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January 1977

Proposal to Technology Transfer Office of Water Research and Technology U.S. Department of Interior


C. Earl Israelsen

Frank W. Haws

Donna H. Falkenborg

L. Douglas James

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Proposal
to
Technology Transfer
Office of Water Research and Technology
U.S. Department of Interior

TECHNOLOGY APPLICATION

Submitted by
Utah Water Research Laboratory
College of Engineering
and the
Utah Center for Water Resources Research
Utah State University
Logan, Utah

May 1977

99958

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Proposal

to

Technology Transfer
Office of Water Research and Technology
U.S. Department of Interior

Title: Technology Application

Submitting Agency: Utah Water Research Laboratory and the Utah Center for
Water Resources Research, Utah State University, Logan, Utah 84322

Desired Starting Date and Duration of Project:

October 1, 1977 through September 30, 1979

Amount of Federal Funds Requested:

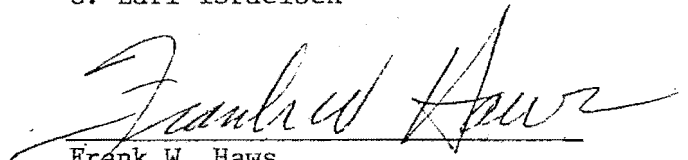
1st year - \$30,000

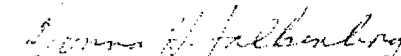
2nd year - \$30,000

Approved:

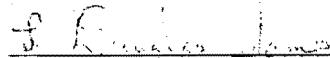
Principal Investigators


C. Earl Israelsen

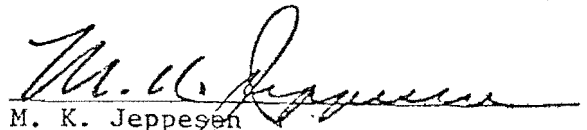

Frank W. Haws


Donna H. Falkenberg

Director, Utah Water Research
Laboratory and Chairman, Utah
Center for Water Resources
Research


L. Douglas James

Contracts Officer, Utah State
University


M. K. Jeppesen

EXECUTIVE SUMMARY

Proposal Title: Technology Application

Principal Investigators:

C. Earl Israelsen--Associate Professor of Civil and Environmental
Engineering

Frank W. Haws--Research Engineer

Donna H. Falkenberg--Technical Editor

Duration of Project and Funds Requested:

The project will be accomplished in a period of two years beginning October 1, 1977. Total federal funding requested for the project is \$30,000 for the first year and \$30,000 for the second year.

Identification of the Problem and Problem Solution Approach:

Much of the technology that is produced from research projects is published in project reports and forgotten, i.e., it never gets transferred to users. A need exists now to transfer technology, to implement it and benefit from it, as opposed to simply disseminate information about it. The guide produced by the UCOWR Technology Transfer Committee stresses that "technology transfer programs should not rely on publication and distribution alone" but should initiate whatever approach is appropriate to ensure that "the end of the process is application of knowledge to resolve problems."

In contrast to studying various kinds of transfer mechanisms and the relative effectiveness of each, the approach to the problem solution in this proposal is to actually transfer technologies from two recently completed research projects. The effectiveness of transfer mechanisms will be indicated by the degree to which the technologies become implemented by user groups.

Research Contribution to Problem Solution:

The most significant contribution of the proposed work will be the implementation by a selected audience of important research results. A second contribution will be the evaluations of the effectiveness of several transfer mechanisms, for implementing these particular types of technology.

Research Objectives:

Two specific objectives of the study are: 1) To educate and train particular center personnel in the performance of technology transfer, and 2) to actually transfer technology from two selected completed projects, and perform pre and post evaluations to determine effectiveness of the transfers.

Research Approach:

This proposal selects two completed research projects that have produced transferable technologies of types that are needed and wanted by particular audiences, and transfers those technologies to potential users. Before and after surveys will be made to determine the degree to which the technologies are actually transferred, i.e., implemented by the users.

Research Results Users:

Two different types of user groups will be the technology recipients in this proposal. The first includes design engineers, employees of municipal sanitation departments, and others who may be interested in using intermittent sand filters for wastewater stabilization ponds. (Attached is a statement from one of the research project leaders relative to the interest already expressed by user groups in the available technology. Their wanting it and needing it are essential first steps in successful transfers of technology.)

The second group of users includes farm managers and operators, as well as all other water users, who may be affected by irrigation return flows.

