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**NASA CR-143822**

ECO 75-C-3-II

# **IMPACT OF REMOTE SENSING UPON THE PLANNING, MANAGEMENT, AND DEVELOPMENT OF WATER RESOURCES**

(NASA-CR-143822) IMPACT OF REMOTE SENSING  
UPON THE PLANNING, MANAGEMENT AND  
DEVELOPMENT OF WATER RESOURCES, APPENDIX  
Final Report, Jun. 1974 - Jun. 1975  
(Ecosystems International, Inc.) 85 p

N75-28500

Unclas  
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MAY 1975  
APPENDIX TO FINAL REPORT  
June 1974-June 1975

Prepared for:  
**GODDARD SPACE FLIGHT CENTER**  
Greenbelt, Maryland 20771



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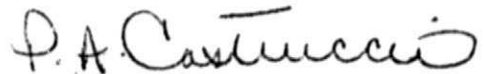
June 17, 1975

Dr. Vincent Salomonson  
Goddard Space Flight Center  
Code: 913  
Greenbelt, Maryland 20771

Dear Vince:

Enclosed please find the required copies of the Appendix to the Type III Final Report, "The Impact of Remote Sensing Upon the Planning, Management, and Development of Water Resources," for Contract NAS5-20567.

Sincerely yours,



Peter A. Castruccio, *v.p.*  
President

PAC/fab

Enclosure: (24)

cc: Documentation Branch, Code 256  
Systems Reliability Directorate, Code 300  
Applications Branch, Code 900  
Publications Branch, Code 251  
Patent Counsel, Code 204  
Contracting Officer, Code 289.1

## APPENDIX A

Organizations Surveyed

## I. Federal Agencies

## A. USDA

1. Agricultural Research Service
2. Soil Conservation Service
3. Forest Service

## B. U.S. Army Corps of Engineers

## C. U.S. Department of Commerce - NOAA

## D. U.S. Department of the Interior

1. Geologic Survey
2. Bureau of Reclamation
3. Fish and Wildlife Service
4. Bonneville Power Administration

## E. Tennessee Valley Authority

## F. Environmental Protection Agency

## II. State Agencies

## A. Alabama Development Office, State Planning Division

## B. Arkansas Dept. of Commerce, Division of Soil &amp; Water Res

## C. California Dept. of Water Resources

## D. Delaware Dept. of Natural Resources

## E. Florida Dept. of Natural Resources

## F. Idaho Dept. of Water Resources

## G. Illinois

1. Dept. of Transportation, Division of Waterways
2. Illinois State Water Survey

## H. Kansas Water Resources Board

## II. State Agencies -- Continued

- I. Kentucky Dept. of Natural Resources & Environmental Protection, Division of Water Resources
- J. Maryland
  - 1. Dept. of Natural Resources
  - 2. Water Resources Administration
- K. Massachusetts
  - 1. Water Resources Commission, Division of Water Resources
  - 2. Division of Water Pollution Control
- L. Mississippi Board of Water Commissioners
- M. Montana Dept. of Natural Resources and Conservation
- N. Nebraska Natural Resources Commission
- O. New Hampshire Office of Comprehensive Planning
- P. North Dakota State Water Commission
- Q. Ohio Dept. of Natural Resources
- R. Pennsylvania Dept. of Environmental Resources
- S. Puerto Rico Aqueduct and Sewer Authority
- T. South Dakota Dept. of Natural Resources Development
- U. Tennessee State Planning Office
- V. Texas Water Development Board
- W. Vermont State Water Resources Board
- X. Virginia
  - 1. Dept. of Conservation and Economic Development
  - 2. State Water Control Board, Bureau of Water Control Management
- Y. Washington State Dept. of Ecology
- Z. Wisconsin Dept. of Natural Resources
- Aa. Wyoming State Engineer's Office, State Water Planning Program

### III. State Water Resources Institutes

- A. University of California Water Resources Center
- B. Colorado State University Dept. of Earth Resources
- C. University of Hawaii Water Resources Research Center
- D. Idaho Water Resources Research Institute
- E. Purdue University Water Resources Research Center, Indiana
- F. Louisiana Water Resources Research Institute
- G. University of Maine at Orono Environmental Studies Center
- H. Montana University Joint Water Resources Research Center
- I. University of Nebraska-Lincoln Water Resources Research Institute
- J. University of Puerto Rico Water Resources Research Institute
- K. Clemson University Water Resources Research Institute, S.C.
- L. University of Tennessee Water Resources Research Center

### IV. Universities

- A. University of Kansas
- B. University of Kentucky
- C. University of Nebraska
- D. North Carolina State University (2 responses)
- E. Ohio State University (2 responses)
- F. Purdue University
- G. University of Texas at Austin
- H. Utah State University
- I. Virginia Polytechnic Institute and State University
- J. Michigan State University

V. Counties

- A. Anne Arundel County, Maryland
- B. Baltimore County, Maryland
- C. Fairfax County, Virginia

VI. Private Consultants

- A. Wilson T. Ballard, Baltimore, Md.
- B. Dalton - Dalton - Little - Newport, Baltimore, Md.
- C. Hittman, Columbia, Md.
- D. Maty, Childs, and Associates, Baltimore, Md.
- E. Rummel, Klepper, and Kahl, Baltimore, Md.
- F. Whitman, Requardt and Associates, Baltimore, Md.

APPENDIX B

WATER RESOURCE ACTIVITIES OF STATE AGENCIES

Appendix B summarizes the activities of state water resource agencies by percentage of time devoted to different areas of research.



WATER RESOURCE ACTIVITIES OF STATE AGENCIES

STATE	AGENCY	ACTIVITIES CONDUCTED (% of time for Reg.)	FLOOD FORECASTING	PUBLIC WORKS DESIGN	RESERVOIR-WATER SUPPLY MGMT.	SANITARY ENGINEERING	WATER QUALITY	DATA GATHERING & CORRELATION	RAINFALL-RUNOFF COMPUTATION & MODELING	SNOWMELT	CONSERVATION	RIVER HYDRAULICS	ECONOMIC ANALYSIS	GROUNDWATER	WATER RIGHTS	RESOURCES PLANNING	OTHER
Ala.	Development Office State Planning Div																
Ark.	Dept. of Commerce Div. of Soil and Water Resources			40			15	30				15					
Calif.	Dept. of Water Resources		3	29	20	3	5	13	0.3	2						22	2.7
	State Water Project			43	50			7									
Del.	Dept. of Natural Resources				20	50	30										
Fla.	Dept. of Natural Resources				X			(1)				X					
Idaho	% of Professional Staff Dept. of Water Resources	Time			10		5	5					2	X	30	15	(2)
Ill.	Dept. of Transportation, Div. of Waterway		2	30	3			1	2			10	12				

(1) Most work done in this area.

(2) Administration, Dam Safety

X = Mentioned, but no percentage figure given.

STATE	AGENCY	ACTIVITIES CONDUCTED (% of Time for Res.)	FLOOD FORECASTING	PUBLIC WORKS DESIGN	RESERVOIR-WATER SUPPLY MGMT.	SANITARY ENGINEERING	WATER QUALITY	DATA GATHERING & CORRELATION	RAINFALL-RUNOFF COMPUTATION & MODELING	SNOWMELT	CONSERVATION	RIVER HYDRAULICS	ECONOMIC ANALYSIS	GROUNDWATER	WATER RIGHTS	RESOURCES PLANNING	OTHER
	State Water Survey				2	5	30	15	5		5	10	5				
Kan.	Water Resources Board				10		<5		<5							15	(3)
Ken.	Dept. of Nat. Res. & Environ. Protec. Div. of Water Res.			10	10			10				5					
Md.	Water Resources Administration				30			10	30			30					
Mass.	Water Res. Comm. Div. of Water Resources				X			(4)	X	X	X	X	X				
	Div. of Water Pollution Control					50	50										
Miss.	Board of Water Commissioners				10			40			25		10		15		
Mont.	Dept. of Natural Res. & Conservation			2	2		1	20	3	(5)	2	4	4				(6)

- (3) Aquifer Simulation <5  
Watershed Simulation <5
- (4) Most work done in this area.
- (5) Part of Rainfall-Runoff Computation & Modeling.
- (6) Other Department Activities 62%

STATE	AGENCY	ACTIVITIES CONDUCTED (% of time for No. 1)	FLOOD FORECASTING	PUBLIC WORKS DESIGN	RESERVOIR-WATER SUPPLY MGMT.	SANITARY ENGINEERING	WATER QUALITY	DATA GATHERING & CORRELATION	RAINFALL-RUNOFF COMPUTATION & MODELING	SNOWMELT	CONSERVATION	RIVER HYDRAULICS	ECONOMIC ANALYSIS	GROUNDWATER	WATER RIGHTS	RESOURCES PLANNING	OTHER
Neb.	Natural Resources Commission						5	10	5			5					
N.H.	Office of Comprehensive Planning			25		25					25		25				(7)
N.D.	State Water Comm.		20	15	1	3	10	4	2	5	10	5	15				(8)
Ohio	Dept. of Natural Resources						20				80						
Pa.	Dept. of Environ. Res., Bureau of Res. Programming		3	26	3	13	32	7	1	3		1				11	
Puerto Rico	Aqueduct & Sewer Authority			30	25	10	15	5		5		10					
S.D.	Dept. of Natural Resource Dev.		10	5		5	25			10	10	20					(9)
Tex.	Water Development Board		2		3		3	12	3			3	3	3			(10)

(7) Total time in water resources = 5.15%

(8) Construction 10%

(9) Land Use Inventory 10%

Other Resources Inventory 10%

(10) Estuarine Hydrology 3%

Estuarine Water Quality 3%

STATE	AGENCY	ACTIVITIES CONDUCTED (% of time for Res.)	FLOOD FORECASTING	PUBLIC WORKS DESIGN	RESERVOIR-WATER SUPPLY MGMT.	SANITARY ENGINEERING	WATER QUALITY	DATA GATHERING & CORRELATION	RAINFALL-RUNOFF COMPUTATION & MODELING	SNOWMELT	CONSERVATION	RIVER HYDRAULICS	ECONOMIC ANALYSIS	GROUNDWATER	WATER RIGHTS	RESOURCES PLANNING	OTHER
Vt.	Water Resources Board						10	90									
Va.	State Water Control Board, Bureau of Water Control Man.		5				30				5	30	2	12			
Wash.	State Department of Ecology			5	30	5	40	5						15			
W. Va.	Water Resources					10	25	35	10			10	10				
Wisc.	Dept. of Natural Resources		1		3	17	71		2			6					1
Wyo.	State Engineer's Office				25						25		25		25		

APPENDIX C

HYDROLOGIC MODELS USED BY STATE AGENCIES

Appendix C lists hydrologic models used by the state water resource agencies. Applications and origins of the models are also included.

