

1961
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CIVIL ENGINEERING SECTION

COLORADO AGRICULTURAL EXPERIMENT STATION

ANNUAL REPORT

1 May 1961

CER61ARC27

I A Hydraulics and General Staff and Funding Projection by Man-Months

Name and rank or title for employee. (Include non-faculty and Grad Asst.)	Months employed 1960-61	1961-62 in Man-Months					1962-63 in Man-Months				
		Grad R.I.	Sta.	CSURF	Ext.	Other	Grad R.I.	Sta.	CSURF	Ext.	Other
Vacancy (Section Chief)	12	4	4	4			4	4	4		
Dunn, I. S. Professor	9	3		1½*			3				
Hayman, R. W. Asst. Prof.	9			1-1½*					1-2*		
Smith, G. L. Asst. Prof.	12			10					10		
Simons, D. B. Professor	3	2		1*			2		1*		
Fend, J. W. H. Professor	9	3					3				
Dils, R. E. Professor	Forestry		2	1			3	2	1		
Parshall, M. Assoc. Prof.	9		2					2			
Schulz, E. F. Asst. Prof.	12	2	7	1			2	8			
Skinner, M. M. Asst. Civil Engr	12		12					10	2		
Karak, S. S. Asst. Civil Engr.	12		2	10				3	9		
Yevdjevich, V. M. Civil Engr	10	2	1	6-2*			2	2	5-2*		
Bayre, W. W. Asst. Civil Engr.	12			12					12		
Dirmeyer, R. D. Asst. Geological Engr.	12		12					12			
Bittinger, M. W. Asst. Civil Engr.	12		12					12			
New 2-Professors	-	2	12	10			3	10	11		

I A. Hydraulics and General Staff and Funding Projection by Man-Months (cont.)

Name and rank or title for employee. (Include non-faculty and Grad. Asst.)	Months employed 1960-61	1961-62 in Man-Months					1962-63 in Man-Months				
		Grad. R.I.	Sta.	CSURF	Ext.	Other	Grad. R.I.	Sta.	CSURF	Ext.	Other
New											
2-Assoc. Prof.	-						2	6	16		
New											
6-Grad. Res. Asst.	-							6	24		
8-Grad. Res. Asst.	10		12	25			9	12	13		
Robinson, A. R.											
Asst. Civil Engr.	3		3					3			

Note: Use an asterisk to indicate temporary summer appointments for CSURF research, summer session teaching, or other special programs.

I B. Aeromechanics Staff and Funding Projection by Man-Months

Name and rank or title for employee. (Include non-faculty and Grad. Asst.)	Months Employed 1960-61	1961-62 in Man-Months					1962-63 in Man-Months				
		Grad. R.I.	Sta.	CSURF	Ext.	Other	Grad. R.I.	Sta.	CSURF	Ext.	Other
Cernak, J. E. Professor	12	4		6			4		6		
Plate, E. J. Asst. Prof.	12	1		11			2		10		
Foreh, M. Jr. Civil Engr.	12	1		11			2		10		
Davar, K. Jr. Civil Engr	12			3							
Nagabhushanaiah, H. S. Grad. Res. Asst	6			1½							
Malhotra, R. Grad. Res. Asst.	6			6					1½		
Chuang, Hsing Grad. Res. Asst.	6			6					3		
Duckstein, Lucien Grad. Res. Asst.	6			6					6		
Tsuei, Yeong-Ging Grad. Res. Asst.	6			6							
New Assoc. Prof.	-	3		9			3		9		
New Assoc. Prof.	-						2	10			
Kemp, B. L. Grad. Res. Asst.	-			6					6		
Bhoduri, S. Grad. Res. Asst.	-			6					1½		
New 5-Grad. Res. Asst. (\$2700)	-			30				2	28		
New 4-Grad. Res. Asst. (\$3300)	-			24					24		
New 2-Grad. Res. Asst. (\$3300)	-							12			