WATER RESOURCES RESEARCH PROPOSAL - TITLE II
(Summary Sheet)

Summary information relating to a proposal submitted to the Office of Water Resources Research for consideration pursuant to Title II of the Water Resources Research Act

C-

Proposal Number
(Assigned by OWRR)

Name and Address of Applicant Organization or Individual:

Utah Water Research Laboratory and the
Utah Center for Water Resources Research
UMC 82 -- USU -- Logan, Utah 84322

FCST Category: NA
OWRR Priority Research
Subject No. NA
(Refer to "Guides")

Type (Non-Profit, Academic, Corporation, etc.): Academic

Title of Proposed Research Project:

Technology Application

Name(s) of Principal Investigator(s):

C. Earl Israelsen, Frank W. Haws, Donna H. Falkenberg

Proposed Starting Date: Oct. 1, 1977

Duration of Project

Proposed Completion Date: Sept. 30, 1979

2 Years, Plus - Mo.

If this research proposal has a relationship to a proposal previously submitted to OWRR, indicate the OWRR number of previous proposal: --

Time period (from--to dates) during which OWRR should regard the proposal as being valid for consideration: _____

Federal Funds Requested for Project: \$ 60,000 . Dollar value of Non-Federal Contributions (if any) to be Applied to Project Accomplishment: \$ 54,867

Estimate, by Years, of Proposed Disbursement of Funds to Defray Project Costs

	1st Yr.	2nd Yr.	3rd Yr.	4th Yr.	Totals
Federal Funds-----	30,000	30,000			60,000
Non-Fed. Contributions-----	27,433	27,434			54,867
Totals-----	57,433	57,434			114,867

Name, Title, and Address of Individual Submitting Proposal:

Frank W. Haws
Research Engineer and Editor
UMC 82 USU
Logan, Utah 84322

TIME AND COST ESTIMATE
FOR
WATER RESOURCES RESEARCH PROPOSAL -- TITLE II - (FOR FEDERAL FUND REQUESTED)

This form indicates, by cost categories, the amounts of FEDERAL FUNDS REQUESTED AND REQUIRED to carry out the research project identified below and described in other descriptive proposal information submitted to the Office of Water Resources Research.

If applicant's method of cost distribution is incompatible with this form, cost estimate information may be set forth in a format of the applicant's choice; provided, however, that all information as requested by this form is fully and adequately shown.

Project Title: Technology Application

Principal Investigator: C. E. Israelsen, F. W. Haws, D. H. Falkenberg

Time Period Covered by this Time and Cost Estimate: 2 Years plus -- Months

<u>Cost Categories</u>	<u>Federal Funds Requested</u>
<u>A. Direct Salaries and Wages:</u> <u>2/</u>	
Principal Investigator(s) - - - - - No. <u>2</u> ; Man-Years: <u>2</u>	\$ <u>14,500</u>
Other Professional Research Staff - - - No. <u>0</u> ; Man-Years: <u>0</u>	<u>0</u>
Research Assistants:	
University Students: - - - - - No. <u>0</u> ; Man-Years: <u>0</u>	<u>0</u>
Others: - - - - - No. <u>0</u> ; Man-Years: <u>0</u>	<u>0</u>
Others (technical) - - - - - No. <u>0</u> ; Man-Years: <u>0</u>	<u>5,500</u>
Others (non-technical) - - - - - No. <u>2</u> ; Man-Years: <u>1.5</u>	<u>9,000</u>
<u>Total Direct Salaries and Wages: - - - - - \$ 14,500</u>	
<u>B. Employee Benefits (if not included elsewhere): - (23.5% x 14,500) - - \$ 3,408</u>	
<u>C. Use, Rental or Depreciation Costs Included as Direct Charges: - - - \$ --</u> (Describe fully the basis used to arrive at these costs.)	
<u>D. Non-expendable Equipment Items: 1/ (List items and attach concise narrative justifications for any items costing over \$1,000)</u>	
Video Cassette Recorder	- \$ 1,000
Video Play-back	- 500
Video Tape	- 375
<u>Total Non-expendable Equipment Items: - - - - - \$ 1,875</u>	

1/ Concerning items D and E of this form, in lieu of procurement from commercial sources, Federal excess and surplus sources should be used to obtain required equipment, material, and supplies whenever possible. 2/ Estimated.

(Continue on page 2)

(Attach additional sheets as may be necessary)

TIME AND COST ESTIMATE - Relating to Federal Funds Required
 (Continued from Page 1 of 2)

Form C-2
 (Page 2 of 2)

