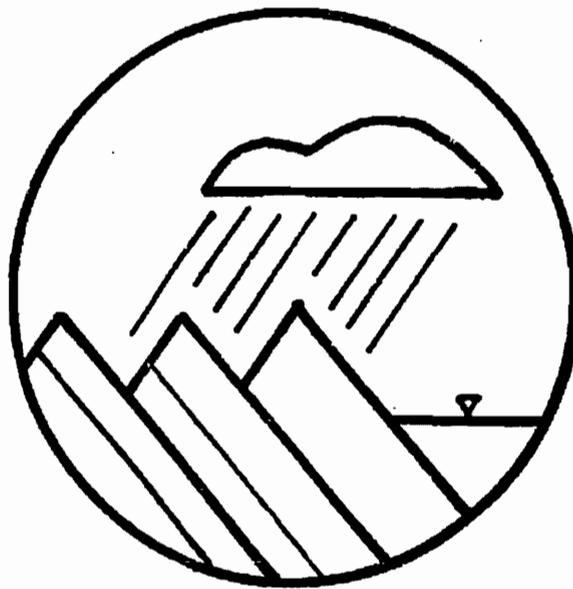


**WATERSHED SCIENCE
AT
COLORADO STATE UNIVERSITY**



**Department of Earth Resources
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**EARLY HISTORY OF THE
WATERSHED SCIENCE
PROGRAM
AT
COLORADO STATE UNIVERSITY
1958-1973**

**BY
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I. SETTING THE STAGE FOR WATERSHED MANAGEMENT EDUCATION

In all likelihood, the very first academic course related to Watershed Management in the United States was "Forest Influences" which was taught by Dr. Joseph Kittredge at the University of California in 1932. Dr. Kittredge subsequently authored a textbook with the same title published in the McGraw-Hill Forestry Series. Both course and text were available in the 1940's.

Colorado State University's interest in the subject of watershed management dates back to the spring term of 1947. In that term, Dr. H.G. Wilm, in charge of watershed management research with the Rocky Mountain Forest and Range Experiment Station, USFS, in Fort Collins offered the first collegiate course in watershed management. This was done with the concurrence and cooperation of Ray Price, Director of the Station and of Dr. J. Lee Deen, Dean of the College of Forestry and Range Management.

The Forest Service had earlier initiated research programs in watershed management throughout the United States. Three such programs of special note were those of the Rocky Mountain Forest and Range Experiment Station under the direction of H.G. Wilm, of the Southeastern Forest Experiment Station, led by Dr. Charles R. Hursh, and that of the Pacific Southwest Forest and Range Experiment Station headed by Henry Anderson.

At the Rocky Mountain Station, field installations involved with watershed management research projects included a facility at the Manitou Experimental Forest west of Colorado Springs, CO, the Fraser Experimental Forest west of Denver, CO and the Sierra-Ancha Experimental Forest near Globe, AZ.

The major watershed research facility of the Southeastern Forest Experiment Station was the Coweeta Hydrologic Laboratory near Franklin, North Carolina while the programs of the Pacific Southwest projects were centered at the San Dimas Experimental Forest east of Los Angeles. Further research for that area was carried out at the Central Sierra Snow Laboratory near Donner Pass, CA.

The very earliest non-academic research efforts in watershed management were carried out through the joint efforts of the U.S. Forest Service, (USDA) and the U.S. Weather Bureau, as early as 1910. Their projects were carried out in the Wagon Wheel gap watersheds near South Fork, Colorado.

While the U.S. Forest Service was the principal federal agency charged with research on federally managed private lands,

a variety of other federal and state agencies had responsibilities for the management of land and/or water resources. These agencies were often particularly interested in the water resources on or derived from such lands. The Bureau of Land Management, the Bureau of Reclamation, the Geological Survey, the Fish and Wildlife Service and the Bureau of Indian Affairs - all in the U.S. Department of the Interior - should be included in this list. The Soil Conservation Service (USDA) and the U.S. Corps of Engineers should also be mentioned. Additionally many state land and resource agencies began to feel increasing responsibility in land and water management as did cities with municipal watershed concerns.

Growing populations with their increasing pressures on land and the limited water resources, and the concurrent public awakening to environmental concerns pointed to an understandable need for professional training in watershed management. Colorado A&M College, currently Colorado State University, was the first educational institution to respond to that need.

The Cooperative Watershed Management Unit

Although others undoubtedly made valuable contributions, two men are largely responsible for the establishment of the watershed management unit at Colorado State University. They are Mr. Raymond Price and Dean Clinton Wasser.

As noted earlier, Ray Price was Director of the Rocky Mountain Forest and Range Experiment Station in 1958. That station's area included North and South Dakota, Nebraska, Kansas, Wyoming, Colorado, New Mexico and Arizona.

Professor Clinton Wasser was then Dean of the College of Forestry and Range Management at Colorado State University. Later, that College became the College of Forestry and Natural Resources and, later still, the College of Natural Resources. At the early date, departments within the College of Forestry and Range Management included Forest Management and Utilization, Grazing and Range Management, Forest Recreation, and Wildlife Management.

As is so often the case, University funds for the establishment of new programs were very limited in 1957. If any new disciplines were to be initiated, external funding would be required. Through his personal acquaintance with Arthur Newton Pack of Tucson, AZ, Dr. Price obtained external funds which provided for the establishment of a new Cooperative Watershed Management Unit at CSU.

At this point, a brief background sketch of the Charles Lathrop Pack Foundation, which made these funds available is pertinent and interesting.

Charles Lathrop Pack was an early "timber baron" and industrialist operating in the Lake States and in Ohio in the late 1800's and early 1900's. He was involved in harvesting vast amounts of timber over a very large area. He was also a major investor in real estate, especially in Cleveland, Ohio. In his later years, he became very much interested in the preservation of our natural resources. His special concern focused on restoration and prudent usage of forest land - particularly those forests from which he had made much of his fortune. He committed a sizable part of that fortune to the Charles Lathrop Pack Foundation which was to be devoted to these concerns.

To manage the Foundation and to dispense its funds, he employed a well-known forester from Washington, D.C., Tom Gill. Under Mr. Gill's direction, Pack Foundation funds provided a variety of new forestry projects and programs. Included among them was a Pack Professorship at the New York State College of Forestry of Syracuse, the establishment of the Pack Forest at the University of Washington and a Professorship of Forest Economics at the University of Michigan.

Upon the deaths of Charles L. Pack and of Tom Gill, the Foundation was taken over by Mr. Pack's son, Arthur Newton Pack, who resided in Tucson, AZ. Arthur Newton Pack's interests were concentrated in the southwest and Pack Foundation funds were soon provided to establish the Arizona Sonoran Desert Museum outside Tucson and to found the Ghost Ranch near Abiqui, New Mexico. Additional grants were made to several churches.

By 1957, the majority of Foundation funds had been used but Arthur Newton Pack wished to make final grants reflecting his father's initial intentions. At this point, Dr. Price, having known both Mr. Pack and the focus of the original policies of the Foundation suggested that three final grants of \$75,000 each be made to universities in the southwest. Mr. Pack agreed and the funds were awarded.

The first of the programs was a grant to the University of Arizona which at that time had a program in range science. They also offered some courses in forestry and wanted to establish a full-fledged forestry program. Since there was already a School of Forestry in Flagstaff, in-state politics mitigated against establishing another such school at state expense.

With the Pack Foundation grant, the University of Arizona employed Dr. Andrew McComb, then a forester at Iowa State University, to set up some watershed management courses and to expand their then-limited program in forestry.