I C. Atmospheric Sciences Staff and Funding Projection by Man-Months

Name and rank or title for employee (Include non-faculty and Grad. Asst.)	Months Employed 1960-61	1961-62 in Man-Months					1962-63 in Man-Months				
		Grad. R.I.	Sta.	CSURF	Ext.	Other MSEA	Grad. R.I.	Sta.	CSURF	Ext.	Other MSEA
Riehl, H. Professor	9		1	6-2*		1	1		6-2*		1
Schlousener, R. A. Assoc. Prof.	12	1	4	6			1	4	6		
Reiter, E. Assoc. Prof.	-			11		1	1		10		1
Beer, F. Asst. Prof.	-		3	6			2	3	7		
Marlatt W. Asst. Prof.	-		3	6			1	3	8		
Grant L. O. Asst Meteorologist	12		3	9				4	8		
Gray W. Asst. Meteorologist	2			11		1			11		1
New Elect. & Equip. Technician	-							6	6		
New Technical & Adm. Asst	-		2	10				2	10		
New 2 Grad Res Asst	9					9					9
New 4 Grad Res Asst	-			22					22		
New 6 Grad Res Asst	-							6	15		9

Note: Use an asterisk to indicate temporary summer appointments for CSURF research, summer session teaching, or other special programs.

I D. Non-Faculty Staff and Funding Projection by Man-Months

Name and rank or title for employee. (Include non-faculty and Grad. Asst.)	Months Employed 1960-61	1961-62 in Man-Months					1962-63 in Man-Months				
		R. I.	Sta.	CSUM	Ext.	Other	R. I.	Sta.	CSUM	Ext.	Other
Amos, R. V. Supervisor of Shops	12	1	2	9			1	2	9		
Blandin, J. B. Clerk-Typist	12			12					12		
Carlson, R. H. Clerk-Typist	12			12					12		
Ficelo, L. H. Account Clerk	12			12					12		
Fengasier, V. H. Sheet Metal Worker	12			12					12		
Fanning, T. R. Machinist	12			12					12		
Farrell, C. P. Carpenter	12			12					12		
Fitch, G. H. Senior Clerk Stone	12		6	6				6	6		
Fox, H. E. Inter. Clerk-Typist	12			12					12		
Garfield, D. K. Supervisor Res. Services	12		2	10				2	10		
Heinman, W. Welder	12			12					12		
Steele, J. D. Clerk-Typist	12			12					12		
Now - Clerk-Typist	12			12					12		
Now - Clerk-Typist	12							3	9		

II, III, IV. STATION 1962-63 NEW AND EXPANDED WATER RESEARCH

Items II, III, and IV have been consolidated in the following tabular form for simple identification as projects or programs. No mention is made of CSURF projects which we expect to have funded. Only State of Colorado projects are indicated for new and expanded research above the 1961-62 levels.

	<u>Prof. Sal.</u>	<u>Expense</u>	<u>Capital Outlay</u>
1. <u>Phreatophytes</u> . Study of mechanics of fluid transport by phreatophytes under controlled environment of CSU wind tunnel. Background research for control of phreatophytes. Complements USDA-Agricultural Research Service research supported at CSU while U. S. Soil Moisture Conservation Laboratory remains in "idea" stage in Washington.	\$ 16,000 2.0 FTE	\$ 9,000	\$ 7,000 (Power plant, electrical switches and breakers for small wind tunnel)
2. <u>Stream Pollution</u> . Mechanics of transport of radioactive and other pollutants in an alluvial stream. Complements basic research supported by AEC. Also complementary to Colorado Public Health data program.	16,000 1.5 FTE	4,000	4,000 (Sonomscope and recorder equipment)
3. <u>Hydraulic Structures</u> . Very little data on supercritical flows in rough channels or junctions is available for urban highway and drainage programs or for design of these structures for watershed control and management. Need structures not requiring concrete energy dissipating aprons in many aspects of water management. Slug flows and unsteady flows should be studied in relation to floods on ephemeral streams.	20,000 2.2 FTE	6,000	4,000 (Modifications of large research flume as structures under study are changed. Sand and plastic)
4. <u>Atmospheric Sciences</u> . This project is to provide certain basic tools for atmospheric research. It is the step which logically follows the acquisition of a radar set (1961-62) in equipping a program. This financing is necessary in order to obtain the larger sums of money from contract and grant sources which are required for field research on the atmosphere resource.	2,500 0.30 FTE	2,500	8,000 (Radiation) 12,000 (Basic mobile facility) 15,000 (Automatic data read-out)