Federal Funds Requested

Cost Categories

<u>E. Expendable Equipment, Material, and Supplies:</u> ^{2/}		
Drafting, graphics, type, slides, and associated expenses	-	\$ 12,000
Script and materials for readers theater	-	500
_____	-	
_____	-	
_____	-	
Total Expendable Equipment, Material and Supplies:	- - -	-\$12,500
<u>F. Travel Costs Included as Direct Charges: (Identify and specify purposes of travel)</u>		
Attend conferences of OWRT communicators,	-	\$ _____
make visits as needed to evaluate attitudes and	-	
skills of audiences, etc.	-	1,200
Readers theater--various locations within the State of	-	
Utah	-	1,575
Total Travel Costs Included as Direct Charges:	- - -	-\$ 2,775
<u>G. Other Direct Charges: (Specify--printing, shipping, etc.)</u>		
Printing a user's manual, pamphlets, brochures,	-	\$ _____
questionnaires, mailers associated with information	-	
transfer techniques	-	13,242
Readers theater workshop	-	3,000
_____	-	
Total Other Direct Charges:	- - -	-\$16,242
<u>H. Indirect Costs: (Explain basis of computation)</u>		
	-	-\$ 8,700
60% S&W		
<u>I. Fee or Estimated Profit: (Explain basis of computation)</u>		
	-	-\$ --

TOTAL AMOUNT OF PROJECT COSTS proposed to be paid from
 Federal funds under provisions of P.L. 88-379 as amended - - - - - \$ 60,000

^{2/} See Footnote 1/, page 1.

As may be necessary, use additional sheets to supplement this form.

TIME AND COST ESTIMATE FOR

WATER RESOURCES RESEARCH PROPOSAL - TITLE II - (NON-FEDERAL CONTRIBUTIONS)

This form indicates, by cost categories, the dollar value of NON-FEDERAL CONTRIBUTIONS that will be expended to accomplish the research project identified below, and described in other project proposal descriptive information, if such project is approved for Federal participation by the Office of Water Resources Research.

Reference is made to Budget (BOB) Circular A-74 which requires that institutions receiving Federal research grants must share in the research costs on more than a token basis.

If applicant's method of cost distribution is incompatible with this form, cost estimate information may be set forth in a format of the applicant's choice; provided, however, that all information as requested by this form is fully and adequately shown.

Project Title: Technology Application

Principal Investigator: C. E. Israelsen, F. W. Haws, D. H. Falkenberg

Time Period Covered by this Time and Cost Estimate: 2 Years, plus -- Months

<u>Cost Categories</u>	<u>Non-Federal Contributions</u>
<u>A. Direct Salaries and Wages:</u>	
Principal Investigator(s) - - - - - No. <u>1/</u> 3 ; Man-Yrs: 1.5	\$ 29,900
Other Professional Research Staff - - No. _____ ; Man-Yrs: _____	_____
Research Assistants:	
University Students: - - - - - No. _____ ; Man-Yrs: _____	_____
Others: - - - - - No. _____ ; Man-Yrs: _____	_____
Others (Technical) - - - - - No. _____ ; Man-Yrs: _____	_____
Others (Non-technical) - - - - - No. _____ ; Man-Yrs: _____	_____
TOTAL Direct Salaries and Wages: - - - - -	\$ 29,900
<u>B. Employee Benefits (if not included elsewhere):</u> - (23.5% x 29,900)	\$ 7,027
<u>C. Use, Rental, or Depreciation Costs Included as Direct Charges:</u> - - - - -	\$ --
(Describe fully the basis used to arrive at these costs.)	

D. Non-expendable Equipment Items: - - - - - \$ // // // // // // //

1/ Estimated. (Continue on page 2. Attach additional sheets as may be necessary)

TIME AND COST ESTIMATE -- Relating to Non-Federal Contributions
(Continued from Page 1 of 2)

<u>Cost Categories</u>	<u>Non-Federal Contributions</u>
E. <u>Expendable Equipment, Material, and Supplies:</u> 2/	
_____	- \$ _____
_____	- _____
_____	- _____
_____	- _____
_____	- _____
TOTAL Expendable Equipment, Materials and Supplies-	- - - - - \$ _____
F. <u>Travel Costs Included as Direct Charges:</u> (Identify and specify purposes of travel)	
_____	- \$ _____
_____	- _____
_____	- _____
_____	- _____
_____	- _____
TOTAL Travel Costs Included as Direct Charges - - - - -	- - - - - \$ _____
G. <u>Other Direct Charges:</u> (Specify--printing, shipping, etc.)	
_____	- \$ _____
_____	- _____
_____	- _____
_____	- _____
_____	- _____
TOTAL Other Direct Charges- - - - -	- - - - - \$ _____
H. <u>Indirect Costs:</u> (Explain basis of computation) - - - - -	- - - - - \$ 17,940

60% of Salaries and Wages

TOTAL AMOUNT OF PROJECT COSTS Proposed to be Paid for by
Using Contributions from Non-Federal Sources- - - - - \$ 54,867

2/ In lieu of procurement from commercial sources, Federal excess and surplus sources should be used to obtain required expendable equipment, material and supplies wherever possible.

(Attach additional sheets as may be necessary)

SUMMARIZED FINANCIAL PLAN - TITLE II RESEARCH PROPOSALProject Title: Technology ApplicationPrincipal Investigator: C. E. Israelsen, F. W. Haws, D. H. Falkenberg

Summarized below, by cost categories, are the estimated total project costs which are set forth, in more detail, on Forms C-2 and C-3.