## HYDROLOGIC MODELS USED BY STATE AGENCIES

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
Arkansas	Dept. of Commerce Div. of Soil & Water Resources	Stanford Watershed Model - Ohio State Version	Rainfall-Run off Computa- tion & Mod.		Ohio State University
California	Dept. of Water Res.	Streamflow Simulation & Snow melt for all Major Rivers & Streams in Calif.	Rainfall-R/O Computation & Mod. Snowmelt River Hydraul- ics	X	
		Estimate of Monthly R/O by & Deviation	Rainfall-R/O Com. & Mod.	X	
		Streamflow Rating Table	Data Gathering & Correlation River Hydraul.	X	
		Rain Frequency Analysis	Data Gathering & Corr. Rainfall-R/O Com. & Mod.	X	
		Unit Hydrograph	Rainfall-R/O Com. & Mod.	X	
		Reservoir Area Capacity Table	Reservoir- Water Supply Management	X	
		Backwater Curve for a Lined Channel	River Hydraul.	X	
		Hydrology Evaluation & Analy- sis Program	Data Ga./Corr.	X	
		Calif. Aqueduct Hydraulic Simulation Model	Public Works Design	X	
		Daily Water Flow Data Summary	Data Ga./Corr.	X	

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
California	Dept. of Water Res. (Cont.)	Daily Flow Data History File Update	Data Ga./Corr.	X	
		River Cross Section Plot	River Hydraul.	X	
		Water Level Plots	Data Ga./Corr.	X	
		Operation of the Calif. Aqueduct Monthly Operation Sub-System 2 & 3 (2 models)	Public Works	X	
		Flood Flow Frequency Analysis	Flood Forecasting	X	
		Probable Maximum Precipitation	Data Ga./Corr. Rainfall-R/O Com. & Mod.	X	
		Flood Hydrograph Package (HEC-1)	Rainfall-R/O Com. & Mod.		U.S. Army Corps of Engineers
		Unit Graph & Hydrograph Computation	Rainfall-R/O Com. & Mod.	X	
		Unit Hydrograph & Loss Rate Optimization	Rainfall-R/O Com. & Mod.	X	
		Water Surface Profile Data Edit	Data Ga./Corr.	X	
		Water Surface Profiles (HEC II) (Modified)	River Hydraul.	X	(Modification of COE Program)
Idaho	Dept. of Water Res.	Snake River Simulation Prog.	Reservoir- Water Supply Management Resources Planning	X	
		Bear River Simulation Prog.	Res.-Water Supply Man. Res. Planning	X	

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
Idaho	Dept. of Water Res. (Cont.)	Snake Plain Groundwater Model	Res.-Water Supply Man. Groundwater Res. Planning		University of Idaho
		Boise Valley Groundwater Mod.	Res.-Water Supply Man. Groundwater Res. Planning	X	(With University of Idaho)
		Boise River Ecologic Model	Res.-Water Supply Man. Water Quality Res. Planning		Tetrattech, Inc.
Illinois	Dept. of Transporta- tion Division of Waterway	Flood Hydrograph Package (HEC I)	Public Works		U.S. Army Corps of Engineers
		Water Surface Profiles (HEC II)	Public Works		U.S. Army COE
		Multiple Correlation & Regression Analysis	Rainfall-R/O Com. & Mod.	X	
		Log Pearson Type III High & Low Frequency Analysis	Rainfall-R/O Com. & Mod.	X	
		Implicit Dynamic Flood Routing	River Hydraul.		National Weather Ser.
		Explicit Natural Streamflow Routing	River Hydraul.	X	
	State Water Survey	Illudas - Urban Pain, R/O	Rainfall-R/O Com. & Mod.	X	
	Numerous Groundwater Models	Data Ga./Corr. Groundwater	X		
Kansas	Water Res. Board	Reservoir Daily Quantity & Quality Routing Model	Res.-Water Supply Man. Water Quality	X	



STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
Kansas	Water Res. Board (Cont.)	Basin Hydrology Simulator	Res.-Water Supply Man. Rainfall-R/O Com. & Mod. Aquifer Simu- lation Watershed Sim- ulation		USGS & Kansas Univ.
		Pricing Policy Model	Economic Ana- lysis	X	
Kentucky	Dept. of Natural Res & Environmental Pro- tection Div. of Water Res.	Unit Response Channel Routing	Res.-Water Supply Man.		USGS
		Reservoir Flood Routing	Public Works Data Ga./Corr.		Soil Conservation Ser
		Water Surface Profiles (HEC II)	River Hydraul		US Army COE
		Reservoir Routing Programs	Public Works	X	(With USGS)
Maryland	Water Resources Administration	WSP-2	River Hydraul		Soil Conservation Ser
		TR-20	Res.-Water Supply Man. Rainfall-R/O Com. & Mod.		Soil Conservation Ser
		WRA-1	Data Corr.	X	
		WRA-2	Data Corr.	X	
		WRA-3	Res.-Water Supply Man.	X	
Massachusetts	Water Res. Comm. Div. of Water Res.	Ipswich River Model	Res.-Water Supply Man. Water Quality		USGS

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
Mass.	Water Res. Comm. (Cont.)	Cape Cod Groundwater Model	Res.-Water Supply Man. Groundwater		USGS
	Div. of Water Pollution Control	Steady State River Quality	Water Quality		R&D Contract by Div.
		Steady State Estuary Model	Water Quality		R&D Contract by Div.
		Time Variable Hydrodynamic and Water Quality Models	Water Quality		R&D Contract by Div.
Montana	Dept. of Natural Res. & Conservation	State of Montana Water Plan- ning Model	Rainfall-R/O Com. & Mod.		Montana State Univ.
Nebraska	Natural Res. Commis- sion	EPA-QUAL-1	Water Quality		Texas Water Develop- ment Board & EPA
		EQP-QUAL-2	Water Quality		Texas Water Develop- ment Board & EPA
		HISARS	Data Ga./Corr. Rainfall-R/O Com. & Mod.	X	
		Water Surface Profiles (HEC-11)	River Hydr.		US Army COE
North Dakota	State Water Commission	Flood Hydrograph	Rainfall-R/O Com. & Mod.	X	
		Benefit-Cost Ratio	Economic Ana.	X	
		Canal Earthwork	Public Works		Bureau of Reclamation
		Streamflow Correlation	Data Ga./Corr.		US Army COE
		River Basin Model	Res.-Water Supply Man.	X	
		Dam Earthwork	Public Works	X	
		Flood Routing	Res.-Water Supply Man.	X	

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
Ohio	Dept. of Natural Res.	Water Surface Profiles (HEC-II)	River Hydraul.		US Army COE
		Regional Frequency Computation (L-2350)	Data Ga./Corr.		US Army COE
Penn.	Dept. of Environmental Res. Bureau of Res. Programming	Water Surface Profiles	River Hydraul.	X	
		Water Surface Profiles (HEC-II)	River Hydraul.		US Army COE
		Synthetic Hydrographs	Flood forecasting	X	
		Reservoir Routing	Public Works	X	
		Average Annual Damage, Comp.	Economic Ana.		US Army COE
		Culvert Design	Public Works		Bureau of Public Roads
		Flood Frequency Analysis	Flood Fore.		Penn. State Univ.
Puerto Rico	Aqueduct & Sewer Authority	P.R. Hydrological Rainfall Simulation	Res.-Water Supply Man. Data Ga./Corr. Rainfall-R/O Com. & Mod.		Prepared for the Commonwealth by Singer Information Ser.
		P.R. Hydrologic Data Bank	Res.-Water Supply Man. Sanitary Engineering Water Quality Data Ga./Corr. Rainfall-R/O Com. & Mod. Conservation		Prepared for the Commonwealth by Singer Information Ser.
		PIPENET (ICES System)	Res.-Water Supply Man.		MIT, Cambridge, Mass.

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
Puerto Rico	Aqueduct & Sewer Authority (Cont.)	STATPAC	Res.-Water Supply Man. Data Ga/Corr. Economic Ana.		USGS
Texas	Water Development Board	SIMLYD-II	Res.-Water Supply Man.	X	
		SIM-IV	Res.-Water Supply Man. Economic Ana.		Water Res. Engineers, Inc.
		MOSS-IV	Data Ga/Corr. Rainfall-R/O Com. & Mod.		Roy Beard, Center for Res. in Water Res., U of Texas/Aus.
		FILL-IN	Data Ga/Corr. Rainfall-R/O Com. & Mod.		Water Res. Engr., Inc.
		QUAL-II, DOSAG	Water Quality		EPA - Water Res. Engineers, Inc.
		LAKECO	Res.-Water Supply Man. Water Quality		Water Res. Engr., Inc.
		ECOSYM	Economic Ana.	X	
		HYD-I	Public Works Res.-Water Supply Man.		Water Res. Engr., Inc.
		SAL-I	Res.-Water Supply Man. Water Quality Estuarine Hy.		Water Res. Engr., Inc.
		ESTECO	Res.-Water Supply Man. Water Quality Estuarine Hy.		Water Res. Engr., Inc.