	<u>Prof. Sal.</u>	<u>Expense</u>	<u>Capital Outlay</u>
<p>4. <u>Atmospheric Sciences. (cont.)</u> Mobile field equipment and an automatic data readout system is needed to take and store observations in support of the field projects. Mobile equipment contains the means for getting about. We need to acquire two trucks: one mainly to serve the radar and make it possible to put this equipment wherever desired; the other to serve as weather station under all topographic conditions, including upper watersheds, hence, construction must be rugged. Instrumentation will be partly of a type to be retained permanently in the station; partly it is planned to take instruments to selected sites for limited periods. Measurements to be taken will be wind, pressure, temperature and humidity near the ground, winds at upper levels, and eventually also pressure, temperature and humidity above the ground.</p> <p>Radiation measurement instrumentation is needed. Important aspects of radiation affecting, for instance, evaporation from soils and from snow surfaces, remain to be discovered. In particular, the role of ultraviolet radiation has not been explored. Yet this may be a very important factor.</p>			
<p>5. <u>Ground Water Tables.</u> Need to expand existing well network in certain areas and to get all data ready for machine analysis on a continuing basis. This would be coordinated with U.S.G.S. and other ground water interests.</p>	8,000 1.0 FTE	4,500	5,000 (Materials for starting expansion of network)
<p>6. <u>Irrigation Water Management.</u> Irrigation system design and management is still done largely by "rule of thumb" design criteria whether it is summer or winter irrigation. Need is getting more critical for studies to obtain more effective utilization of water in a way to minimize deterioration of water quality.</p>	13,000 1.5 FTE	6,000	3,000 (Material for model)

V. CAPITAL CONSTRUCTION BUDGET

Except for the one item given below, no capital construction funds other than what is already budgeted will be needed in 1961-62 or 1962-63. It is expected that more capital construction money will be requested for 1963-64 or 1964-65 for the Foothills Research campus facility; probably on a matching fund basis. This may total about \$400,000.

Item: Expansion of Main Campus Weather Station (Estimate \$10,000)

The new weather station now being built on the main campus will essentially serve the functions of the old stations: to act as an airways observation station for the U. S. Weather Bureau.

In the last year a facsimile receiving and processing facility has been acquired which serves both instruction and research on the campus with the complete set of weather charts and forecasts issued by the Weather Bureau and disseminated by this method. Housing for this facility is needed. Further, a central location is necessary for the storing and maintenance of various pieces of equipment. These functions cannot be adequately accommodated on the Foothills Research campus.

The new weather station has been built with the thought of extension of the building in the background. There is a blank wall for such an addition, and the building is oriented so that space for the addition is laid out. Power outlets, etc., are already provided for in this wall, and it is merely necessary to cut a door.

Hence, it is proposed to double, approximately, the space of the weather station by building onto the wall which has been constructed with this addition in mind. The cost of this will be \$10,000.

VI. LIST OUTSTANDING ACHIEVEMENTS DURING 1960-61

The services of two international authorities were obtained as additions to the faculty.

These personnel are:

Dr. Herbert Riehl - University of Chicago
Dr. V. M. Yevdjovich - U. S. Geological
Survey

Contracts were let and construction was started on the \$1.3 million new Hydraulics and Aeromechanics Laboratories.

The following staff were sent overseas for consulting or professional society conference assignments:

Dr. R. A. Schleusener - Verona, Italy
Dr. V. M. Yevdjevich - Beirut, Lebanon
Dr. A. R. Chamberlain - East Kilbride, Scotland and
Bogota, Colombia, South America

VII. ACCOMPLISHMENTS BY PROJECTS (Excluding CSURF Non-Agricultural Projects)

Project 103 - Fund 303: Laboratory and Field Study of the Vortex Tube Sand Trap

This project has been completed. A final report was published in December 1960.