<u>Cost Categories</u>	<u>Federal Funds Requested</u>	<u>Non-Federal Contributions</u>
A. Direct Salaries and Wages: -----	\$ 14,500	\$ 29,900
B. Employee Benefits (if not included elsewhere): ---	\$ 3,408	\$ 7,027
C. Use, Rental, or Depreciation Costs Included as Direct Charges: -----	\$ --	\$ ---
D. Non-expendable Equipment Items: -----	\$ 1,875	\$ / / / / / /
E. Expendable Equipment, Material, and Supplies: ----	\$ 12,500	\$ --
F. Travel Costs Included as Direct Charges: -----	\$ 2,775	\$ --
G. Other Direct Charges: -----	\$ 16,242	\$ --
H. Indirect Costs: -----	\$ 8,700	\$ 17,940
I. Fee or Estimated Profit: -----	\$ --	\$ --
 <u>TOTAL PROJECT COSTS:</u> -----	 \$ 60,000	 \$ 54,867

ESTIMATED TIMING FOR THE EXPENDITURE OF SPECIFIED AMOUNTS OF
FEDERAL FUNDS, AND FOR THE EXPENDITURE OF NON-FEDERAL CONTRI-
BUTIONS, TO MEET PROJECT COSTS, DURING TIME PERIOD THAT THE
PROJECT IS IN PROGRESS

In the space below, estimate the times (such as: 1st quarter, 2nd quarter, etc.) when Federal funds will be required to meet project costs, and the amounts of such Federal funds. Also estimate the times and amounts for expenditure of non-Federal contributions, if any. (Educational institutions and non-profit organizations may obtain quarterly advance payments of Federal funds pursuant to properly prepared vouchers submitted to OWRR.)

--Time Periods or Dates--	Federal Funds	Non-Federal Contributions
1st Quarter Oct 1 - Dec 31, 1977	\$ 7,500	\$ 6,858
2nd Quarter Jan 1 - Mar 31, 1978	\$ 7,500	\$ 6,858
3rd Quarter Apr 1 - Jun 30, 1978	\$ 7,500	\$ 6,858
4th Quarter Jul 1 - Sept 30, 1978	\$ 7,500	\$ 6,858
1st Quarter Oct 1 - Dec 31, 1978	\$ 7,500	\$ 6,858
2nd Quarter Jan 1 - Mar 31, 1979	\$ 7,500	\$ 6,858
3rd Quarter Apr 1 - Jun 30, 1979	\$ 7,500	\$ 6,858
4th Quarter Jul 1 - Sept 30, 1979	\$ 7,500	\$ 6,861

TECHNOLOGY APPLICATION

Project Duration

This proposed study will be accomplished in a two year period from October 1, 1977 to September 30, 1979.

Relevance

The 1971 Congress amended OWRT's enabling legislation with a charge to emphasize the effective use of the water resources research information produced by the OWRT program. Specifically, the amendment provided for:

1. Scientific information dissemination. This was to include:
 - a. Identifying potentially significant research
 - b. Assembling information on significant research
 - c. Interpreting results and coupling solutions to water resources problems.
2. Improved communications regarding the results of significant research.
3. Evaluating the effectiveness of research and the communication process as an aid in the solution of practical problems.
4. Training qualified persons in the performance of scientific information dissemination.

The intent of Congress is clearly directed toward the economic payoff of the research effort. The public investment in research should result in practical solutions to water resources problems and the "know-how" or the "how to" presented in such a way that those in need of a solution can and do readily adopt or adapt the new methods into their own economy

and be benefited thereby. Technology transfer is the term used to describe this process of taking a technical method of achieving a practical purpose out of the realm of the researcher and making it available or "transferring" it to the practitioner or user. The term "transfer" implies that the user has actually adopted or put into use the new knowledge or skill which the researcher provided.

Congress recognized that too much of the research effort was directed toward the exchange of scientific knowledge or research findings and not enough toward technology transfer. Completion reports of projects and their published results in sophisticated scientific journals, both of which have very limited audiences, are counter-productive to technology transfer. Unfortunately, this system is favored by academic institutions and a researcher gains little personal stature by contributing to more widely read non-technical journals or to those means by which his contributions to society could be effectuated.

There is a need therefore, to establish at the State Centers, capabilities that make planned and concerted efforts toward technology transfer. Two major benefits can be seen in developing such programs:

1. The practical aspects of current research can be placed within the reach of the user, and
2. Future research can be directed to those problems of water resources which seem to have the greatest social need and for which a practical solution can be implemented.