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
Texas	Water Development Board (Cont.)	RESOP	Res.-Water Supply Man.	X	
		GWSIM	Res.-Water Supply Man. Estuarine Water Quality	X	
		IMAGE-1	Estuarine Water Quality	X	
		AL-3	Res.-Water Supply Man.		Water Res. Engr., Inc.
		RIVTID	Flood Fore. River Hydraul.		Water Res. Engr., Inc.
		MOM	Water Quality	X	
Vermont	Water Res. Board	DOWIN	River Hydraul.		TRW, Inc.
Virginia	State Water Control Board	Water Quality Mathematical Model - Streams, Estuaries	Water Quality	X	(With Va. Institute of Marine Science)
		Water Quality Mathematical Model - Waste Discharge Permits	Water Quality	X	(With Va. Institute of Marine Science)
		Groundwater Simulation Digital Model	Groundwater	X	(With USGS Water Div.)
Washington	Dept. of Ecology	Columbia Basin (3 models)	Groundwater		USGS
		Odessa	Groundwater		USGS
		Walla Walla	Groundwater		USGS
		Pullman	Groundwater		USGS
		Spokane	Groundwater		USGS
		Yakima	Res.-Water Supply Man.		Wash. State Water Res. Center

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
West Va.	Water Resources	EPA QUAL II	Sanitary Eng. Water Quality		EPA
		EPA Horne	Sanitary Eng. Water Quality		EPA
		Curve Fittings & Model Selection Methods	Rainfall-R/O Com. & Mod. River Hydraul.		PhD Dissertation, W. Va. University
Wisconsin	Dept. of Natural Resources	Low Flow Study for Water Quality	Water Quality		USGS
Wyoming	State Engineer's Office	Water Rights Information System	Water Rights		State Dept. of Central Data Proc.
		Surface Water System	Res.-Water Supply Man. Conservation Res. Planning Economic Ana.		U. of Wyoming Water Resources Research Institute
		Reservoir Operation Model	Res.-Water Supply Man. Conservation Economic Ana. Res. Planning		State Dept. of Central Data Proc.
		Platte River Hydrologic Model	Res.-Water Supply Man. Conservation Economic Ana. Res. Planning		U. of Wyoming Water Resources Research Institute
		Lower Platte River Groundwater Model	Res.-Water Supply Man. Conservation Economic Ana. Groundwater Res. Planning		USGS

APPENDIX D

COMPUTERS IN WATER RESOURCE USE BY STATE AGENCIES

Appendix D lists the computers used by each state water resource agency, indicating utilization (whether shared or dedicated), location if not in-house, total use in hours per week, and percentage of total utilization for water resource activities.

## COMPUTERS IN WATER RESOURCE USE BY STATE AGENCIES

STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs/wk)	% of total utilization for water res. activities	
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY			
Ark.	Dept. of Commerce Div. of Soil & Water Resources	IBM 370	X			Univ. of Arkansas		Little (in Development Stage)	
Calif.	Dept. of Water Resources	CDC 3300	X		X	Sacramento	115	20	
		IBM 1130 tied to 360/195 in Suitland, Md.		X		Res. Bldg. shared with Natl. Weather Service		100	
		Nova 1220		X	X	Sacramento		100	
	State Water Project	UNIVAC 418			X	X	Sacramento	168	100
		HP 2114			X	X	Sacramento	168	100
		HP 2116			X	X	Sacramento	168	100
		HP 2110			X	X	Sacramento	168	100
		GE 4040			X	X	Sacramento	168	
		Honeywell 316			X	X	Sacramento	168	100
		DMI 620			X	X	Sacramento	168	100
PDP 85			X	X	Sacramento	168	100		

ECOSYSTEMS  
INTERNATIONAL INC.



STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs/wk)	% of total utilization for water res. activities
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY		
		CDC 6400	X			U.C. Berkeley	1	Unknown
Idaho	Dept. of Water Resources	IBM 370/145	X			Idaho State Office Bldg., Boise (State Auditor's Office)	1	Unknown
Ill.	Dept. of Transportation. Div. of Waterway	IBM 360/155	X		X		40	
	State Water Survey	WANG 3300		X	X		50 (several consoles)	100
		IBM 360	X			Univ. of Ill.	20	Unknown
Kan.	Water Resources Board	Honeywell 635		1		Kansas Univ. Computation Center	2-10	100
Ken.	Dept. for Natural Resources, Div. of Water Resources	IBM 370/165	X		X		Shared by all State Agencies	1
Md.	Dept. of Natural Resources	IBM 370/155	X					\$3000/mo for time & storage
	Water Resources Administration	IBM 370/168 or 155	X			McLean, Va.	Unknown	20 hrs/wk
Mass.	Water Resources Comm. Div. of Water Res.	IBM 370/145	X			Dept. of Public Works, Boston		
	Div. of Water Pollution Control	IBM 370/145	X			Dept. of Public Works, Boston	5-10	
Miss.	Board of Water Commissioners	Unknown				Waterways Exper. Station, Vicksburg		Unknown

STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs/wk)	% of total utilization for water res. activities
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY		
Mont.	Dept. of Natural Resources & Conservation	IBM 370/145	X			Dept. of Admin.		
		Sigma 7	X			Mont. State Univ.		
N.D.	State Water Comm.	IBM 370/145	X			State Central Data Processing, Highway Bldg.	110	1.5
		IBM 360/20	X			State Central Data Processing, Hgwy. Bld.	40	0
Ohio	Dept. of Natural Resources	IBM 370/158				State of Ohio Data Center	5 min.	5
Pa.	Dept. of Environ. Resources Bureau of Resources Prog.	Burroughs B-670J	X			Dept. of Transpor.	3	100
Puerto Rico	Aqueduct & Sewer Authority	IBM 360/40	X		X		100	0
		IBM 370	X			P.R. Highway Authority Scientific Cen.		0
Tex.	Water Development Board	UNIVAC 1106	X		X		125	38
Vt.	Water Resources Board	IBM 370/158		X		Bethesda, Md.	20	100
		IBM 360/148	X		X			Minimal

STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs/wk)	% of total utilization for water res. activities	
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY			
Va.	Dept. of Conservation & Economic Development, State Water Control Board	IBM 370/158	X			Private Contractor in Richmond			
		IBM 370/158	X			Va. Dept. of Motor Vehicles, Richmond			
		IBM 370/145	X			Va. Commonwealth Univ., Richmond			
		IBM 360/50	X						
	Va. State Water Control Board, Bureau of Water Control Management		X	X		Va. Commonwealth Univ. of Richmond	2	2	
Wash.	Dept. of Ecology	USGS & WSU Facilities used							
W. Va.	Water Resources	IBM 360-series				W.V.U., Morgantown, W. Va.			
Wisc.	Dept. of Natural Resources (Figures in last column are total DNR Water Resources terminal time; do not include total usage for out of house computers.)	IBM 155	X			Boeing Computer Services, Va.	10		
		IBM 360/155 IBM 370/158	X			Optimum Systems Inc. Bethesda	30		
		UNIVAC 1110	X			Univ. of Wisc. Madison	15		
		UNIVAC 9400		X	X		(35 water resources)	140	25

STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs./wk)	% of total utilization for water res. activities
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY		
		IBM 370	X			Dept. of Admin. Madison	7	
		Cal. Comp. Plotter	X			Dept. of Trans. Madison	1	
Wyo.	State Engineer's Office	Sigma 7	Unknown to user	Unknown to user		Univ. of Wisc.	Unknown to user	Unknown to user
		IBM 370/155				State Dept. of Central D.P.		

APPENDIX E

WATER RESOURCE ACTIVITIES OF STATE

WATER RESOURCE RESEARCH INSTITUTES

Appendix E summarizes the activities of state Water Resources Research Institutes by percentage of time devoted to different areas of research.

## WATER RESOURCE ACTIVITIES OF STATE WATER RESOURCE INSTITUTES

STATE	AGENCY	ACTIVITIES CONDUCTED (% of time for Res.)	FLOOD FORECASTING	PUBLIC WORKS DESIGN	RESERVOIR-WATER SUPPLY MGMT.	SANITARY ENGINEERING	WATER QUALITY	DATA GATHERING & CORRELATION	RAINFALL-RUNOFF COMPUTATION & MODELING	SNOWMELT	CONSERVATION	RIVER HYDRAULICS	ECONOMIC ANALYSIS	GROUNDWATER	WATER RIGHTS	RESOURCES PLANNING	OTHER
Calif.	Water Resources Center	Does not conduct in-house research.															
Colo.	Dept. of Earth Resources						10	15	5	40		5				25	
Hawaii	Water Resources Research Center	X	X	X	X	X	X	X	X			X	X			X	
Idaho	Water Resources Research Institute	1	2	3	2	20	3+	3	1		10	15	15			3	(1)
La.	Water Resources Research Institute	5	10	15		10	25	5				5	15			10	(2)
Maine	Environmental Studies Center					10	50	20					10			10	
Mont.	Mont. U. Joint Water Resources Res. Center			X	X	X	X	X	X			X	X			X	
Neb.	Water Resources Research Institute					20	30		25				10			15	

- (1) Public Attitude Surveys 2%  
 Fishery Res. 15%  
 Legal 5%

- (2) Deep Well Waste Disposal

\*X = Mentioned, but no percentage figures given.

STATE	AGENCY	ACTIVITIES CONDUCTED (% of time for Res.)	FLOOD	FORECASTING	PUBLIC WORKS DESIGN	RESERVOIR-WATER SUPPLY MGMT.	SANITARY ENGINEERING	WATER QUALITY	DATA GATHERING & CORRELATION	RAINFALL-RUNOFF COMPUTATION & MODELING	SNOWMELT	CONSERVATION	RIVER HYDRAULICS	ECONOMIC ANALYSIS	GROUNDWATER	WATER RIGHTS	RESOURCES PLANNING	OTHER
Nev.	Water Resources Res. Center, Desert Res. Institute		2.8	0.5	4.5	0.3	17.8	15.9	2.4	1.0	17.7	1.1	0.9	20				(3)
Puerto Rico	Water Resources Research Institute			12.5	25	12.5	12.5										12.5	(4)
S.C.	Clemson Univ. Water Res. Res. Institute				15		30					10	15				30	
Tenn.	Water Resources Research Center																	

- (3) Geothermal Energy 5.1%  
 Radionuclide Transport 10%
- (4) Identification of Water Resource Problems and Needs 12.5%  
 Hydrogeologic Studies 12.5%

APPENDIX F

HYDROLOGIC MODELS USED BY STATE

WATER RESOURCE RESEARCH INSTITUTES

Appendix F lists hydrologic models used by the state Water Resources Research Institutes. Applications and origins of the models are also included.