Project 104 - Fund 303: Meteorological Observations

Climatological observations are taken twice daily at 7:00 a.m. and 7:00 p.m. to form the basis for a long-term record of weather elements at this station. In addition, airways meteorological observations are taken regularly every odd hour. All of these observations are regularly made available to interested parties, including press and radio for public dissemination.

A limited amount of time was spent in analysis of meteorological data in connection with studies of snowfall in the higher elevations of Colorado.

Project 104 - Fund 310: Effect of Cloud Seeding on Rocky Mountain Snowfall

This project involves an investigation of snowfall and the effects of artificial seeding at the higher elevations of the Rocky Mountains. Daily observations of new snow are being made at 65 sites spaced at about one-mile intervals over Fremont, Hoosier and Vail Passes. Additional atmospheric observations are being made and artificial seeding is being carried out with silver iodide generators from upwind sites on days selected at random.

This project is still in progress. Principal result to date is the collection of snowfall and atmospheric data for both "artificially seeded" and "unseeded" days selected at random. A larger sample than presently available is required for statistical analysis. Substantially higher concentrations of effective ice nuclei have been observed on days of seeding.

Project 105 - Fund 303: Ground Water Fluctuations and Their Relation to Pumping

Water levels are measured with a tape each spring and fall in approximately 250 observation wells (the majority are existing irrigation wells) in the South Platte and Arkansas River Basin. A few continuous ground-water level recorders are in operation. Electrical power consumption amounts for irrigation pumping plants are obtained.

According to the limited observation well network, ground-water levels in eastern Colorado were comparable to the preceding year with some areas continuing their long time downward trend.

Project 106 - Fund 303: Development and Improvement of Water Measuring Devices

During the past year progress has been made on the following phases of the study:

1. Design and calibration of trapezoidal flumes for flow measurement in canals.
2. Evaluation of the Pendvane Flowmeter.
3. Study of the Cox Flowmeter.
4. Development of flumes for flow measurements on streams with steep gradients.

The trapezoidal flume has been demonstrated superior in operation to the Parshall type. A standard rating curve was determined for trapezoidal flumes. Individual calibration of the Cox Flowmeters may be necessary for accuracy with five per cent.

Project 107 - Fund 303: Hydraulics Laboratory

The fall velocity field of porous particles in a zero-turbulence ambient fluid field is being investigated both theoretically and experimentally. The experiment phase is about ready to start and the theoretical work is to the point that there is little doubt about being able to solve the case of the laminar flow regime.

Project 108 - Fund 810: Development and Use of Colorado Clay in Sealing Canals and Reservoirs

This is a combined field and laboratory investigation relating to Colorado clays and to their potential for canal and reservoir sealing purposes.

162 analyses of clays from 85 deposits in Colorado have been completed. Initial evaluation of 32 field trials in canals and reservoirs in Colorado has been accomplished.

Project 112 - Fund 303: Research on Artificial and Natural Recharge of Ground Water in Colorado

Work has been concentrated primarily in five areas: (1) Kiowa Creek Basin, (2) High Plains, (3) Fountain Creek Valley, (4) Prospect Valley and (5) Municipal Water Supplies.

Kiowa Creek. Test holes were drilled to help define the aquifer, and to provide additional observation wells for the measurement of ground-water levels. Pumping tests were conducted to determine aquifer characteristics. Ring infiltration tests were conducted in the stream bottom to determine relative

infiltration rates. A network of 35 wells are measured monthly, three of these wells are equipped with automatic water-level recorders. A network of 100 observation wells is measured twice yearly.

High Plains. Five closed-drainage watersheds were instrumented with staff gages and rain gages in the High Plains of Colorado. Local observers, including Soil Conservation personnel, take the rainfall and runoff readings.