The second of these Pack Foundation grants, to the University of New Mexico, was used to expand their extension and outreach programs in which some emphasis was placed on Watershed

Management. Some of the money may also have been spent to enhance University interests in the Ghost Ranch at Abique.

The \$75,000 grant to Colorado State University, was specifically given to establish both undergraduate and graduate programs in watershed management.

With this financial assistance, Dean Wasser, with the sanction of CSU President William E. Morgan, guided the fledgling program through the necessary university approval channels until the Cooperative Watershed Management Unit was officially established in 1958.

The University employed Dr. Robert E. Dils as leader of the new unit and Pack Professor of Watershed Management. Coincidentally, Dr. Dils had been a student in that first course in watershed management taught by Dr. H.G. Wilm in 1947. Prior to that time, he had attended Wittenberg College in Springfield, Ohio and had served 3 $\frac{1}{2}$ years in the USAAF Weather Service.

After his military service, Dr. Dils completed BS and MF degrees in Forestry at Colorado A&M College. In 1947 he began his teaching career at Michigan State University in East Lansing. In 1955 he moved to Ann Arbor and became a forestry faculty member in the School of Natural Resources, University of Michigan where he served until 1958. At both Michigan and Michigan State Universities he established and taught courses in watershed management or in water resource management.

During his initial years in Michigan, Dr. Dils completed a Ph.D. degree in Soil Science, (Michigan State University, 1952). Significantly, his doctoral research was conducted at the Coweeta Hydrologic Laboratory, Southeastern Forest Experiment Station. It dealt with the soil and hydrology of a small watershed.

Dr. Dils began his tenure at CSU on August 1, 1958. Mrs. James Grace (Clare) was the Unit's first secretary. The Unit was housed in what had been a long, narrow file room on the second floor of the original forestry building. Two desks, a file cabinet and a bookcase completely filled the room.

In that first year, two courses were offered: "Principles of Watershed Management" and "Applied Watershed Management". Three undergraduates enrolled in the program, Tom Elson, Bob Swanson and Ron Tabler. Later watershed management students are listed in the Appendix.

A unit in University Academic Administration might be likened to a fledgling department or a sub-department although in this case the leader of the unit was treated as a department head and reported directly to the dean of the college.

At the outset, the "cooperative" in the unit title denoted a close tie to the Rocky Mountain Forest and Range Experiment Station. Although no transfer of funds was involved, Forest Service personnel provided guest lecturers and taught classes within the unit on an occasional basis. Subsequent cooperative efforts with a variety of federal, state and municipal agencies provided a broad spectrum of guest lecturers, research opportunities and graduate student support

Thus with this background history the Cooperative Watershed Management Unit was off and running in 1958!

II. EDUCATIONAL PHILOSOPHY

The Watershed Management program was established on the following principles:

- 1) Focus on the effects of land use on water - its quantity, its quality, and timing - within the context of sustainable use of watersheds for multiple resource products and uses.
- 2) An interdisciplinary approach incorporating both biophysical and socio-economic disciplines.
- 3) Field oriented education using case studies, field practicums, and field-oriented research.
- 4) A focus on solution of practical problems
- 5) Flexibility for individual students to develop their personal interests around the central core focus and curriculum.

The central focus of the program was on the effects of land use on water. All facets of the hydrologic cycle were included and a basic understanding of the biophysical processes was the most fundamental part of the curriculum. The emphasis was on "wildlands" i.e. forest, range, and alpine areas, as opposed to cultivated lands. Although most land uses were considered, the role of vegetation was the key ingredient. The very first courses emphasized the influence of vegetation on water and a key text was "Vegetation and Watershed Management" by E.A. Colman. Although system theory was at a relatively early stage of development, the concept of the hydrologic cycle as a system within yet a larger system - a watershed - was a very fundamental integrating principle for the program. Perhaps it is for this reason that so many of the early graduates ended up in planning or other positions that required a large amount of integration. Other key references used included Kittredge's "Forest Influences", Brater's "Hydrology" and Marsh's "The Earth as Influenced by Human Action". For the more applied courses the handbooks from the Soil Conservation Service and the U.S. Forest

Service were used along with the "Small Dams" publication of the U.S.B.R. The main reference for snow related topics was "Snow Hydrology" published by the U.S. Corps of Engineers in 1956.

Since inception, the program focused on an interdisciplinary approach to the solution of land-use water problems. Both undergraduate and graduate programs involved a combination of soil science, plant science, hydrology, geomorphology, and meteorology. Because the program was housed within the College of Forestry, special emphasis was placed on forest/water and range/water relationships. Social, political, economic, and, to a limited extent, legal considerations were also included. From the very start, the course "Watershed programs, Administration and Policy" was included. The first dissertation, by Peter Black, was on water law, but subsequent research was heavily oriented to biophysical problems. This emphasis is illustrated in Appendix Tables 1 and 2 - a listing of graduate research topics. One of the most popular courses required at both the undergraduate and graduate levels was "Logic and Scientific Method" taught by Professor Willard Eddy. A common joke among the early graduate students was that they were "hydroecogeomorphologists". For a while there was a sign on the graduate student office in the basement of the old forestry building to that effect!

The watershed program had a very strong orientation toward field experience. This was accomplished in a number of ways. Field trips were an important ingredient of the early program. One of the most extensive was in March 1960 when Bob Dils took a group of graduate students - Peter Black, Roger Hoffer, Pete Hawkins, Jim Meiman, and Brian Reich - on a tour of watershed projects in New Mexico and Arizona.

Throughout the sixties the watershed program maintained several weather stations, snow courses, and stream gages in the Little South Poudre River Watershed. This provided students the opportunity to gain much practical experience in instrumentation and measurements, and to observe hydrologic processes first hand. It also provided very practical lessons in working in mountainous terrain, sometimes under very harsh conditions. The results of these observations are published as "The Climate and Hydrology of the Little South Watershed" by Jim Meiman and George Leavesly, 1974. In addition to providing practical field experience the Little South studies field projects were an excellent way to bring students and staff closer together. There are many great stories from these times and some will be recounted later in the section on research.

Practical experience was also incorporated into field practicums and lab sessions for most courses. One of the most prominent was the Watershed Analysis course which was almost entirely field-based. Starting with the North Fork of the Cache la Poudre River, each year a different watershed was analyzed and a final report produced as a team effort. Some of these reports still appear as referenced material.

Closely related to the field orientation was a focus on the solution of practical problems. Although some of the research involved work on fundamental hydrologic processes, it was usually driven by the desire to apply the resulting knowledge to watershed management. The faculty worked hard in those early years to keep close contact with agencies and individuals who would use the knowledge coming from our research. These relationships are discussed in detail in a following section.

The watershed graduate program drew students with widely diverse backgrounds and interests and thus an attempt was made to maintain maximum flexibility in designing graduate programs. Quite commonly the majority of the graduate committee was from outside the watershed program with strong support from other departments within the College as well as from outside the College.

Among the faculty from outside the College who frequently served on watershed management graduate student committees were:

Walter V. Garstka	Civil Engineering
Norman Evans	Civil Engineering
Edward Schultz	Civil Engineering
Philip Foss	Political Science
Henry Caulfield	Political Science
Stephen Smith	Economics
Ray Anderson	Economics
Ken Nobe	Economics
Art Corey	Agricultural Engineering
David Harris	Geology
Elmer Remmenga	Statistics
Evan Vlachos	Sociology
Bob Danielson	Agronomy
Bob Whitney	Agronomy
Sumner Morrison	Microbiology
Don Klein	Microbiology

At the same time that maximum flexibility was provided there was an attempt to insure that all students were grounded in the core areas previously discussed.