## HYDROLOGIC MODELS USED BY STATE WATER RESOURCE INSTITUTES

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
Colo.	Dept. of Earth Resources, Colo. State Univ.	CSU Version of Kentucky	Rainfall-R/O Computation & Mod. Snowmelt		Kentucky Version of Stanford Watershed Model
		Leavesley CSU Model	Rainfall-R/O Com. & Mod. Snowmelt	X	
		Leaf Model	Rainfall-R/O Com. & Mod. Snowmelt		U.S. Forest Service
		ELM	Ecological Research Related to Water		Total Ecosystem Model Incl. Hydrologic Systems
		SOGCY	Rainfall-R/O Com. & Mod. Ecological Res. Re. to Water		AEC, ET Model
Hawaii	Water Resources Res. Center, University of Hawaii	Hawaii Watershed Model, modified from Kentucky Watershed Model	Initial investigation done in testing stage	X	
		Conceptual non-linear hydrograph simulation model	Preliminary report done in testing stage	X	
		Instantaneous unit hydrograph model	Study completed	X	
		Several water quality models	Study progress	X	
Idaho	Water Resources Research Institute	Ralston's Raft River Model	Groundwater	X being dev.	

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
		Snake Plain Model	Groundwater	X being dev.	
		An array of 3-4 dozen standardized statistical and hydrological/hydraulic models. (Count as 42)		X	
Indiana	Water Resources Research Center Purdue University	Stanford Watershed			Stanford Univ.
		Streeter-Phillips			
La.	La. Water Resources Research Institute La. State Univ. & Agricultural & Mechanical College	Lafourche Bayou Hydraulic	Flood Fore. Ecological Res. Re: to Water River Hydraul. Water Quality	X	
		Qual 1 - Modify	Water Quality		Texas Water Board
		Mississippi River Salt Water Intrusion	Water Quality River Hydraul.	X	
		Storage of Water in Saline Aquifer	Res.-Water Supply Man. Water Quality	X	
		Movement of Wastes in Deep Well Disposal Projects	Deep Well Waste Disposal		
Montana	Montana Univ. Joint Water Resources Research Center	Water Planning Model	Public Works Design Res.-Water Supply Man.	X	Now being used by Mont. State Dept. of Natural Resources
		Reservoir Operations Model	Res.-Water Supply Man.	X	Produced for Mont. State Dept. of Natural Resources

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
Nebraska	Water Resources Research Institute Univ. of Neb. Lincoln	Stanford			Stanford Univ
		Nebraska Hydrologic Model		X	
Nevada	Center for Water Resources Research Desert Research Institute, Univ. of Nevada System	Jacobsen Water Chemistry Prog.	Water Quality		Penn State Univ.
		Cooley SIP	Groundwater Geothermal Energy Radionuclide Transport	X	
		Stanford Watershed Model	Rainfall-R/O Com. & Mod.	Modifica- tions	Stanford Univ., Palo Alto, California
		Carson-Truckee Simulation Model	Res.-Water Supply Man. Sanitary Eng. Snowmelt River Hydraulics Economic Ana	X	
		Frequency Distribution Selector	Flood Fore. Rainfall-R/O Com. & Mod.	X	
		Water Distribution Network Analysis	Public Works	Modifica- tions	Dr. Don Wood, Univ. of Kentucky
		Finite Difference River Flow	River Hydraulics	X	
		Wastewater Treatment Plant Performance Variability	Sanitary Eng.	X	
		Serial Correlation, Spectral and Cross-Spectral Analysis	Data Correlation Water Quality	X	
Sequential Flow Simulator	Flood Fore. Data Corr.		U.S. Corp. of Engineers Hydrologic Engr. Center Davis, Calif.		

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
		DOSAG	Sanitary Engg Water Quality	Modifica- tions	Environ. Dynamics, Mod of Texas Water Dev. Board
		Unsteady Finite Element Model	Groundwater Hydraulics	X	
		Steady State Finite Element Model	Groundwater Hydraulics	X	
So. Caro.	Water Resources Research Institute Clemson Univ.	Stanford Watershed Model (Kentucky Version), Ligon	Rainfall-R/O Com. & Mod.		Dr. L. Douglas James, Univ. of Ken. (now GI)
		Snyder Basin Yield Model, Wilson, Ligon, Law	Rainfall-R/O Com & Mod.		Mr. W.M. Snyder, ARS, USDA, Athens, Ga.

APPENDIX G

COMPUTERS IN WATER RESOURCE USE BY STATE

WATER RESOURCE RESEARCH INSTITUTES

Appendix G lists the computers used by each state Water Resources Research Institute, indicating utilization (whether shared or dedicated), location if not in-house, total use in hours per week, and percentage of total utilization for water resource activities.

## COMPUTERS IN WATER RESOURCE USE BY WATER RESOURCE RESEARCH INSTITUTES

STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs/wk)	% of total utilization for water res. activities
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY		
Colo.	Dept. of Earth Res Colo. State Univ.	CDC 6400	X		X		10 by this dept.	50
		WANG 520			X		20	5
		HP 35			X		10	85
Hawaii	Water Resources Research Center Univ. of Hawaii	Aloha System	X	X	X		Unknown to user	Unknown to user
		IBM 7040/1401	X	X	X		Unknown to user	Unknown to user
		IBM 360/65	X	X	X		Unknown to user	Unknown to user
Idaho	Water Resources Research Insititute	Both digital and analog models are used. We operate on 3 major computer center facilities, a number of desk top programs & a few terminals.						
Ind.	Water Resources Research Center, Purdue Univ.	CDC 6500/ IBM 7094						
		CDC 1700 & 2 EAI 680 analog						
		DEC-PDP-11 Other computers as well						
La.	Water Resources Research Institute La. State Univ.	IBM 360/65	X		X		84.6	<5
Maine.	Environ. Studies Center, Univ. of Maine at Orono	IBM 370/145			X		160	2

STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs/wk)	% of total utilization for water res. activities
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY		
Mont.	Mont. Univ. Joint Water Resources Research Center	Xerox Sigma		X		MSU - Bozeman	112	Unknown to user
		IBM 1620		X		Mont. College of Mineral Science & Tech., Butte	Unknown to user	Unknown to user
		IBM 360		X		State of Montana Helena, Mont.	Unknown to user	Unknown to user
		Digital Eq. Corp. DEC 10		X		Univ. of Mont. Missoula, Mont.	Unknown to user	Unknown to user
Neb.	Water Resources Research Institute Univ. of Neb. Lincoln	IBM 360/65						
Nev.	Desert Research Institute, Center for Water Resources Research	CDC 6400	X			Univ. of Nev. System, Reno, Nev.	96	5
		CDC 6400	X			US AEC, Las Vegas Nev.	96	1
		WANG	X		X		35	100
		HP-45 (2)	X		X		30	100
		HP-35 (4)	X		X		30	100
Puerto Rico	Water Resources Res. Institute, U. of PR	IBM 360	X			U.P.R.		<1
S.C.	Clemson Univ., Water Res. Res. Institute	IBM 370/158VS		X	X		41.4	5

APPENDIX H

SUMMARY OF RESPONSES FROM UNIVERSITIES

Appendix H summarizes the water resource activities of universities by percentage of time devoted to different areas of research. Also included are the hydrologic models and computers utilized.



## WATER RESOURCE ACTIVITIES OF UNIVERSITIES

STATE	AGENCY	ACTIVITIES CONDUCTED (% of time for Res.)	FLOOD FORECASTING	PUBLIC WORKS DESIGN	RESERVOIR-WATER SUPPLY MGMT.	SANITARY ENGINEERING	WATER QUALITY	DATA GATHERING & CORRELATION	RAINFALL-RUNOFF COMPUTATION & MODELING	SNOWMELT	CONSERVATION	RIVER HYDRAULICS	ECONOMIC ANALYSIS	GROUNDWATER	WATER RIGHTS	RESOURCES PLANNING	OTHER
Kan.	Univ. of Kansas Chem. & Pet. Engr.													20			
Ken.	Univ. of Kentucky Agri. Engr.			20			30	40				10					
Mich.	Mich. State Univ. Civil Engr.													100			
Neb.	Univ. of Nebraska Agri. Engr.	1/3 of personal research time												5			
N.C.	N.C. State Univ. Civil Engr.						50					50					
	N.C. State Univ. Bio & Agri. Engr.							40	40								
Ohio	Ohio State Univ. Civil Engr.						10	5	20	5		10					
	Ohio State Univ. Agronomy																(1)

(1) Aquifer Characteristics Modeling 10%

STATE	AGENCY	ACTIVITIES CONDUCTED (% of time for Res.)	FLOOD FORECASTING	PUBLIC WORKS DESIGN	RESERVOIR-WATER SUPPLY MGN.C.	SANITARY ENGINEERING	WATER QUALITY	DATA GATHERING & CORRELATION	RAINFALL-RUNOFF COMPUTATION & MODELING	SNOWMELT	CONSERVATION	RIVER HYDRAULICS	ECONOMIC ANALYSIS	GROUNDWATER	WATER RIGHTS	RESOURCES PLANNING	OTHER
Ind.	Purdue Univ. Agri. Engr.							20	25								
Tex.	Univ. of Tex/Austin Mech. Engr.			20		20						20					(2)
Utah	Utah State Univ. Forest Science						50	(3) 50									
Va.	VPI & State Univ. Agri. Engr.						5	30	60							5	(4)

(2) One project only.

(3) Modeling only.