Objectives

The objectives to be accomplished during this proposed study are:

1. To educate and train particular center personnel in the performance of technology transfer.
2. To actually transfer technology from two selected projects, and perform pre and post evaluations to determine effectiveness of the transfers.

Procedures

It is recognized that technology transfer will require persons with broad technical backgrounds in water resources and with experience in practical resources problems. We have such persons presently on the staff, but they lack experience in the communicative skills of technology transfer. The training of those individuals to become transfer specialists will best be done by "hands on" experimentations with transfer techniques.

Several completed projects will be analyzed for potential transfer possibilities. Techniques of transfer will then be chosen which best fit the type of user audience for which the research was intended. Actual implementation of the techniques will then begin with a pre-evaluation of the present uses and attitudes of the audience. When transfer is deemed to have been completed a post evaluation will be made.

Technology selected for transfer will be some that was developed for particular audiences and for which different transfer techniques can be applied. At least the two following types of technology will be included.

1. That for a technical user audience which would most readily respond to a "how to" manual of practice.
2. That for a non-technical administrative audience which requires an attitude change toward water resource problems.

In addition to these efforts, we will continue to publish a quarterly newsletter and a semi-annual information bulletin which are directed to general audiences to create awareness of water resource problems. Hopefully these will generate feedback so that further research can be directed to specific problems and other communication means generated to complete the transfer process.

A USU Center project has developed technology of the kind that fits into category (1) above. It includes the use of an intermittent sand filter for cleaning up the final effluent from sewage treatment plants. This new process is currently being evaluated in three different geographic areas of the United States and also in Australia. We propose to transfer this technology to consulting engineers and municipal sanitation departments by means of a "how to" manual which will provide step-by-step details of installation and maintenance.

A colleague who assisted in the development of the sand filtration technology has already received numerous verbal and written expressions of interest in this system which indicates that others throughout the country would like to be able to implement similar systems in their own areas. A receptive audience is a great assist in effecting a transfer of technology.

In order that some measure may be made of the degree of transfer that has taken place of this particular technology, before and after surveys will be made of selected user groups.

The second "technology package" selected for transfer includes management and operational practices for controlling quality and quantity of irrigation return flow. Successful transfer of this type of information will require attitude changes in people, and probably cannot be accomplished with a manual. We would like to try some innovative approaches here that have proved successful in other fields, but which to our knowledge have not been tried in the engineering field. One of these methods consists of using a reader's theater coupled with audio-visual presentations to small select audiences. This technique is presently being used by some University staff members for teaching proper nutritional care to senior citizens in the community and is proving quite effective. These same staff members have expressed an interest in working with us in using the same method to help us effect a transfer of water-related technology. The technology we have selected would lend itself nicely to this particular method.

Other methods to be considered will include field demonstrations for selected audiences, and workshops wherein participants discuss and use the practices.

As indicated previously, before and after studies will be made in order to have some basis for estimating the effectiveness of the transfer method.

Related Work

The Utah Center for Water Resources Research has long been committed to attempting to transfer technology derived from its research program. Progress is being made and some successes have been noted, but many alternative approaches and ideas are yet to be implemented as funds become available. Our technology transfer activities have included the following:

Cloud seeding technology: Ways and means of seeding clouds for the purpose of increasing precipitation have been studied at the Utah Water Research Laboratory since the mid 1960s. Included in these studies were determinations of when and where to seed for optimum results and evaluations to determine overall effectiveness. Over the years, numerous meetings have been held with state and local leaders to explain to them the methods and results of cloud seeding. Slide shows have been presented in public meetings to assist in answering questions from citizens.

The success of the transfer of this particular technology through public and individual contacts is apparent in the fact that the southern 12 counties in the State of Utah have seeded their areas for the past four years, and last year they were joined by the northern half of the state and southern Idaho. The citizens themselves voted to implement seeding programs, and they are paying for them themselves. They hire the necessary equipment and technical help, and are now completely involved in seeding clouds--almost a 100 percent acceptance and implementation of a technology that 10 years ago was generally scoffed at.

Computer modeling: A computer model was developed for determining the adequacy of existing community culinary pipeline networks, and design requirements for expanding them to accommodate additional home hookups. Short-courses were conducted at the university to which interested potential users were invited, and they paid their own way. Users included design engineers from public and private concerns, community mayors, and city councilmen responsible for water. They were invited to bring their own problems with them, and were shown how to use the computer to obtain solutions. Even those who were unfamiliar with computers were able to follow the outlined step-by-step procedure for obtaining answers to their questions. The program remains in the computer where those who were trained at the seminars can continue to use it on a continuing basis for solving water and pipeline problems that may arise.

Publications: The Utah Center publishes a newsletter four times a year, and a special bulletin twice a year, as a means of transferring information to those who may need and use it. (A copy of each of these is included with this proposal.) The special bulletin on the Great Salt Lake is an attempt to translate results of numerous technical research projects into language that can be understood and enjoyed by laymen.