A hallmark of the program was the unusual esprit de corps engendered both among and between the faculty and the students. The watershed unit truly had a very special "spirit". Perhaps it was because it was new, but there was a definite feeling of comradeship and pride in being a part of it. Perhaps it was also in part a result of the people who were attracted to the program. Faculty and students were interested in looking at the bigger picture in managing natural resources to include concern for the entire watershed system including both physical and biological considerations together with the impact of humans on these systems. Then there was the very important role that Bob and Nedra Dils played in making everyone feel as though they were part of a family. Frequent get-together of faculty and students, spouses and children on holidays and special events contributed

greatly to the feeling of being part of a team. Nedra worked hard at networking with the wives of faculty and students.

A good description of the flexibility and general atmosphere of those early days is given by Dr. Peter Black, the first Ph.D. in Watershed at CSU who writes, "Bob gave me the opportunity to "sink or swim" on my own; he never looked over my shoulder at what I was doing, and was always available, usually approving with a hearty "Okey doke" response to some proposal. I have learned over the years that different faculty use the reins differently for their graduate students; I thrived under the challenging atmosphere that Bob created, and have by and large treated my students the same way, like responsible grown ups. They respond in kind, and I am grateful to Bob for showing me by example how to go about it."

III. FACULTY AND STAFF

Bob Dils' background is given in Section 1 - Setting the Stage. In the following paragraphs a brief statement is included about each of the other staff during these early years. Other comments on their activities may also be included in other sections.

Clare Grace was the other original staff member along with Bob. Clare took a deep interest in the program well beyond her official duties as secretary and became a real friend and helper for the students, including having get-togethers at her home. Ted Sheng, one of the early foreign students, and the first of a series from Taiwan, recalls cooking a Chinese dinner at Clare's for a group of watershed staff and students. Clare's husband Jim was in charge of CSURF - Colorado State University Research Foundation - and was also a good friend of the program. Jim recalled in later years how Bob was always after him to waive overhead on some project or other and, if memory serves us correctly, he usually did!

From the very start, Bert Goodell was a special lecturer from the Rocky Mountain Forest and Range Experiment Station, assigned by Director Ray Price to the Watershed Unit. Bert obtained his Ph.D. in the Program in 1963 and remained as a core staff person until early seventies. Bert was an excellent researcher and in his quiet, unassuming way played a very important role in guiding graduate students. He was particularly interested in energy budget studies and the concentration of dissertations and theses in this area is a direct result of Bert's influence. His own dissertation was on developing a totalizer of solar and thermal radiation and he received much good-natured kidding about his "pinball radiometers" because they involved an electric relay switch which sounded much like a roomful of pinball machines when he was testing them. Bert was a "Yankee tinkerer" from New England and loved to develop instrumentation. Another interest while at CSU was to develop a

dye dilution method of measuring streamflow in turbulent mountain streams. Bert had many admirable characteristics not the least of which was his wry sense of humor. He was a delight to work with as well as to learn from. Bert and Jim Meiman worked closely together on obtaining research funding from the U.S. Bureau of Reclamation. This support lasted over a 5-year period and was the direct result of the personal interest of Mr. Hollis (Sandy) Sanford of USBR.

Bernard Frank came as Professor in March, 1960. Bernie retired from the Division of Watershed Management Research of the U.S. Forest Service. His stature in the field of watershed management is reflected in the fact that he wrote the lead article in the 1955 Yearbook of Agriculture-Water. He brought great enthusiasm and much experience and was a stimulating lecturer. Among his many experiences was his work on the Rock Creek Watershed in the Washington D.C. area. Bernie was outgoing and very articulate, and strengthened the policy and administrative aspects of the program. He remained a vital part of the teaching program until his death in 1965.

In January 1962, Jim Meiman was hired as a lecturer while still working on his Ph.D. Jim completed his Ph.D. in June of '62 and stayed on with the Department until 1975 when he became Dean of the Graduate School. Jim added a laboratory section to the applied watershed course, developed the snow hydrology course and research programs, expanded the Little South research program, and generally filled in for Bob in his absence on foreign trips and promotional activities in behalf of the program. He was also instrumental in starting research on wildland water quality working with Sam Kunkle and others in the Little South. Jim had worked for the U.S. Soil Conservation Service in Kentucky on the Small Watershed Program before coming to Colorado. He learned of the new Watershed Unit at CSU by reading an article in the Journal of Forestry and decided to head west in the summer of 1959. Because there were no summer courses, Bob arranged for Jim to work for Neil Rahm and Walt Poole at the U.S. Forest Service in Region 2 on watershed rehabilitation planning. This led to summer employment opportunities for over a dozen watershed students over the next several years. Jim's interests were field-oriented and he maintained close working relationships with the USFS, SCS, USBR, and USGS. He also served as President of the Colorado chapter of the Soil Conservation Society of America and was on the National Academy of Sciences Snow and Ice Committee.

Kendall L. Johnson began as assistant Professor in September, 1964 before receiving his Ph.D. in the program in 1965. Ken had degrees in Range and English literature and liked to tell how he used to work summers on range jobs and sit on his horse along the highway and pose for tourists as a "real cowboy". He led the efforts of the watershed analysis class on the Little South Poudre - probably the best watershed analysis class report in the series. He also worked on improving the watershed policy

course. His research interests were focused on erosion of grazed lands in the Upper Hourglass watershed. Ken left in 1967 to enter private business and later went on to Utah as Extension Range Scientist.

Dave Striffler arrived in Fort Collins in late August, 1966 and unloaded his household goods in Bob Dils' garage. Dave had been one of Bob Dil's watershed students at the University of Michigan and received MS and PhD degrees from Michigan. He came to CSU with research experience with both the Lake States and Central States Forest and Range Experiment Stations. Dave recalls seeing smoke in the Pingree Park area from the Comanche Burn - an area he would later conduct some of his first research at CSU along with three graduate students, Phil Delp, Mustafa Kilinc and Show-Chyuan Chu. Dave remembers using our old worn out jeep and Mr. Chu would sit on the hood. They called him their Chinese (Taiwan) hood ornament! Dave's early research included fire impact, alpine erosion, and hydrologic studies on the Pawnee Grasslands. Dave also developed new courses on evapotranspiration and watershed measurements. He stayed with the program until his retirement in 1991 and, along with Freeman Smith who joined the program in 1972, provided continuity after both Bob Dils and Jim Meiman moved to Dean's positions. Dave recalls the many good times when the Watershed Unit was joined with Recreation Resources and an "Epicurean and Philosophical Society" was formed by Art Wilcox to bring the two groups closer together. Dave became the official wine taster for that group. Dave and Chuck Maloney from Recreation Resources shared an office that first quarter.

Two new personalities entered the scene at this time - Art Wilcox and Barbara Spencer. Art, an Outdoor Recreation specialist, was named head of the Department of Recreation and Watershed Resources, newly created in 1966, which merged the Recreation Department and the Watershed Coop Unit. Because of his jovial ways and tremendously helpful personality he was nicknamed the "Jolly Green Giant". Barbara was secretary for the watershed program and did a great job in the almost impossible task of "filling the shoes" of Clare Grace. Both Art and Barbara made what could have been a difficult association a very pleasant one. The other members of Recreation Resources, including Chuck Mahoney, Bernie Held, Duane Miller, and Stu Case also helped to make this somewhat unusual "marriage" a happy one. Bob Dils was now serving as Associate Dean and Jim Meiman was in charge of the watershed program.

Art Wilcox was a very congenial Department Head and relations with the Recreation faculty were very cordial, especially when we held faculty meetings at the Black Knight restaurant on S. College. Art organized the Epicurean and Philosophical Society which met once a quarter at a restaurant within driving distance of Fort Collins. The destination would not be revealed until we arrived. The Society was more epicurean than Philosophical.