(4) Soil Moisture Accounting (Irrigation Forecasting)

## HYDROLOGIC MODELS USED BY UNIVERSITIES

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
Kansas	Univ. of Kansas Chem. & Pet. Engr.	Basin Hydrology Simulator	Groundwater Confined and Unconfined Aquifers Flow in Un- Saturated Zone	X	
		Flow in Unsaturated Zone	Groundwater Confined and Unconfined Aquifers Flow in Un- Saturated Zone	X	
		Aquifer Simulator	Groundwater Confined and Unconfined Aquifers Flow in Un- Saturated Zone	X	
Kentucky	Univ. of Ken. Agri. Engr.	4 Parameter Water Yield Model	Res.-Water Supply Man. Rainfall-R/O Com. & Mod. Ecological Research Re- lated to Water	X	
		Thomas-Fiering	Res.-Water Supply Man. Rainfall-R/O Com. & Mod. Ecological Res. Re. to Water		Harvard

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
Michigan	Michigan State Univ. Civil Engr.	Finite Element - Unsteady Groundwater Flow	Groundwater Management	X	
Nebraska	Univ. of Nebraska	Recharge Simulation	Groundwater Recharge	X	
No. Caro.	N.C. State Univ. Civil Engr.	Implicit Hydrodynamic Model	River Hydrau.	X	
		Explicit Water Quality	Water Quality	X	
	N.C. State Univ. Bio. & Agr. Engr.	SSARR	Rainfall-R/O Com. & Mod.		COE
		Many others being tested.			
Ohio	Ohio State Univ. Civil Engr.	O.S.U. Version of the Stan- ford Watershed Model	Water Quality Rainfall-R/O Com. & Mod. Snowmelt	Partially	Stanford Group Hydro- comp
		HEC II	River Hydrau.		COE
		Acid Mine Drainage Unit Source Models	Water Quality Economic Ana.	X	
	Ohio State Univ. Agronomy	Mathematical (Numerical Analysis)	Aquifer Char- acteristics Mod. Aspect Only	Basically	"Other" with some modification "In" house."
Ind.	Purdue Univ. Agric. Engr.	Distributed Parameter Water- shed Model	Rainfall-R/O Com. & Mod.	X	
Texas	Univ. of Texas/Austin Mechanical Engr.	Out of Kilter Algorithm	Network Flow Optimization Algorithm (Res.-Water Supply Man., Economic Ana.)	X	

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
		Gain	Res.-Water Supply Man. Water Quality Economic Ana.	X	
		CAPEX	Economic Ana.	X	
Utah	Utah State Univ. Forest Science	No name	Rainfall-F/O Modeling		
Virginia	VPI & State Univ. Agri.Engr.	Stanford VPI & SU Modification	Water Quality Rainfall-R/O Com. & Mod. Ecological Res. Re. to Water	X	Stanford University
		Kentucky Watershed Model	Rainfall-R/O Com. & Mod.		Univ. of Kentucky (Mod. of Stanford Model)
		USDA Hydrograph Model	Rainfall-R/O Com. & Mod.		USDA Hydrograph Lab Beltsville, Md.
		Soil Water Model	Soil Moisture Accounting (Irrigation Forecasting)	X	

STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs/wk)	% of total utilization for water res. activities
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY		
Kansas	Univ. of Kansas Chem. & Pet. Engr.	Honeywell 625 series			X	Services entire	160	Unknown
Ken.	Univ. of Kentucky Agri. Engr.	IBM 360/65			X		personal usage 14 hrs during last year	95
Mich.	Mich. State Univ. Civil Engr.	CDC 6500					168	<1
Neb.	Univ. of Neb. Agri. Engr.	IBM 360/65		X	X		personal usage 1	100
N.C.	N.C. State Univ. Civil Engr.	IBM 360					1	
	N.C. State Univ. Bio. & Agri. Engr.	IBM 370/165	X			TUCC (Triangle Univ. Computation Center)	?	<1
Ohio	Ohio State Univ. Civil Engr.	IBM 370/165				Terminals throughout campus		
	Ohio State Univ. Agronomy	IBM 360/75				Main campus	1.	30
Ind.	Purdue Univ. Agri. Engr.	PDP-11/20	X				100	5
Tex.	Univ. of Tex/Austin Mech. Engr.	CDC 6500					100	Unknown
		CDC 6500		X			n/a	n/a

ECOSYSTEMS  
INTERNATIONAL INC.

STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs/wk)	% of total utilization for water res. activities
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY		
Utah	Utah State Univ. Forest Science	Burroughs 7600	Unknown	Unknown		USU	Unknown	Unknown
		WANG 600 desk- top mini-com puter	X			LAB	25% of time	80
Va.	VPI & State Univ. Agri. Engr.	IBM 370						

ECOSYSTEMS  
INTERNATIONAL INC.

APPENDIX I

SUMMARY OF RESPONSES FROM PRIVATE CONSULTANTS

Appendix I lists the hydrologic models and computers utilized by the private contractors surveyed.



**COMPUTERS IN WATER RESOURCE USE BY PRIVATE CONSULTANTS**

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGI. OF MODEL	
				IN HOUSE	OTHER
Md.	Wilson T. Ballard	Mathematical Models	Flood Control	X	
Md.	Dalton-Dalton-Little Newport	HEC II	Flood Plain Delineation		COE
Md.	Hittman	Water Demand Forecasting Models		X	
		Drainage Design Models		X	
		EPA Stormwater Management Model			EPA
Md.	Maty, Childs, and Associates	SCS series of Models, inc. TR-20			SCS
		Backwater and Floodwater Models			TAMS
		Bureau of Roads Programs			Bureau of Roads
		Log-Pearson Flood Distribu- tion Programs			Log-Pearson
		EPA Programs	Water Quality		EPA
Md.	Rummel, Klepper and Kahl	SCS package, incl. TR-20 & 8 other Programs	Flood Routing Unit Hydro- graph Reservoir Studies		SCS
Md.	Whitman, Requardt & Associates	HEC II			COE
		Package of Small Storm Drainage & Backwater Models			



APPENDIX J

SUMMARY OF ACTIVITIES AND BUDGETS OF MAJOR  
FEDERAL WATER AGENCIES

Appendix J gives information on the activities, location and detailed budget of each of the eleven major federal water resources research agencies.

United States Department of Agriculture

Agricultural Research Service

A. Activities

1. Watershed development research

- a. Research using experimental watersheds & changing various conditions (ex. effects of land use, watershed management schemes on runoff, streamflow, etc.)
- b. Development of methods of prediction of sediment properties & sources
- c. Control of reservoir sedimentation
- d. Erosion control
- e. Hydraulic design

2. Soil and water conservation and development research

- a. Recharging groundwater; sewage filtering
- b. Water harvest
- c. Irrigation
- d. Improving agricultural drainage systems
- e. Reduction of salinity damage
- f. Improving water-use efficiency on non-irrigation lands
- g. Energy conversion

3. Agricultural pollution

- a. Disposal of animal waste
- b. Control of pesticides
- c. Control of fertilizer pollution
- d. Development of pesticide pollutant equipment
- e. Disposal of sludge
- f. Elimination of water pollution from processing of agricultural products

4. Remote sensing research
5. Production efficiency research - improved agricultural products & facilities

B. Locations

1. Beltsville, Md. Regional Office
2. Peoria, Ill. Regional Office
3. New Orleans, La. Regional Office
4. Berkeley, Calif. Regional Office

DEPARTMENT OF AGRICULTURE  
Agricultural Research Service

Allocation of Funding by Fiscal Years  
(thousands of dollars)

<u>Research Category</u>	<u>FY 1971</u> (actual)	<u>FY 1972</u> (actual)	<u>FY 1973</u> (estimate)
II. Water Cycle			
A. General	1,155	1,336	1,057
B. Precipitation	466	597	605
C. Snow, ice, and frost	177	277	120
D. Evaporation and transpiration	863	902	936
E. Streamflow and runoff	387	406	464
F. Groundwater	238	147	165
G. Water and soils	642	609	656
I. Water in plants	249	203	131
J. Erosion and sedimentation	1,864	1,961	2,196
SUBTOTAL	<u>6,041</u>	<u>6,438</u>	<u>6,330</u>
III. Water Supply Augmentation and Conservation			
B. Water yield improvement	603	294	315
C. Use of water of impaired quality	1,326	1,383	1,319
D. Conservation in domestic & municipal use	20	5	20
F. Conservation in agricultural use	1,339	2,539	2,573
SUBTOTAL	<u>3,288</u>	<u>4,221</u>	<u>4,227</u>
IV. Water Quantity Management and Control			
A. Control of water on the surface	2,040	2,129	1,957
B. Groundwater management	599	315	341
D. Watershed protection	1,031	1,011	1,055
SUBTOTAL	<u>3,670</u>	<u>3,454</u>	<u>3,352</u>
V. Water Quality Management and Protection			
A. Identification of pollutants	500	577	577
B. Sources and fate of pollution	1,209	1,507	1,543
C. Effects of pollution	190	295	214
D. Waste treatment processes	2,675	3,766	3,762
E. Ultimate disposal of wastes	231	341	412
F. Water treatment and distribution	74	77	67
G. Water quality and distribution	737	849	948
SUBTOTAL	<u>5,616</u>	<u>7,412</u>	<u>7,523</u>
VII. Resource Data			
B. Data Acquisition	98	96	95
C. Evaluation, processing & publica- tion	75	84	84
SUBTOTAL	<u>173</u>	<u>180</u>	<u>170</u>

DEPARTMENT OF AGRICULTURE  
Agricultural Research Service

Allocation of Funding by Fiscal Years  
(thousands of dollars)

Research Category Cont.	<u>FY 1971</u> (actual)	<u>FY 1972</u> (actual)	<u>FY 1973</u> (estimate)
VIII. Engineering Works			
A. Structures	20	5	20
B. Hydraulics	<u>357</u>	<u>208</u>	<u>217</u>
SUBTOTAL	377	213	237
TOTAL	19,165	21,918	21,848
EXTRAMURAL: (included in categories and Total above)			
Contracts and co-op agreements	92	103	no estimate

SOURCE: Federal Water Resources Research Program for 1972:  
William S. Butcher, O.W.R.R., p. 5-6.