Audience survey: A questionnaire (copy enclosed with proposal) was sent to several thousand potential users of UWRL and Center publications to attempt to determine their interests related to water, and to ask for suggestions as to how we could better serve them and meet their needs. Another source that we use for this kind of guidance and information is a specially-appointed advisory group made up of knowledgeable and prominent leaders in the state. Their inputs and suggestions together with those

received from state and federal agencies within the state, assist us in structuring our research program to best meet the needs of those whom we're obligated to serve.

Publication and Information Dissemination Plan

The results and evaluation of this study will be shared with the other centers throughout the United States and a final completion report sent to OWRT. In addition, the transfer products developed for specific projects will be shared and critical comments sought from any interested respondents.

Principal Investigators

The following members of the Utah State University professional staff will serve together on the project as co-principal investigators.

C. Earl Israelsen - Associate Professor

Frank W. Haws - Research Engineer

Donna H. Falkenberg - UWRL Editor

A detailed resume of each of these investigators appears in the appendix.

Training Accomplishments

Information gained from this study will assist UWRL personnel in becoming more effective in transmitting research results to potential user groups, and in assisting them to implement the same.

Appendix

C. EARL ISRAELSEN

Associate Professor
Utah Water Research Laboratory
Utah State University

Date and Place of Birth

April 21, 1928

Hyrum, Utah

Degrees

B.S. Utah State University, Logan, Utah, 1959

Ph.D. University of Arizona, Tucson, Arizona, 1968

Fellowships and Honors

NDEA (Title IV) Fellow, Department of Hydrology, University of
Arizona, 1963-66

Member, Sigma Tau, Honorary Engineering Fraternity

Professional Societies

American Society of Civil Engineers, Member

American Society of Agricultural Engineers, Member

American Geophysical Union, Member

American Association for the Advancement of Science, Member

International Water Resources Associates, Member

Language Proficiency

English - Native Language

Spanish: Speaking, reading, writing, understanding: good

Dutch: Speaking, reading, writing, understanding: good

Portuguese: Understanding and reading: fair

German: Understanding and reading: fair

Professional Experience

1960-1963 Assistant Research Engineer, Engineering Experiment
Station, Utah State University, Logan, Utah.

1966-1968 Research Engineer, Utah Water Research Laboratory,
Utah State University

1968-present Associate Professor, Civil and Environmental Engineering,
Utah State University.

1968-1970 Executive Secretary, Utah Center for Water Resources
Research, Logan, Utah. Also co-director Atmospheric
Water Resources Project (Weather Modification), Utah
Water Research Laboratory, Utah State University.

- 1970-1972 Director, Inter-American Center for the Integral Development of Land and Water Resources (CIDIAT) Merida, Venezuela.
- 1972-1973 Associate Professor, International Programs and Studies Office, Utah State University.
- 1973-present Associate Professor, Utah Water Research Laboratory, Logan, Utah.

Research Projects

Model Study for Utah Water and Power Board of Red Creek Spillway and Stilling Basin.

Model Study for Utah Water and Power Board of Woodruff Narrows Spillway and Outlet Works.

Model Study for Utah Water and Power Board of Porcupine Spillway and Stilling Basin.

Designing and Testing Aerial Application Equipment for Evaporation-Reducing Chemicals for U.S. Bureau of Reclamation.

Designing and Testing of Prefabricated Irrigation Structures for United States Steel Corporation.

Preparation of Historical Information and Bibliography of Weather Modification Studies in Various Selected Locations.

Atmospheric Water Resources in Utah, (Weather Modification) Sponsored by U.S. Bureau of Reclamation.

Capacitance Method for Sediment Sensing in Streams, Sponsored by Agricultural Research Service.

Waste Load Allocation Study of the Bear, Sevier, and Virgin River Basins in Utah.

Stabilization and Revegetation of Surface Mine Spoil Dumps.

Erosion Control During Highway Construction.

Preparation of Architect's Planning Guide for addition to Utah Water Research Laboratory.

Design Criteria for Rural Domestic Water Systems Inventory.

Inventory Related to Water Quality Objectives--Bear River Basin.

Publications

Individual Authorship

Reliability of Can-Type Precipitation Gage Measurements, Utah Water Research Laboratory, Utah State University, Logan, Utah, 1967.

Feasibility Study of a Capacitance Method for Measuring Concentrations of Suspended Sediment in Water, Utah Water Research Laboratory, Utah State University, Logan, Utah, July 1968.

The Effects of Suspended Sediment, Temperature, Frequency, and Dissolved Salts on the Dielectric Properties of Water, Ph.D. Dissertation, The University of Arizona, Tucson, Arizona, 1968.