Vaughn Noonan joined the watershed program as technician in 1967. He was a great help both on the Little South field program and in the Department in general. He had great patience with the sometimes "wild" faculty and students and their research escapades. Vaughn retired in 1977.

Two new faculty were added in 1968, Drs. Leo Teller and Lee Miller. Leo came from FAO in Rome and added an international flavor to the faculty. His interests were in water quality and he added a new course in that area and strengthened the research program by participating in the San Juan Weather Modification Project. Leo had a great sense of humor and a great rapport with students. He stayed until 1974 when he took a position with the UNESCO MAB program. Lee Miller came with a background in remote sensing and started the program which eventually would grow when the new Earth Resources Department was formed in 1973. Lee obtained an NSF Program Development Grant which provided equipment for the program and led to the employment of Jim Smith and Gene Maxwell. Lee stayed with CSU until the early 70's.

Walter Gartska joined the faculty on a part time basis in the late 60's. Walt was retired from the Bureau of Reclamation and had broad experience in a number of land management and water resource agencies. Walt had participated in many pioneering water projects in the Western Region and brought a unique historical perspective as well as hydrologic expertise to the program.

Bill Marlatt transferred to the watershed group in 1969 from the Atmospheric Science Dept. and became the first department head of the new Watershed Sciences Department in 1970. Bill brought a background in both natural resources climatology and remote sensing. Bill had great enthusiasm and worked well across disciplines. His imprint on programs would remain for many years and he was to guide the transition from a watershed focus to an expanded new Earth Resources Department in 1973 with graduate programs in watershed science, geology, remote sensing, and air resources management. The merger with the former Geology Department gave us sharply enlarged undergraduate programs in both watershed and geology. Bill's research focused on bioclimatology and air resource management. The department's course offerings were expanded to include undergraduate and graduate courses in both of these fields. In 1971 he began a new course in environmental impact assessment which became known as one of the best courses in the college to help students find jobs in the 1970's and 80's.

Freeman Smith joined the program in 1971. He received his Ph.D. from the watershed program specializing in modeling and ecosystem processes and worked closely with the IBP Grassland Ecosystem Program over many years. When he joined the faculty he inherited the Watershed Principles course from Bob and went on to the develop new courses in watershed systems and modelling. He was also the key person from the Department in all-college

natural resource management courses. Freeman took a special interest in foreign students and more than 1/2 of his many graduate students over the years have been those from other countries. He has many memories of those early years but recalls the strong leadership Bob provided in making the Watershed program the best known all around the world. His favorite memory as a graduate student was the close association with fellow graduate students in the "bull-pen" offices in the basement of the Morgan Library.

Dr. Jim Smith arrived in September 1971 to augment the remote sensing program. Jim had a great sense of humor and began a productive career of teaching, research, and grad student advising with great enthusiasm. Jim and the remote sensing program were transferred to the Forestry Department in 1978.

IV. RESEARCH PROGRAM

a. General

During the first 15 years (through 1973) there were 37 Ph.D.s awarded, (Appendix Table 1). These ranged over a dozen different topical areas but are concentrated in four general areas: 1) vegetation and water relationships, 2) soils, 3) snow hydrology, and 4) energy balance studies. These same concentrations appear in the 53 master's theses (Appendix Table 2) with the addition of water quality. These dissertations and theses reflect the interests of the faculty during this period with the provision that there was considerable flexibility to accommodate student interests to the extent possible.

Funding for research came from multiple sources including federal, state, local and private. After the funding by the Pack Foundation the next most sustained support came from the U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station (RMFRES). The Station provided the full time services of Bert Goodell after he received his Ph.D. in 1968. Bert was a tremendous help to the research program because of his many years of experience as well as his great personality in working with graduate students. In addition to Bert, others from RMFRES gave much of their professional expertise including Marvin Hoover, Dudley Love, Jake Kovner, and Pete Martinelli. In addition to professional services the RMFRES also provided logistical support to faculty and students at the Fraser Experimental Forest and occasionally provided some direct financial assistance for specific studies.

The other major source of support during these early years was from the U.S. Bureau of Reclamation, Division of Irrigation Operations. Mr. Hollis "Sandy" Sanford took a real interest in watershed work. Support included studies on the dye dilution technique of measuring streamflow, snow management, energy and water balance studies in lodgepole pine, and feasibility studies on applying forest management for water yields on USBR project areas. These research projects supported both Ph.D. and M.S. students supervised by Bert Goodell and Jim Meiman.

In the very first years of the graduate program Bob was major professor for all theses and dissertations. After Jim and Bert Goodell came on board Bob tended to take the soils, social, economic, and more broadly based research projects. Jim began to focus a program in snow hydrology and water quality studies while Bert focused a number of students on energy budget and water balance studies on forest lands and also on dye dilution techniques to measure streamflow.

Both Kendall Johnson and Dave Striffler were interested in grazed lands. Kendall began a study of erosion from alpine grazing lands. Dave continued these studies when Kendall left and also became involved in the newly-blossoming IBP Grasslands

Ecology Program. Dave also had a strong interest in soils and conducted several studies on the effects of fire. This was stimulated by the Comanche Burn in the Little South Watershed in 1966.

Although Jim and Sam Kunkle started the first water quality research in 1965, Dr. Leo Teller expanded both research and teaching programs in water quality when he arrived in December 1968. In 1969, Jim was approached by the Bureau of Reclamation to work with the University of Colorado and Fort Lewis College on a large weather modification impact study. Because Jim was leaving for a sabbatical in Switzerland that December, he turned over the study to Leo. Leo stayed with the San Juan Weather Modification Program for his entire stay at CSU and supported his own research and that of a number of graduate students. The San Juan Program was under the leadership of Dr. Jack Ives at the University of Colorado. Dr. Don Klein from the CSU Department of Microbiology also worked closely with Leo on this project.

In 1969 a whole new thrust was added to the watershed program when Dr. Lee Miller joined the program. Lee was trained in remote sensing and immediately began watershed studies using that tool. This area of concentration was further strengthened in July, 1970 when Dr. Bill Marlatt transferred to the watershed group from Atmospheric Sciences. Bill added strength to the research program in both remote sensing and microclimatology. Clifford Harlan, Douglass Cameron, and Robert Pearson show up as the first Ph.D.s in these new programs.

Freeman Smith received his Ph.D. from the Watershed program and began on the staff in January of 1971. Thus his influence on graduate students is not yet reflected in the listings for the first 15 years. Freeman brought a strong background in watershed hydrology and modeling plus experience with rangelands to the research program and was to become the principal person working with foreign graduate students in the future watershed program.

b. Little South Studies

During the 1960's a research program was conducted in the Little South Poudre Watershed with headquarters at Pingree Park. Weather stations were established to get year around data at Pingree and at Quigley Mountain just across from the Greeley Water Company cabin and east of the main Pingree Road. Snow courses were established at Cirque Meadows and at Sheep Saddle just off the Bennett Creek Logging Road at the point where a small road was constructed to reach the upper Little Beaver streamgage. The U.S. Geological Survey operated gages at Fall Creek (Cirque Meadows), Main Little South, Upper Little Beaver, and Lower Little Beaver. All but the Main Little South gage were installed as part of a cooperative agreement between CSU and USGS. In addition gages were added in cooperation with the U.S. Forest Service on Fish Creek, Pennock Creek, Upper Hourglass,

Lower Hourglass, and on either side of the Hourglass Snowfield.