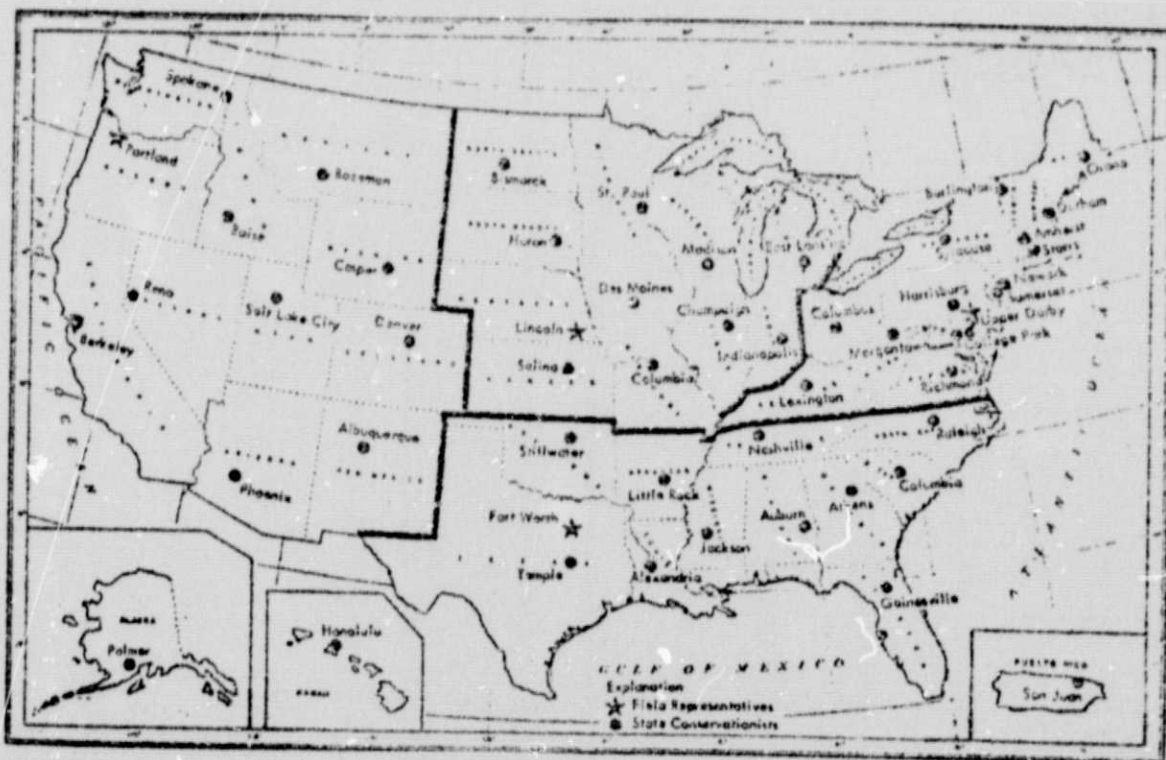
United States Department of Agriculture

Soil Conservation Service

A. Activities

1. Watershed planning
  - a. Flood prevention
  - b. Water development, utilization & conservation
2. Snow melt & yield - total volume by month
3. Storm runoff as a function of averaged land use, soil type, & rainfall using a statistical analysis of historic storms
4. Stream routing with hydrographs
5. Just beginning in urban hydrology, studying the effects of changed land use
6. Radiation as a measure of water content of snow
7. Using TR-20 on a national scale

B. Locations of Soil Conservation Service Region and Office



Source: The Water Encyclopedia, Water Resources Council, p. 472



C. Budget FY 1973

River Basin Surveys & Investigations	\$ 11,855,000
Conservation Operations - Technical Programming, Installation Services & Snow Surveys	138,734,000
Watershed Planning - Small Watershed Project Investigations & Planning	7,786,000
Watershed & Flood Prevention Operations	<u>170,029,000</u>
Total	\$328,404,000

Source: The Budget of the U.S. Government, FY 1975

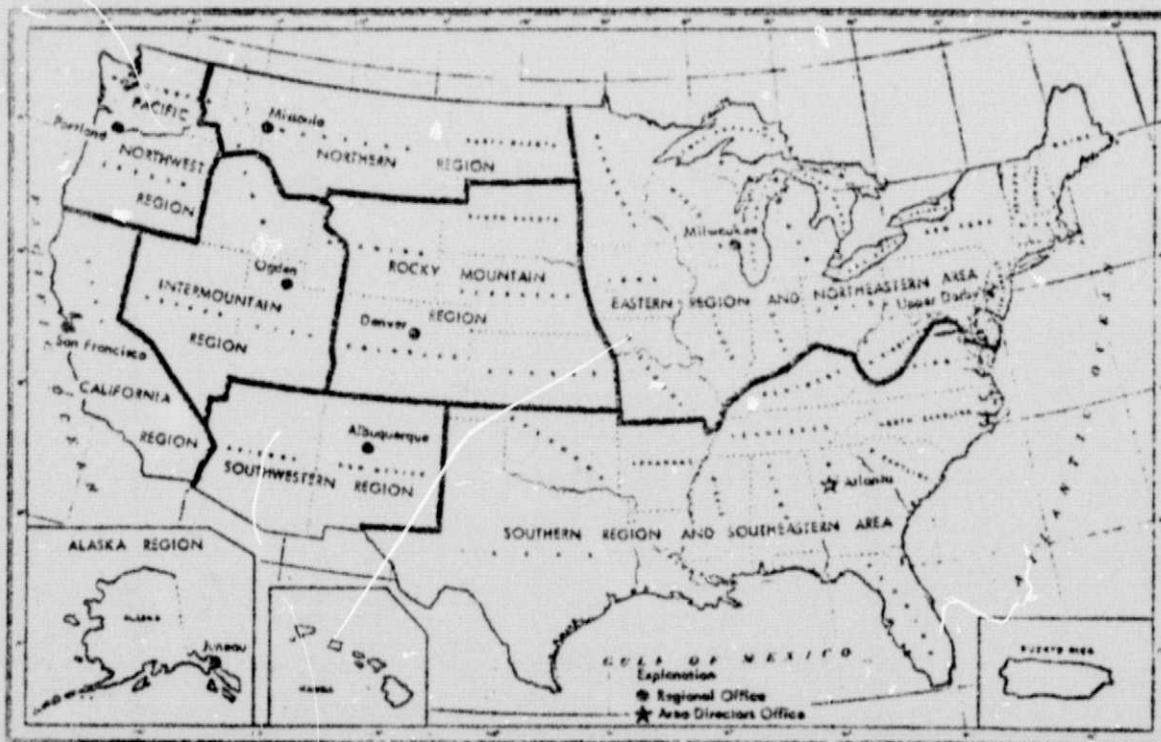
United States Department of Agriculture

Forest Service

A. Activities

1. Water yield improvement
  - a. Watershed management for flow control
  - b. Influence of vegetative cover on streamflow
  - c. Water movement through forest soil
  - d. Improvement of snowpack water yield through forest management
2. Watershed protection
  - a. Land use effects on watersheds
  - b. Minimization of soil disturbances & erosion
  - c. Watershed rehabilitation
3. Soil and water quality protection
  - a. Research in wetland forest hydrology
  - b. Forest pollution control

B. Locations of Forest Service Regions and Offices



Source: The Water Encyclopedia, Water Resources Council, p. 474

DEPARTMENT OF AGRICULTURE

Forest Service

Allocation of Funding by Fiscal Years  
(thousand of dollars)

<u>Research Category</u>	<u>FY 1971</u> (actual)	<u>FY 1972</u> (actual)	<u>FY 1973</u> (estimate)
II. Water Cycle			
A. General	63	261	185
B. Precipitation	12	86	74
C. Snow, ice, & frost	145	399	375
D. Evaporation and transpiration	272	292	376
F. Groundwater	92	22	22
G. Water in soils	446	542	510
I. Water in plants	513	384	577
J. Erosion and sedimentation	<u>169</u>	<u>252</u>	<u>246</u>
SUBTOTAL	1,712	2,238	2,165
III. Water Supply Augmentation and Conservation			
B. Water yield improvement	1,625	1,963	1,889
IV. Water Quality Management and Control			
A. Control of water on the surface	494	523	554
C. Effect of man's nonwater activities	184	245	235
D. Watershed protection	<u>605</u>	<u>857</u>	<u>834</u>
SUBTOTAL	1,283	1,625	1,623
V. Water Quality Management and Protection			
B. Sources and fate of pollution	155	186	239
C. Effects of pollution	--	57	150
E. Ultimate disposal of wastes	14	15	15
G. Water quality control	<u>43</u>	<u>52</u>	<u>66</u>
SUBTOTAL	212	310	470
TOTAL	4,832	6,136	6,147

Source: Federal Water Resources Research Program for 1972,  
William S. Butcher, O.W.R.R., p. 16

Department of Commerce

NOAA

A. Activities

1. Hydrologic forecasting
2. Hydrologic modeling
3. In charge of research in sensing equipment and data acquisition
4. Weather data collection & analysis
5. Lake Hydrology

B. Location

1. Western Division
  - a. Seattle, Wash. - Coast & Geodetic Survey Marine Center
  - b. Salt Lake City, Utah - Weather Bureau Regional Office
2. Central Division
  - a. Boulder, Colo. - Research Laboratory
  - b. Kansas City, Mo. - Weather Bureau Regional Office, Coast & Geodetic Survey Field Director Headquarters
3. Southern Division - Fort Worth, Tex. - Weather Bureau Regional Office
4. Eastern Division
  - a. New York - Weather Bureau Regional Office
  - b. Norfolk, Va. - Coast & Geodetic Survey Marine Center
5. Pacific Division - Honolulu, Hawaii - Weather Bureau Regional Office
6. Alaska Division - Anchorage, Ala. - Weather Bureau Regional Office
7. Washington, D.C. - National Headquarters

Source: Federal Water Resources Research Program for 1972,  
William S. Butcher, C.W.R.R., p. 18

DEPARTMENT OF COMMERCE

Allocation of Funding by Fiscal Years  
(thousands of dollars)