CIDIAT-completion report of the activities of Utah State University on the CIDIAT project of the Department of Regional Development of the OAS, 1964-72. Utah State University, Logan, Utah. 1973.

Joint Authorship

Model Analysis of Red Creek Spillway and Stilling Basin, Engineering Experiment Station, Utah State University, Logan, Utah. (Mimeo) 1960. (with Gordon H. Flammer)

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Aerial Application of Evaporation—Reducing Chemicals, Engineering Experiment Station, Utah State University, Logan, Utah. July 1963. (with Vaughn E. Hansen)

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Planning for Water Quality in the Bear River System in the State of Utah (5 volumes). Utah Water Research Laboratory, Utah State University, Logan, Utah. March 1974 (multiple authorship)

Planning for Water Quality in the Virgin River System in the State of Utah (5 volumes). Utah Water Research Laboratory, Utah State University, Logan, Utah. March 1974 (multiple authorship)

Planning for Water Quality in the Sevier River System of the State of Utah (5 volumes). Utah Water Research Laboratory, Utah State University, Logan, Utah. March 1974 (multiple authorship)

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Papers

An Approach to Determining the State of the Art of Controlling Erosion During Highway Construction, presented at the 5th Conference of the International Erosion Control Assoc., Sacramento, California. February 1974.

Erosion Control During Highway Construction, presented at the 60th Annual Meeting of the American Association of State Highway and Transportation Officials (AASHTO), Detroit, Michigan. November 1974.

Erosion Control Techniques in Reclamation of Mined Lands, presented at Annual Meeting of Mineral Waste Stabilization Liaison Committee, Vail, Colorado. August 1975.

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Date and Place of Birth

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Degrees

B.S. Utah State University, Logan, Utah, 1946
M.S. Utah State University, Logan, Utah, 1965

Experience

1953-57 Irrigation Engineer, Research, Agricultural Research Service, USDA, Logan, Utah
1957-64 Research Associate, Utah Agricultural Experiment Station, Logan, Utah
1964-present Research Engineer, Utah Water Research Laboratory, Logan, Utah
1967- Participant in NSF sponsored short-course on Remote Sensing of Environment, University of Michigan, Ann Arbor, Michigan

Major Research Projects

Lining of Irrigation Canals and Reservoirs
Developing a State Water Plan
Hydrologic Inventories and Land Use Study
Evaluation of Remote Electromagnetic Sensors for Detecting Transpirational Water Use by Plants Subjected to Various Foliar Chemical Treatments Designed to Reduce Transpirational Losses
A Study of Water Institution in Utah and their Influence on the Planning, Developing, and Managing of Water Resources
Urban Storm Runoff Inlet Hydrograph Study

Consulting Experience

1957-61 Logan River Water Users Association, Logan, Utah
1964 Richmond Irrigation Company, Richmond, Utah
1962-present Logan Cow Pasture Irrigation Company, Logan, Utah
1965-67 United Park City Mining Company, Salt Lake City, Utah
1969 Expert Witness before Local Groundwater Board for Bannock County, Idaho
1970-71 A consortium of 5 water companies in Northern Utah
1971- Expert witness in two court trials involving movement of groundwater through alluvial fill

Professional and Scientific Societies

American Society of Agricultural Engineers
 American Society of Civil Engineers
 Sigma Xi
 National Society of Professional Engineers
 Utah Society of Professional Engineers
 American Society of Photogrammetry

Accomplishments, Honors, etc.

Secretary, ASAE Rocky Mountain Section, 1962
 Secretary, USPE, Northern Utah Chapter, 1963
 President, USPE, Northern Utah Chapter, 1965
 Registered Professional Engineer, Utah

Publications

Individual Authorship

Annual Report of Logan River Water Commissioner. Report to the State Engineer. 4 Volumes - 1961, 1962, 1963, 1964.

Summary Report on Project 211, Lining of Irrigation Canals and Reservoirs, UAES Typescript. 1964.

A Critical Analysis of Water Rights on Logan River Report. Utah Water Research Laboratory, Logan, Utah. 1967.

Hydrologic Inventory of the Weber River Drainage Area. Report No. PRWG40-6. Utah Water Research Laboratory, Logan, Utah. 1969.

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Water Related Land Use in the Bear River Drainage Area. Report No. PRWG40-2. Utah Water Research Laboratory, Logan, Utah. 1969.

Water Related Land Use in the Weber River Drainage Area. Report No. PRWG40-4. Utah Water Research Laboratory, Logan, Utah. 1970.

A Study of Water Institutions in Utah and their Influence on the Planning, Developing, and Managing of Water Resources. Utah Water Research Laboratory Report PRWG79-1, Logan, Utah. 1973.

A Study of Alternative Methods to Modernize Water Institutions and Eliminate Problems of Multiple Jurisdiction and Conflicting Objectives. Utah Water Research Laboratory Report PRWG122-1, Logan, Utah. 1975.