In the first years, measurements and service trips were usually done on weekends with students helping. Generally this involved an overnight stay at Pingree. The northernmost end student cabin was insulated and used. Water was obtained from the Little South, often by digging through snow and ice. Our first acquaintance with giardia occurred when Bob came down with it on one of these trips, perhaps because we did not boil the water adequately! In time we convinced Dean Clint Wasser that we needed a research lab and, although there was no money, Clint reluctantly let us draw up some plans. It turned out there was a little money available in the Fall of 1967 so we decided to pour the footings and before we knew it and with help from Physical Plant, the building was completed including a garage for an oversnow vehicle and a self contained well. This was a great lesson - always have a plan!

Transportation at first was on snowshoes or skis from the vicinity of the Lazy D ranch. There was usually a large snow drift that stopped us there but then the road would be open another mile or so - very frustrating. We drove to the Lazy D in an army surplus 4x4 truck furnished by Tom Borden of the State Forest Service. Since it had no heater and only a canvas top we would take along a catalytic burner for warmth. After several years we purchased an early model Polaris snowmobile. It was next to worthless as it was hinged in the middle and the heavy rear-engine part was always sinking into the snow. There is a classic photo of R.A. Schmidt and Howard Wertsbaugh administering the coup de gras with a pistol to a stuck Polaris. Later we obtained a Kristi oversnow vehicle which was enclosed with heater and leveling hydraulics and we thought then that we were "really living".

On the subject of snow vehicles, Leo Eisel tells the story when he and Howard Wertsbaugh, both undergrads at the time, went to the basement of the Administration Building to obtain a gallon of ethanol to use as starting fluid. Leo doesn't think any ethanol ever made it to the carburetors but does remember various exotic liquid refreshments in the cabin at Pingree.

Fred Beauvais, another undergrad at the time, and now Senior Research Scientist in Psychology at CSU, remembers, ...

"The early years of data collection in the Little South drainage was part possible, and part barely possible. The latter, of course, was what was required in the winter and the extreme difficulty would not be admitted to by those who often took part. Bob Dils and Jim Meiman would indicate that weather data and snow pack measurements were needed and a group of us would take off and give it a try. Most data were collected as planned, some not.

Equipment consisted of what was available--some new, mostly

old, and all redolent of army surplus. Personal gear was mostly what each of us could bring to bear. These were the years prior to the revolution in outdoor clothing protection and by today's standards it was quite primitive: canvas for Gortex (60-40 cloth if you were lucky), kapok for Thinsulite, cotton for polypropylene and leather for most everything else, including boots--uninsulated of course.

The mainstay for the trips to the Little South was the Dodge Power Wagon. Its size and demeanor instilled confidence, not always deserved. Once it was started, there was no question it would get you where you needed to be--starting in town and starting on the mountain, however, was another thing. On the highway you felt more like a cattle driver, herding it down the road. But, once off of Highway 14 there was little question you would get where you needed to be.

Communications consisted of letting Jim know about when you would return to Ft. Collins. Beyond Ted's place there were a few phones and beyond the Pingree Park turnoff reliance was totally on "walkie-talkies". These depended, however, on the repeater being turned on at the West White Pine fire tower. To my knowledge this rarely occurred, and when it was you had to be in "line of sight". Good Luck!"

The Little South was pretty isolated in those days, Mrs. Koenig was at the home place just across the fence from the Pingree campus some of the time but only rarely did we see her there in the winter although on at least one occasion she came over to visit while we were there. King Koenig, who lived at the mouth of Pennock Creek (now the Hotchkiss cabin) was a different story. If he saw you coming he would run out to the road to visit and the visits were long since King had quite a propensity to quote scriptures. I am sure he was lonesome but we had either a full day ahead or behind us and were anxious to move on.

The other sometimes inhabitant was Les McCartney who worked for the Greeley Water Co., was a deputy sheriff and ran trap lines. Les would occasionally stay at the cabin near the Quigley weather station at the junction of the Old Flowers Wagon Road and the Pingree Road. If we happened to go to Pingree during the week instead of on a weekend we would sometimes run into the USGS technicians.

And yet another snowmobile story is the time Roger Hoffer went with Jim on a two person snowmobile and they turned it over on a steep sidehill. This is perhaps one of the reasons why Roger went into "remote" sensing instead of the direct version but Roger still values the field experience highly in his career formation even though he had to wear a damaged field jacket for many years thereafter as a result of the spill.

In December of 1967, Vaughn Noonan joined the staff as a

watershed technician and continued until his retirement in 1977. Vaughn was a tremendous help not only on the Little South Program but in supporting the total watershed research program. Vaughn was a quiet and unassuming person and never said much but you could sometime read in his expression "what will these crazy professors and students do next!" He was both a good helper and a good friend.

We installed four stream gages on Hourglass Creek and used everything from pack horses from the Lees over at Stove Prairie to helicopters to pack materials in. The helicopter required clearing around a small open meadow. Howard Wertsbaugh, Dave Falletti, R.A. Schmidt and Jim cleared a spot but each load the chopper pilot would give a signal to make it larger and so the crew would work frantically between loads to open up the "heliport". These were long hard days and each site was named after a different wine, for obvious reasons.

Installation of the lower Hourglass gage required a bulldozer and we were hauling one in with the USFS late one afternoon when we decided the bridge over Big Beaver Creek would not take the load. We all got busy cutting logs to build a new bridge and finally got the dozer delivered to the site very late at night. This was the night before Bob was to leave for New Zealand and it caused some degree of family friction. The incident illustrates the spirit of those days - much like that of the Seabees - no job was impossible!

The concept for the Little South Studies was that the watershed would serve as a common research area for many different disciplines and that this knowledge would reinforce the teaching program at Pingree and the main campus. Although the program never reached its full potential because of lack of funds, 69 theses and scientific publications on the Little South were produced in the period from the late 50s to the early 70s.

V. SUPPORTING INSTITUTIONS AND COOPERATORS

As already noted, the Rocky Mountain Forest and Range Experiment Station of the U.S. Forest Service played a major role in both the establishment and the continuance of the Cooperative Watershed Management Unit. The management arm (National Forest Administration) of the Forest Service contributed to the unit in a variety of ways. The Watershed Management Division of the regional office of the Forest Service in Denver was an active supporter of the units program under the direction of Neal Rahm, Tom Evans, Walt Pool and their staffs. Forest Service facilities were made available for both teaching and research activities. A succession of supervisors on the Roosevelt National Forest were particularly helpful in permitting the use of the Jacks Gulch area northwest of Fort Collins and the Comanche Peak area near the University's Pingree Park campus. In the latter case permission was granted for the unit to install two small stream-

gauging stations at the foot of a remnant but still-alive glacier. The Trout Creek area on the Pike/San Isabel National Forest was utilized on several occasions for student visits and training. This area provided an excellent example of early Civilian Conservation Corps watershed Management Practices.

The Bureau of Reclamation, under the leadership of Mr. Hollis Sanford, was a strong supporter of the Units Program. A series of grants to the Unit aided materially in establishing graduate assistantships, and in acquiring equipment for the weather stations at Pingree Park, a Bur-Rec grant partially funded a snow cat used for servicing the station and conducting snow surveys in the winter months.

Other early supporters of the program included the Denver Water Board, the City of Colorado Springs and the American Metals Climax Corporation (AMAX- or CLIMAX Molybdenum).

Mr. Felix Sparks, Head of the Denver Water Board, provided some early funds to the program and in addition, personally gave several guest lectures on the subject of water law. Similarly, the City of Colorado Springs, because of their concerns with the management of municipal watersheds made a grant to the program.

American Metals Climax (AMAX) Corporation had concerns regarding the stabilization of their spoil-banks at the molybdenum mine at Climax, CO. They provided a graduate research assistantship for several years for work on vegetative stabilization of these sits.