<u>Research Category</u>	<u>FY 1971</u> (actual)	<u>FY 1972</u> (actual)	<u>FY 1973</u> (estimate)
I. Nature of Water	-	-	50
II. Water Cycle	1,057	2,304	3,545
III. Water Supply Augmentation & Conservation	83	99	10
IV. Water Quantity Management & Control	-	320	320
V. Water Quality Management & Protection	874	1,343	5,044
VI. Water Resource Planning	1,350	1,140	1,530
VII. Resources Data	1,533	2,448	2,660
IX. Manpower, Grants and Facilities	2,028	2,458	1,007
X. Scientific and Technical Information	-	50	520
TOTAL	6,925	10,162	15,136

Breakdown by office:

Bureau of Domestic Commerce	83	99	100
National Oceanic and Atmospheric Administration			
National Weather Service	790	805	808
National Marine Fisheries	2,751	2,603	5,708
National Ocean Survey	1,367	1,570	2,870
Office of Sea Grant	1,386	1,895	2,450
International Field Year for the Great Lakes	548	3,240	3,200

Source: Federal Water Resources Research Program for 1972,  
William S. Butcher, O.W.R.R., p. 18

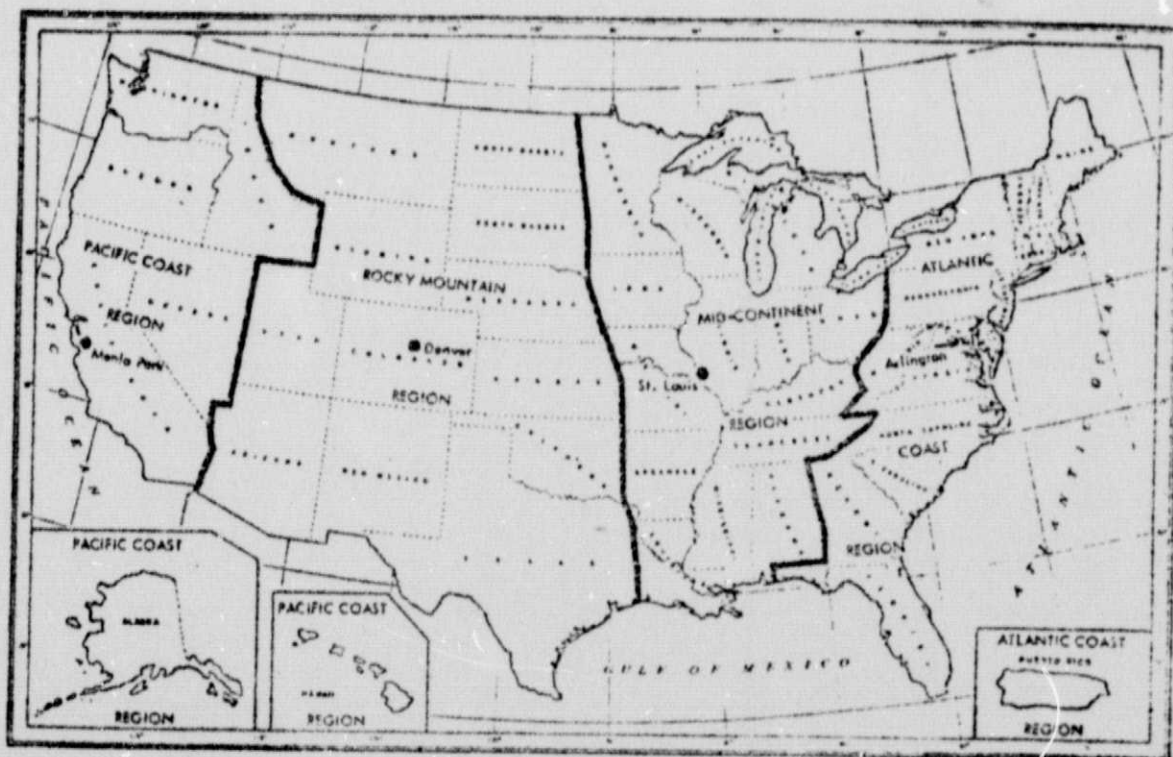
Department of the Interior

Geological Survey

A. Activities

1. Flood magnitude & frequency
2. Hydrologic modeling
3. Remote sensing application in water resource mapping
4. Water losses from evaporation
5. Hydrodynamics of groundwater
6. Estuarine research
7. Urban storm drainage
8. Examination of water requirements of Federal lands
9. Stream and lake and reservoir data acquisition
10. Flood plain mapping
11. Sedimentation

B. Locations of U.S.G.S. Regions and Offices



DEPARTMENT OF THE INTERIOR

Geological Survey

Allocation of Funding by Fiscal Years  
(thousands of dollars)

<u>Research Category</u>	<u>FY 1971</u> (actual)	<u>FY 1972</u> (actual)	<u>FY 1973</u> (estimate)
I. Nature of Water	0	0	50
II. Water Cycle	7,360	7,680	7,730
III. Water Supply Augmentation and Conservation	540	650	280
IV. Water Quantity Management and Control	1,810	2,053	1,910
V. Water Quality Management and Protection	1,230	1,878	1,930
VI. Water Resources Planning	260	471	130
VII. Resources Data	2,740	1,728	1,960
IX. Manpower, Grants, and Facilities	430	532	550
X. Scientific and Technical Information	<u>60</u>	<u>46</u>	<u>47</u>
TOTAL	14,430	15,038	14,587

Source: Federal Water Resources Research Program for 1972,  
William S. Butcher, O.W.R.R., p. 54.

Department of the Interior

Bureau of Reclamation

A. Activities

1. Water supply and distribution investigations
2. Water resource project planning & management
3. Sedimentation
4. Cloud seeding/Weather modification
5. Irrigation

B. Locations of Bureau of Reclamation Region and Office



Source: The Water Encyclopedia, Water Resources Council, p. 499



DEPARTMENT OF THE INTERIOR

Bureau of Reclamation

Allocation of Funding by Fiscal Years  
(thousands of dollars)

<u>Research Category</u>	<u>FY 1971</u> (actual)	<u>FY 1972</u> (actual)	<u>FY 1973</u> (estimate)
Atmospheric Water Resources Management	6,574	6,559	6,388
Regional Research	220	479	444
Water Resources Planning and Engineering Research	<u>2,434</u>	<u>2,884</u>	<u>2,468</u>
TOTAL	9,228	9,922	9,300

Distribution of Funding  
(thousands of dollars)

	<u>FY 1971</u>	<u>FY 1972</u>	<u>FY 1973</u>
In house	3,549	4,218	4,181
Industry	1,303	943	1,006
University	3,818	4,124	3,518
Other	558	637	595

Source: Federal Water Resources Research Program for 1972,  
William S. Butcher, O.W.R.R., p. 45

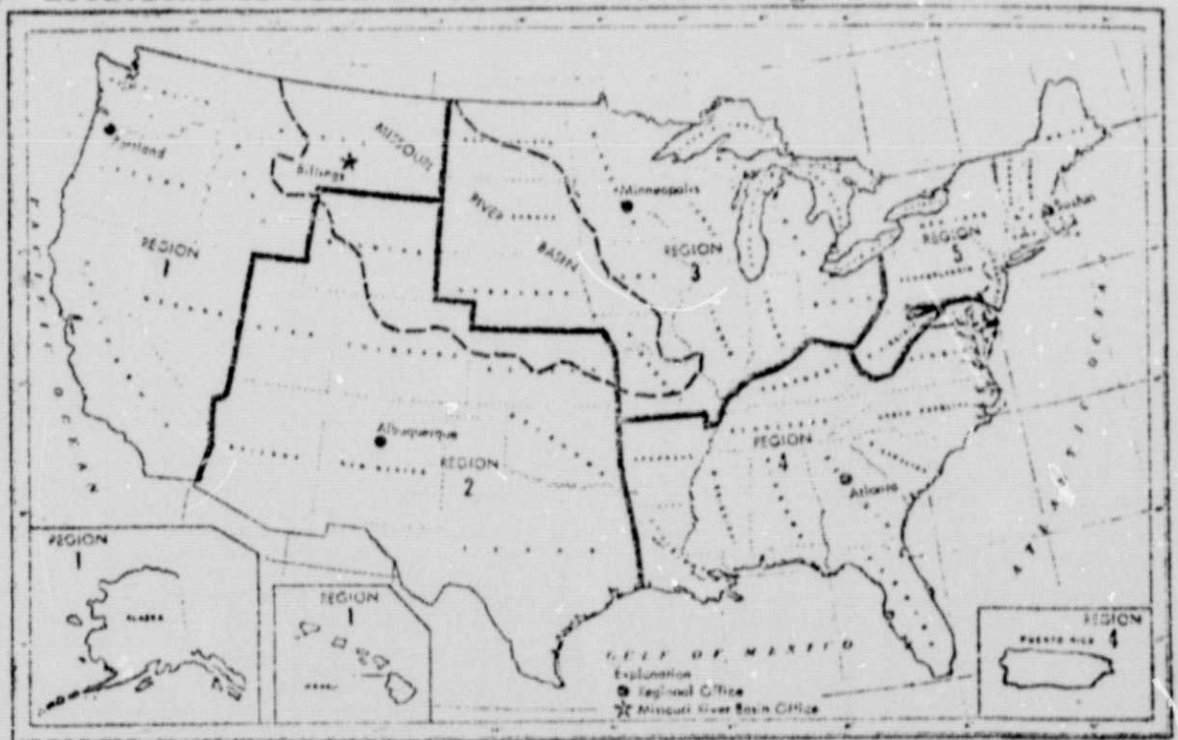
Department of the Interior

Fish and Wildlife Service

A. Activities

1. Fresh water inventory
2. Wetland inventory
3. Sea ice breakup studies
4. Remote sensing to assist impact of water development projects on fish and wildlife resources
5. Coastal marsh inundation
6. Surface area in small impoundments as related to production of fishes
7. Thermal pollution investigation

B. Locations of Fish & Wildlife Service Regions & Offices



Source: The Water Encyclopedia, Water Resources Council

DEPARTMENT OF THE INTERIOR

Fish & Wildlife Service

Allocation of Funding by Fiscal Years  
(thousands of dollars)