Fountain Creek Valley. A mathematical model has been developed for the aquifer of the Widefield area of the Fountain Creek Valley and checked against field measurements. Various artificial recharge schemes are being tested to determine relative benefits to those using ground water from this aquifer.

Prospect Valley. Work on the Prospect Valley has consisted primarily of analysis of data and preparation of reports and papers.

Municipal Water Supplies. This study is being conducted by the U. S. Geological Survey under agreement with the Experiment Station. Survey of 296 Colorado municipalities and communities of over 100 population has been completed and reports are in progress.

Project 227 (W-32) - Funds 303, 810, 815: Evaporation from Soil Surfaces in Terms of Soil and Micrometeorological Factors

The effects of gradation and thickness of a gravel mulch on three (3) soil types was studied for a variety of ambient conditions in a controlled environment chamber. The results were analyzed using an analysis of variance, and indicate that each of these variables produced significant differences.

Project 1412: Investigations to Develop Wind Tunnel Techniques for Measuring Atmospheric Gaseous Diffusion in Model Vegetative Surfaces

A study of gaseous diffusion within a turbulent boundary layer has been initiated in the large wind tunnel of the Aero-mechanics Laboratory. Design and construction has been completed on the following:

1. Multiple point sampling system.
2. Two-dimensional gas feed system.

3. Traversing assembly and velocity measuring system. Data on gas concentrations downstream from the two-dimensional, floor gas-source have been obtained for a smooth floor.

VIII. PUBLICATIONS (Excluding CSURF Non-Agricultural Projects)

- Bittinger, M. W. and Trelease, F. J. Development and Dissipation of Ground Water Mound Beneath a Spreading Basin, paper presented at 1960 Winter ASAE Meeting and submitted for publication in Agricultural Engineering.
- Bittinger, M. W. and Barnard, J. B., Jr. Management of Colorado's Ground-Water Reservoirs, in preparation.
- Glover, R. E. and Bittinger, M. W. Drawdown Due to Pumping from an Unconfined Aquifer, Proc. ASCE, Irrigation and Drainage Division No. 2594, Sept. 1960, pp. 63-70.
- Grant, L. O. and Schleusener, R. A. Progress Report on Cloud Seeding in Central Colorado. Paper presented at the 16th Annual Meeting - Colorado River Forecast Committee, Senate Chamber - State Capitol Bldg. - Salt Lake City, Utah - 10 April 1961.
- Grant, L. O. and Schleusener, R. A. Snow and Snowfall Accumulation Near Climax, Colorado. Paper presented at the Western Snow Conference and Columbia River Forecast Committee - Spokane, Washington - April 11-13, 1961.
- Gregg, D. O., Meyer, E. L., and Moulder, E. A., (U. S. Geological Survey) Public Water Supplies of Colorado 1959-60. To be published as a General Series Bulletin by Colorado Experiment Station.
- Parshall, M. Summary of 71 Years of Meteorological Data at the Colorado Agricultural Experiment Station, Fort Collins, 1887-1957. Bulletin in press.
- Robinson, A. R. Vortex Tube Sand Trap, Proceedings Paper No. 2669, Irrigation and Drainage Division, ASCE, December 1960.
- Robinson, A. R. Study of the Cox Flowmeter, Report to Board of Water Commissioners, City and County of Denver, Colorado, CER61ARR5, Colorado State University, January 1961.
- Robinson, A. R. Study of the Beaver Creek Measuring Flumes, Report to Rocky Mtn. For. and Range Exp. Sta., CER61ARR10, Colorado State University, February 1961.
- Schleusener, R. A. and King, L. G. Modification of Bridge Controls to Simulate Diurnal Variation of Temperature, Humidity and Radiation, Agricultural Engineering 41(7): 450-451, 1961.
- Skinner, M. M. Ground Water Recharge and Reservoir Management in Prospect Valley, Colorado (tentative title). M. S. in preparation for Experiment Station Bulletin.
- Trelease, F. J. Benefits of Ground Water Recharge in Fountain Creek Valley, Colorado. M. S. Thesis, 1961.