Of special importance were the contributions of the Rocky Mountain Forest and Range Experiment Station. During most of this early period, four watershed researchers contributed materially to the program through guest lecturing, serving on graduate student committees, and personally counseling staff and students. These were: Dr. Bertram C. Goodell, who was assigned by the station to work with the unit and who later to become a faculty member of the unit; Marvin D. Hoover, Director of Watershed Management Research; Dr. Mario (Pete) Martinelli, who headed up the Snow and Avalanche Research; and Burchard Heede whose research was concentrated on soil erosion.

The employment of Hans Frutiger of Davos, Switzerland serves as another example of productive cooperation between the Experiment Station and the Watershed Unit. Mr. Frutiger was a forest engineer with the Swiss Snow and Avalanche Research Institute and a world authority on avalanche control. Although the Forest Service felt a strong need for consultations with an outside expert in this field, administrative restrictions make it virtually impossible for them to employ such foreign consultants. There were no similar restrictions on CSU or on the Unit in this regard, as Mr. Frutiger was employed by them with some financial aid being supplied as a grant from the Station. Mr. Frutiger worked tirelessly and effectively for both entities during his

year in the United States. From the outset, the Watershed Management Unit was a cooperative undertaking in every way.

One of the more interesting stories in the history of the Unit was the day we received a phone call from Hans indicating he had been "captured" by the U.S. Army. It turns out he was skiing around Camp Hale observing (avalanche) "installations" and there was some kind of very secret activity apparently underway there. We often joked that Hans was probably the only Swiss ever captured by the U.S. Army!

VI. THE INTERNATIONAL DIMENSION

Several international agencies and U.S. agencies with strong international interests had begun to recognize their growing needs for professionals trained in the various aspects of world-wide watershed management. Among these agencies were the Food and Agriculture Organization of the United Nations, the World Bank and the Agency for International Development of the U.S. State Department. These internationally-oriented concerns were cited in the press release announcing the establishment of the Cooperative Watershed Management Unit at C.S.U.

From the beginning, training personnel to address international needs and interests in the area of watershed management was a goal as important as was the training directed toward the solution of problems at state, local or national levels. For this reason, Bob embarked on a series of overseas travel designed to explain what the new curriculum had to offer and how these trained in it could help with watershed management concerns at any level, in any country.

In 1961, a travel grant from the Society of American Foresters and the National Science Foundation made it possible for him to participate in the meeting of the International Union of Forest Research Organizations in Vienna, Austria. This meeting and subsequent post-meeting visits to Switzerland and Germany led to contacts with Dr. Hans Kurth and Hans Keller of the Swiss Forest Research Institute and with Hans Frutiger of the Swiss Snow and Avalanche Research Institute. In Germany, Bob became acquainted with Dr. Gilbert Baumgartner, German Forestry Research, Munich and, in Austria, with John Morris of the New Zealand Forest Experiment Station and with Talat Eren, Head of Watershed Management for FAO, United Nations. Each of these contacts resulted in official visits to CSU by scientists from those countries. In addition the marked increase in enrollment of graduate students from these and other foreign countries helped the Unit become more international in scope each year.

In 1963 Bob served as a consultant to the Chinese American Joint Commission on Rural Reconstruction (JCRR) in Taiwan for USAID. Ted Sheng was Bob's counterpart in Taiwan and later returned to get his Master's degree in the program and still later, after his FAO retirement, joined the faculty. In 1964-65 he spent most of a year in New Zealand (including visits to Australia and the Antarctic) as a Fulbright Research Scholar with the Tussock Grasslands and Mountain Lands Institute.

Other short-term consultancies and international meetings which provided foreign contacts in watershed management included Argentina in 1968 (with additional visits to FAOLUN watershed projects in Peru, Columbia and Costa Rica). FAO projects in Guatemala, El Salvador and Mexico were also visited. In 1970, Bob attended the FAO/UN-USSR Seminar on Forest Influences and

Watershed Management which was held in Moscow.

The international flavor of the basic Watershed Management program in Fort Collins was enhanced in 1968 when Dr. H. Leo Teller joined its faculty. Dr. Teller came to the University from a staff position with the Watershed Division of FAO/United Nations. He was educated in Australia and worked there before going to the FAO/UN in Rome, Italy. Fluent in several languages, Dr. Teller's contributions to the unit were unique.

In the late 1960's Bob was invited to give a series of lectures on watershed management to students and faculty at the University of the Andes in Merida, Venezuela. The visit led to a continuing cooperative effort in forestry, outdoor recreation and watershed management between the two institutions. Subsequently both Jim Meiman and Leo Teller visited the University of the Andes to offer guest lectures and/or to teach courses in watershed management. In the early 1970's Dr. Ramon Masini-Osuna, President of the University of the Andes, visited Colorado State University and he and CSU President Ray Chamberlin formalized a cooperative arrangement between the two institutions.

In the early seventies the College of Forestry and Natural Resources participated in a Peace Corps Support Program for volunteers in Peru and Venezuela. Gil Fechner (Forestry) and Jim Meiman visited Peace Corps volunteers in those two countries to provide technical backstopping in forestry and natural resources. Also in the early seventies, Freeman Smith began accepting large numbers of foreign graduate students, a practice he has continued throughout his career.

Hans Keller, after completing a master's degree at CSU returned to Switzerland to head up watershed research at the Swiss Forest Research Institute. He subsequently completed his doctoral degree in Switzerland and in 1974 returned to CSU as a visiting Professor of Watershed Management. Dr. Keller's untimely death in an avalanche accident in Switzerland in 1994 cut short an outstanding career which always had close ties with the Cooperative Watershed Management Unit in Colorado.

In addition to the graduate students from other countries who were listed earlier in this account, there were a large number of foreign visitors who came to the unit for official visits or for the purpose of taking a specific watershed management course or courses. Many came under the auspices of the FAO/United Nations or the US/AID Program. Some were sent by their home countries. All were involved in some aspect of watershed management or in a closely related science. Each of these visitors added a great deal to the international emphasis of the program. Although it is not intended to be complete, the partial list below indicates the wide range of international participation.

Karin Djavanshir	Iran
Teja Singh	Pakistan
John C. Rodda	England
Dr. Edson Potsch	Brazil
Dr. Yooichi Noguchi	Japan
Lance W. McCaskill	New Zealand
Ed Y L Lin	Taiwan
Dr. Salem Al Lozi	Jordan
Dr. M. Said Kettaneh	Iraq
C.C. Koh	Taiwan
Peter John	New Zealand
Dr. Alec Costin	Australia
Dr. Turnan Istanbulu	Turkey
Gordon Hunt	New Zealand
A. Necot Gulgun	Turkey
Dr. Israel Gindel	Israel
Alan R. Frampton	New Zealand
Tov Ashbel	Israel
Elmisani Elmadi	Libya
Chin Kwei Chien	Taiwan
Lewis Campbell	Trinidad, WI
Luis Santiago Botero	Colombia
Bjan Bavandi	Iran
Gumersindo Borgo	Mexico
Jose Bucarey	Chile
Dr. Albert Baumgartner	Germany
John Y. Morris	New Zealand
H.N. Harvey	New Zealand
Dr. Ramon Masini-Osuna	Venezuela
Dr. Pei	E. Africa

Thus, the international objectives of the program have been met successfully. The earlier efforts documented here have continued and have led to further international cooperative activities on the part of a number of our U.S. students and many of the subsequent watershed management faculty members.