Joint Authorship

Plastics Prevent Water Loss. Utah Farm and Home Science. 17(2):40-41, 48. June 1956. (with C. W. Lauritzen)

Plastic Film for Controlling Seepage Losses on Farm Reservoirs. Bul. 391, UAES, 18 pp. July 1956. (with C. W. Lauritzen)

Asphalt - Burlap Linings for Canals and Reservoirs. Ag. Eng. 40(6): 340-342, 244. June 1959. (with C. W. Lauritzen)

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Using Remote Infrared Sensors to Detect Changes in Moisture Conditions on Natural Watersheds. Report No. CWRR-14a-1. Utah Center for Water Resources Research. 1967. (with Ralph D. Briscoe)

Water Related Land Use in the Utah Lake Drainage Area. Report No. PRWG40-1. Utah Water Research Laboratory, Logan, Utah. 1968. (with M. Leon Hyatt)

Spectral Infrared Reflection Measurements from Natural and Treated Aspen Forests. Report No. CWRR-14-4. 1969. (with Ralph D. Briscoe and Allan Steed)

Hydrologic Inventory of the Utah Lake Drainage Area. Report No. PRWG40-3. Utah Water Research Laboratory, Logan, Utah. 1969. (with Gaylord V. Skogerboe, M. Leon Hyatt, and Lloyd H. Austin)

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Degrees

B.S. Utah State University, Logan, Utah, 1963

Experience

1961-63 Assistant Editor, Tremonton Leader newspaper,
Tremonton, Utah (summers)
1962-63 Editor, Student Life newspaper, Utah State
University, Logan, Utah
1963 Part-time, News Assistant, News Bureau, Utah State
University, Logan, Utah
1963-65 Editorial Associate, The Improvement Era
magazine, Salt Lake City, Utah
1965-
present Editor, Utah Water Research Laboratory, Utah
State University, Logan, Utah
1969-
present Editor, Aquarius, bimonthly newsletter of the
Utah Center for Water Resources Research and Utah
Water Research Laboratory

Professional and Social Organizations

National Press Women's Association
Kappa Delta Sorority

Accomplishments, Honors, etc.

1960 Top Freshman Journalist Award
1961-62 Member, Spurs, Sophomore Service Organization
1962-63 Listed in "Who's Who in American Colleges and
Universities"
1962-63 Member, Sigma Phi Eta, Senior Women's Honorary
Society
1967-69 Publicity Chairperson, Cache County Unit, American
Cancer Society
1975-76 Chairperson, USU Editors Council

Publications

Individual Authorship

Smiths, Youngs, and Vermont. The Improvement Era, November 1964.

Spiritual Gifts. The Improvement Era, November 1965.

Samoa. The Improvement Era, March 1966, Spanish translation, Liahona, October 1966.

USU's Summer Rainmakers. Outlook. September 1972.

Joint Authorship

The Great Salt Lake, Hub of Utah's Water Development. Utah Science. March 1967. (with Jay M. Bagley and Gaylord V. Skogerboe)

Modeling the Eutrophication Process. Proceedings of a Workshop held at Utah State University, Logan, Utah, September 5-7, 1973. PRWG136-1, UWRL. November 1973. (with E. Joe Middlebrooks and Thomas E. Maloney)

Upgrading Wastewater Stabilization Ponds to Meet New Discharge Standards. Proceedings of a Symposium held at Utah State University, Logan, Utah, August 21-23, 1974. PRWG159-1, UWRL. November 1974. (with E. Joe Middlebrooks, Ronald F. Lewis and Donald J. Ehreth)

Biostimulation and Nutrient Assessment. Proceedings of a Workshop held at Utah State University, Logan, Utah, September 10-12, 1975. PRWG168-1, UWRL. November 1975. (with E. Joe Middlebrooks and Thomas E. Maloney)

Colorado River Basin Modeling Studies. Proceedings of a Seminar held at Utah State University, Logan, Utah, July 16-18, 1975. UWRL. March 1976. (with Calvin G. Clyde and J. Paul Riley)

Watershed Management on Range and Forest Lands. Proceedings of the Fifth Workshop of the United States/Australia Rangelands Panel, Boise, Idaho, June 15-22, 1975. UWRL. March 1976. (with Harold F. Heady and J. Paul Riley)

Books

Modeling the Eutrophication Process. Ann Arbor Science, Ann Arbor, Michigan. 1974. (with E. Joe Middlebrooks and Thomas E. Maloney)

Biostimulation and Nutrient Assessment. Ann Arbor Science, Ann Arbor, Michigan. 1976. (with E. Joe Middlebrooks and Thomas E. Maloney)

Publications Edited

Project Reports	220
Occasional Papers	8
Proceedings	8