APPENDIX TABLE 1

Ph.D.'s in Watershed Science 1961 - 1973

Black, Peter E. - 1961
Timber and Water Resources Management - A physical and Economic Approach.
Advisor: R.E. Dils

Hoffer, Roger M. - 1962
Regime of solar and thermal radiation in relation to density of LP stands.
Advisor: R.E. Dils

Lee, Richard - 1962

Relationships between potential insolation and the orientation of watersheds with respect to evapotranspiration.

Advisor: R.E. Dils

Meiman, James R. - 1962

Influence of coarse fragment on soil moisture and soil temperature.

Advisor: R.E. Dils

Goodell, Bertram A. - 1963

Development and application of an inexpensive totalizer of solar and thermal radiation.

Advisor: R.E. Dils

Jones, E. Bruce - 1964

Some aspects of ground-water development and management in the northern high plains.

Advisor: R.E. Dils

Johnson, Kendall L. - 1965

An analysis of state regulations of surface-groundwater development and use in Colorado.

Advisor: R.E. Dils

Tabler, Ronald D. - 1965

Soil moisture response to spraying big sagebrush(AT) with 2,4-D.

Advisor: B.C. Goodell

Hair, R. Dennis - 1966

Influence of intercepted water on evapotranspiration losses from small pott.

Advisor: B.C. Goodell

Zurich, Theodore M. - 1966

Stream hydrography by florescent dyes.

Advisor: Goodell, B.C.

Heed, Burchard H. - 1967

Gully development and control in the Rocky Mountains of Colorado.

Advisor: R.E. Dils

Kunkle, Samuel H. - 1967

Sampling bacteria in a mountain stream.

Advisor: J.R. Meiman

Schmidt, Ralph A. Jr. - 1967

Wind flow over alpine ridges

Advisor: B.C. Goodell

Settergren, Carl D. - 1967

The effects of fire on wildland hydrology

Advisor: R.E. Dils

Hawkins, Richard H. - 1968
Water projects and watershed treatment
Advisor: R.E. Dils

Hubbard, John E. - 1968
Cesium-137 in an alpine watershed
Advisor: W.D. Striffler

Jeffrey, Walter W. - 1968
Hydrologic significance of stand density variations in Alberta
Lodgepole Pine forests.
Advisor: R.E. Dils

Megahan, Walter F. - 1968
Increasing snowmelt rate by surface additives
Advisor: J.R. Meiman

Slaughter, Charles W. - 1968
Snow evaporation retardation by monolayers
Advisor: Meiman, J.R.

DeWalle, David - 1969
Disposition of late lying snowpacks in forests of
Colorado Rockies
Advisor: Meiman, J.R.

Froehlich, Henry A. - 1969
Forest snow accumulation factors in the Colorado Front Range
Advisor: Meiman, J.R.

Leaf, Charles - 1969
Snowpack depletion and runoff in Colorado
Advisor: Meiman, J.R.

Rango, Albert - 1969
Possible effects of precipitation modification on selected
watershed parameters
Advisor: Dils, R.E.

Rice, Raymond M. - 1969
Storm runoff from chaparral watershed
Advisor: R.E. Dils

Zoghet, Mouine F. - 1969
Alpine surface soil movement
Advisor: R.E. Dils

Judy, Clark H. - 1970
Deuterium and snow hydrology
Advisor: J.R. Meiman

Steppuhn, Harold W. - 1970
A system for detecting fluorescent tracers in streamflow
Advisor: Goodell, B.C.

Burroughs, Edward R. - 1971
Short-wave reflectivity of lodgepole pine
Advisor: Meiman, J.R.

Galbraith, Alan F. - 1971
The soil water regime of a shortgrass prairie ecosystem
Advisor: W.D. Striffler

Harlan, J. Clifford, Jr. - 1971
Haze effects of infrared remote sensing on the tropical
North Atlantic
Advisor: W.E. Marlatt

Krygier, James T. - 1971
Comparative water loss of Douglas Fir and Oregon white oak
Advisor: R.E. Dils

Sheppard, John S. - 1971
The influence of geothermal temperature gradients upon vegetation
patterns in Yellowstone National Park
Advisor: L.D. Miller

Smith, Freeman M. - 1971
A volumetric-threshold infiltration model
Advisor: Van Dyne/Striffler

Cameron, Douglas R. - 1973
Modeling silver transport in the soil
Advisor: J. Smith

Currier, John B. - 1973
Water quality effects of logging residue decomposition from
lodgepole pine
Advisor: H.L. Teller

Leavesley, George H. - 1973
A mountain watershed simulation model
Advisor: W.D. Striffler

Pearson, Robert L. - 1973
Remote sensing biomass
Advisor: L.D. Miller

APPENDIX TABLE 2

M.S. Degrees in Watershed Science 1960 - 1973

Hoffer, Roger M. - 1960

Relationships between transmission of insolation and characteristics of Lodgepole Pine stands

Advisor: R.E. Dils

Brown, George W. III - 1961

Some physical and chemical soil properties as possible causes of piping erosion

Advisor: B. Frank

Hawkins, Richard E. - 1961

A Study to Predict Storm Runoff from Storm Characteristics and Antecedant basin conditions

Advisor: R.E. Dils

Berndt, Herbert W. - 1962

A reconnaissance study of the influence of clear-cut block size on snow accumulation and melt in the Big Horns

Advisor: R.E. Dils

Frank, Earnest C. - 1962

Correlations between physiographic factors and annual streamflow

Advisor: R.E. Dils

Hutchinson, Boyd A. - 1962

Evaporation from snow and soil surfaces - a comparative study

Advisor: R.E. Dils

Barnett, Loyd O. Jr. - 1963

Storm runoff characteristics of three small watersheds in Western Oregon

Advisor: B. Frank

Hansen, Edward A. - 1963

Advisor: R.E. Dils

Keller, Hans M. - 1963

Some ecological relationships of a mountain watershed

Advisor: R.E. Dils

Tischendorf, Wilhelm G. - 1963

An evaluation of infiltration theory and methods

Advisor: R.E. Dils

Bruce-Okine, Emmanuel - 1964

A watershed management program for Northern Ghana

Advisor: R.E. Dils

Maloney, Ralph C. - 1964

Some effects of fire and lands use upon hydrologic characteristics of a central Sierra watershed

Advisor: R.E. Dils

Ohlander, Coryell A. - 1964

Effects of rehabilitation treatments on the sediment production granitic road material

Advisor: R.E. Dils

Ritchey, Norman C. - 1964

A multiple use plan for the Little South Fork of the Cache la Poudre River basin

Advisor: J.R. Meiman

Chunkao, Kasem - 1965

A comparison of methods for evaluation aggregate stability of mountain soils

Advisor: J.R. Meiman

Grubb, Hayes F. - 1965

The feasibility of vegetating mine tailings at Climax, Colorado

Advisor: J.R. Meiman

Ollman, Ralph H. - 1965

Cloud formation and storm movement over the Little South Cache la Poudre Watershed

Advisor: J.R. Meiman

Sheng, Tse Cheng - 1965

Development of a landslide classification for mountain watersheds of Taiwan

Advisor: R.E. Dils

Watt, James P.C. - 1965

Development of the dye dilution method for measuring water yields from mountain watersheds.

Advisor: J.R. Meiman

Fleming, William M. - 1966

Geohydrology of a mountain peat wetland

Advisor: J.R. Meiman

Haiges, Manfred L. - 1966

Hydrologic analysis of the Rattlesnake drainage

Advisor: R.E. Dils

Holtje, R. Kenneth Jr. - 1966

Hydrologic trends of the Brandywine Creek, Pennsylvania

Advisor: R.E. Dils

Juneidi, Mahmoud J. - 1966
Proposed workplan for Ziglab Watershed in Jordan
Advisor: J.R. Meiman

Swanson, Robert H. - 1966
Wood moisture measurement above fiber saturation - a dielectric
method
Advisor: R.E. Dils

Brechtel, Horst M. - 1967
Chemical Totalizer of radiation
Advisor: B.C. Goodell

Kunkle, Samuel H. - 1967
Water quality of a mountain watershed in Colorado
Advisor: J.R. Meiman

Siverts, Leaf E. - 1967
Application of the dye dilution technique to periodic summations
of streamflow from mountain watersheds
Advisor: B.C. Goodell

Chu, Show-Chyuan - 1968
Development of water resources in Tachia River Basin
Advisor: R.E. Dils

Delp, Phil G. - 1968
Soil movement following an intense burn
Advisor: W.D. Striffler

Elson, Thomas E. - 1968
The Federal-State water rights controversy
Advisor: R.E. Dils

Khan, Abdur Rahman - 1968
Watershed conditions, problems and research needs in West
Pakistan
Advisor: R.E. Dils

Kilinc, Mustafa Y. - 1968
The effects of wildfire on soil properties
Advisor: W.D. Striffler

Meyers, Alan E. - 1968
Mountain water pollution from road reconstruction and wildfire
Advisor: J.R. Meiman

Murray, David L. - 1968
Calibration of Little Beaver Watershed
Advisor: R.E. Dils

Reid, James E. - 1968
Snowmelt indexes for small mountain watersheds
Advisor: J.R. Meiman

Roark, Phillip W. - 1968
Watershed management in the underdeveloped countries
Advisor: R.E. Dils

Dourojeanni, Axel C. - 1969
Hydrologic soil study of an alpine watershed
Advisor: J.R. Meiman

Richardson, Stuart - 1969
Physical-chemical and radiation properties of mountain streams
Advisor: W.D. Striffler

Spangenberg, Norman E. - 1969
Partitioning and hydrologic process models in watershed yield models
Advisor: W.D. Striffler

Swift, David M. - 1969
Summer precipitation and streamflow
Advisor: J.R. Meiman

Wheeler, Richard H. - 1969
Preliminary evaluation of the Anaconda industrial watershed
Advisor: R.E. Dils

Hernandez, Edgar A. - 1970
Application of a water balance model to tropical watersheds
Advisor: H.L. Teller

Ramirez-Rivera, Jaime - 1970
Process, prediction, and measurement of soil loss from watersheds.
Advisor: H.L. Teller

Wolff, Delbert Noel - 1970
Grassland infiltration phenomena
Advisor: W.D. Striffler

Chang, Tien-po - 1971
Landslide investigation techniques
Advisor: R.E. Dils

Haeffner, Arden D. - 1971
Photogrammetric analysis of snow cover
Advisor: J.R. Meiman

Pearson, Robert L. - 1971
Design of field spectrophotometer lab
Advisor: L.D. Miller

Ross, Richard N. - 1971
Snow and soil water response to logging
Advisor: J.R. Meiman

Sanchez, Maria P. - 1971
An evapotranspiration study in Paraguay
Advisor: H.L. Teller

Davis, Ronald - 1972
Strip mining effects on water quality
Advisor: H.L. Teller

Kuehn, Michael H. - 1972
Acid rain and conifer seedlings
Advisor: W.D. Striffler

Bassett, Richard H. - 1973
Beaver pond hydrology
Advisor: W.D. Striffler

Dietrich, Thomas L. - 1973
Hydrologic effects of patch cutting in Lodgepole Pine
on the eastern slope, Front Range.
Advisor: J.R. Meiman

Hornung, Richard J. - 1973
The measurement of snowfall rates using long path radiation
attenuation
Advisor: W.E. Marlatt

Oliver, Robert E. - 1973
Vegetation canopy reflectance models
Advisor: J. Smith

Tucker, Compton J. - 1973
The remote estimation of a grassland canopy
Advisor: J. Smith

APPENDIX TABLE 3

B. S. Degrees in Watershed Science
1959 - 1973

1959 Elson, Thomas E.
1959 Swanson, Robert H.
1959 Tabler, Ronald D.
1960 Barnett, Loyd O. Jr.
1962 Ohlander, Coryell A.
1962 Schmidt, Ralph A. Jr.
1963 Falletti, David A.
1963 Siverts, Leaf E.
1963 Wertsbaugh, Howard L.
1964 Eisel, Leo M.
1964 Meyers, Alan E.
1964 Oldemeyer, John L.
1964 Stender, Peter J.
1965 Bennett, Charles M.
1965 Corner, Roger M.
1965 Eikerman, Gary H.
1965 Harper, Warren C.
1965 Owen, John R. Jr.
1965 Sanders, Larry K.
1966 Batten, Alan R.
1966 Delp, Phil G.
1966 Harnish, Charles E.
1966 McKim, Gerry C.
1966 Schiefer, Randall N.
1967 Aygarn, Ronald S.
1967 Borchert, William B.
1967 Fisher, James C.
1967 Larsen, Jan A.
1967 Levin, Edward D.
1967 Lynn, Robert E.
1967 Rahm, Gary N.
1967 Scholz, Kenneth R.
1968 Conklin, Calvin A.
1968 Crist, Charles
1968 Fritz, Gary
1968 Lappala, Eric G.
1968 Livingston, Russell K.
1969 Holt, William Kent
1969 Kilpatrick, Robert F.
1969 Lester, Frank W. Jr.
1969 McClelland, Patrick F.
1969 Renoux, Edward R.
1969 Russell, Robert A.
1969 Schiefer, Michael C.
1969 Troyer, Jack G.
1969 Worsham, E. Lee
1970 Jardine, Ronald G.
1970 Keiser, Merrill S.

1970 O'Hayre, Arthur P.
1970 Sundberg, Eric
1971 Hohmann, Kenneth
1971 McCammon, Bruce P.
1971 Olsen, Stephen
1971 Tarum, Roger D.
1971 Wergowske, David J.
1972 Bonham, Jack D.
1972 Jackson, Patrick D.
1972 Kornfeld, John E.
1972 Marron, James K.
1972 Ransom, Jon K.
1972 Seaholm, Dwight R.
1972 Smith, Jeffrey P.
1972 Strom, Donald E.
1973 Bailey, Thomas P.
1973 Brock, Terral V.
1973 Chavez, Lee
1973 Elsea, William J.
1973 Fifer, R. Scott
1973 Hanes, William T.
1973 Inglis, Richard R. II
1973 Jones, Stanley K.
1973 Pyles, Phillip B.
1973 Retzlaff, Michael F.
1973 Rosenbach, Jay A.
1973 Sanger, Donald E.
1973 Shannon, Richard H.
1973 Trevithick, Douglas D.
1973 Waltemeyer, Scott D.
1973 Weaver, C. Wesley

APPENDIX TABLE 4

Special Students in Watershed Management

1959-60	John Nishimura, USFS, Region 2
1961-62	Orhan Baykal, Turkey Abdul F.S. Hasso, Iraq
1962-63	Faruk Gunay, Turkey John P. Hess, USFS, Region 6 In Ho Lee, Korea K.M. Subbayya, India
1963-64	Arminio Gericke, Italy Orhan Kutahyali, Turkey Charles Kirby, Canada
1964-65	Nicholas Papamichos, Greece Ta Chun Peng, Taiwan
1965-66	Rashid Mahmood, Pakistan Vicente Veracion, Philippines
1966-67	Safdar Ali, Pakistan Hikmet Galioglu, Turkey Abdur Rahman Khan, Pakistan
1967-68	Chin-Kwei Chien, Taiwan
1971-72	Necdet Ozuvaci, Turkey Kai-Shun Yeh, Republic of China