<u>Research Category</u>	<u>FY 1971</u> (actual)	<u>FY 1972</u> (actual)	<u>FY 1973</u> (estimate)
Thermal Pollution	108	224	535
Water Quality	2,416	2,638	2,460
Conserving Ecological Values in Water Resource Planning	1,187	1,226	1,172
Other	<u>937</u>	<u>1,011</u>	<u>850</u>
TOTAL	4,648	5,099	5,017

Distribution of Funding  
(thousands of dollars)

	<u>FY 1971</u> (actual)	<u>FY 1972</u> (actual)	<u>FY 1973</u> (estimate)
In-house	3,071	3,492	3,125
University	50	50	381
	<u>1,527</u>	<u>1,557</u>	<u>1,511</u>
TOTAL	4,648	5,099	5,017

Source: Federal Water Resources Research Program for 1972,  
William S. Butcher, O.W.R.R., p. 49

Department of the Interior

Bonneville Power Administration

A. Activities

1. Marketing of surplus electric power
2. Operation and maintenance of transmission facilities
3. Power requirements studies
4. Planning and integration of power resources

B. Budget FY 1973

Construction	\$ 94,493,000
Operation & Maintenance	31,020,000
Administration	102,000
Trust Fund Receipts	<u>20,623,000</u>
Total	\$146,238,000

Source: Budget of the U.S. Government, FY 1975

Department of Defense

U.S. Army Corps of Engineers

A. Activities

1. Comprehensive river basin and regional planning
2. Reservoir sizing
3. Reservoir management
4. Flood plain mapping
5. Flood control projects
6. River hydraulic models
7. Research in coastal zone hydrology - coastal engineering activities
8. River basin studies
9. Flood frequency studies
10. Rainfall - runoff investigations

B. Locations of Corps of Engineers Regions & Offices



Sources: The Water Encyclopedia, Water Resources Council, p. 484

## DEPARTMENT OF DEFENSE (CIVIL)

## Army Corps of Engineers

Allocation of Funding by Fiscal Years  
(thousands of dollars)

<u>Research Category</u>	<u>FY 1971</u> (actual)	<u>FY 1972</u> (actual)	<u>FY 1973</u> (estimate)
II. Water Cycle			
A. General	213	235	230
B. Precipitation	131	145	143
C. Snow, ice, and frost	24	-	-
H. Lakes	224	-	-
J. Erosion and sedimentation	883	759	727
L. Estuaries	<u>277</u>	<u>571</u>	<u>626</u>
SUBTOTAL	1,752	1,710	1,726
IV. Water Quantity Management and Control			
A. Control of water on the surface	500	500	500
V. Water Quality Management and Protection			
G. Water quality control	100	450	720
VI. Water Resources Planning			
A. Techniques of planning	545	595	495
B. Evaluation process	780	1,400	1,365
G. Ecologic impact of water development	<u>434</u>	<u>765</u>	<u>932</u>
SUBTOTAL	1,759	2,760	2,792
VII. Resources Data			
B. Data acquisition	5	5	10
VIII. Engineering Works:			
A. Structures	311	497	518
B. Hydraulics	3,042	3,466	2,189
C. Hydraulics machinery	150	500	846
D. Soil mechanics	552	642	529
E. Rock mechanics and geology	225	299	396
F. Concrete	509	561	470
G. Materials	45	125	60
H. Rapid excavation	960	61	200
I. Fisheries engineering	<u>125</u>	<u>145</u>	<u>155</u>
SUBTOTAL	5,919	6,296	5,363

DEPARTMENT OF DEFENSE (CIVIL)

Army Corps of Engineers

Allocation of Funding by Fiscal Years  
(thousands of dollars)

<u>Research Category (cont.)</u>	<u>FY 1971</u> (actual)	<u>FY 1972</u> (actual)	<u>FY 1973</u> (estimate)
X. Scientific and Technical Information:			
D. Specialized information center services	<u>28</u>	<u>100</u>	<u>67</u>
TOTAL	10,063	11,821	11,178

Source: Federal Water Resources Research Program for 1972,  
William S. Butcher, O.W.R.R. p. 36-37.

Environmental Protection Agency

A. Activities

1. Identify and quantity pollutants
2. Develop technology for pollution control
3. Develop methods for pollution detection
4. Pollution stress modeling
5. Urban, industrial and agricultural pollution control
6. Environmental impact studies



ENVIRONMENTAL PROTECTION AGENCY

Allocation of Funding by Fiscal Years  
(thousands of dollars)

<u>Research Category</u>	<u>FY 1971</u> (actual)	<u>FY 1972</u> (actual)	<u>FY 1973</u> (estimate)
V. Water Quality Management and Protection			
A. Identification of pollutants	3,959	2,948	3,212
B. Sources and fate of pollution	3,405	4,301	8,157
C. Effects of pollution	9,279	9,337	11,386
D. Waste treatment process	40,551	24,253	22,641
E. Ultimate disposal of wastes			
F. Water treatment and distribution	-	888	704
G. Water quality control	<u>1,326</u>	<u>610</u>	<u>880</u>
SUBTOTAL	58,520	42,337	46,980
VI. Water Resources Planning			
A. Techniques of planning	176	242	131
B. Evaluation process	125	186	182
C. Cost allocation, cost sharing, pricing, repayment	-	-	101
D. Water demand	-	-	61
E. Water law and institutions	150	223	344
F. Non-structural alternatives	50	93	71
G. Ecological impact of water development	<u>-</u>	<u>-</u>	<u>121</u>
SUBTOTAL	501	744	1,011
VII. Resources Data			
A. Network design	77	31	33
B. Data acquisition	270	102	108
C. Evaluation, processing and publication	<u>135</u>	<u>53</u>	<u>56</u>
SUBTOTAL	482	186	197
TOTAL	59,503	43,267	48,188
<u>Extramural (included in above amounts)</u>			
Contracts and co-op agreements	14,746	12,534	9,687
Grants	26,796	13,057	15,957

Source: Federal Water Resources Research Program for 1972,  
William S. Butcher, O.W.R.R., p. 89

## TENNESSEE VALLEY AUTHORITY

### I. Activities

- A. Rainfall studies
- B. Evaporation
- C. Modeling
  - 1. Water yield, storm hydrograph, water quality
  - 2. Effect of land-use changes
- D. Development of water resource management methods
- E. Flow frequency studies
- F. Effects of urbanization upon streamflow
- G. Measurement of sediment & sediment density
- H. Forest hydrology
- I. Irrigation
- J. Ecologic studies
- K. Water quality
- L. Thermal pollution
- M. River & reservoir water-control structures
- N. Nutrient enrichment
- O. Radiological impact of an expanding nuclear-power economy (HERMES model)
- P. Wastewater irrigation

TENNESSEE VALLEY AUTHORITY

Allocation of Funding by Fiscal Years  
(thousands of dollars)

<u>Research Category</u>	<u>FY 1971</u> (actual)	<u>FY 1972</u> (actual)	<u>FY 1973</u> (estimate)
II. Water Cycle			
A. General	148	128	99
B. Precipitation	80	72	78
D. Evaporation and transpiration	7	8	8
E. Streamflow and runoff	102	57	69
F. Groundwater			
H. Lakes	2	2	2
J. Erosion and sedimentation	<u>12</u>	<u>5</u>	<u>5</u>
SUBTOTAL	351	272	258
IV. Water Quantity Management & Control			
A. Control of water on the surface	94	76	85
C. Effects of man's non-water activities	<u>51</u>	<u>91</u>	<u>84</u>
SUBTOTAL	145	167	169
V. Water Quality Management & Protection			
B. Sources and fate of pollution	337	318	232
G. Water quality control	<u>256</u>	<u>281</u>	<u>263</u>
SUBTOTAL	593	599	495
VI. Water Resources Planning			
A. Techniques of planning	3	150	277
B. Evaluation process	17	16	5
G. Ecologic impact of water development	<u>--</u>	<u>--</u>	<u>12</u>
SUBTOTAL	20	166	294
IX. Manpower, Grants and Facilities			
B. Education--in-house	3	3	3
D. Grants, contracts & research allotments	<u>3</u>	<u>1</u>	<u>5</u>
SUBTOTAL	6	4	8
TOTAL	1,115	1,208	1,224

Source: Federal Water Resources Research Program for 1972,  
William S. Butcher, O.W.R.R., p. 114

APPENDIX K

HYDROLOGIC MODELS USED BY FEDERAL AGENCIES

Appendix K lists hydrologic models used by the federal water resource agencies. Applications and origins of the models are also included.

## HYDROLOGIC MODELS USED BY FEDERAL AGENCIES

DEPT.	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL		
				IN HOUSE	OTHER	
USDA	Agricultural Research Service	HL-70	Agri.-Chem Transport Water Balance Erosion Reservoir Sedimentation	X		
		Wischmeier's Universal Soil Loss Equation	Agri.-Chem Transport Water Balance Erosion Reservoir Sedimentation			
		Precipitation Models	Precipitation	X		
		Snowmelt Models	Snowmelt	X		
	Soil Conservation Service	Snowmelt and Yield	Snowmelt			
		Storm Runoff	Rainfall-R/O Computation & Modeling			
		Stream Routing with Hydrographs				
		Urban Hydrology				
		Radiation as a measure of water content of snow				
	Forest Service	TR-20			X	
		BURP	Water Yield			
		EROSON	Erosion			
		Snowmelt	Snowmelt			
		INVEST III	Economic Anal.			
		Resources Planning	Resource Planning			

DEPT.	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL		
				IN HOUSE	OTHER	
US Army	Corps of Engineers North Pacific Div.	Lammit			River Forecast Center, ORE.	
		SSARR	Streamflow Simulation & Reservoir Regulation			
		HYSIS	Hydro-systems Simulation			
	Corps of Engineers Hydrologic Engineering Center	HEC I	Simulation- traditional large scale	X		
		HEC II	River Hydraul- ics	X		
		HEC III	Reservoir Sys- tems, Conserv.	X		
		HEC IV	Statistical Streamflow	X		
		HEC V	Large Scale Systems of Flood Reser- voirs	X		
	Commerce	NOAA	API			
SSARR					Corps of Engineers	
Stanford					Stanford University	
Sacramento					Sacramento River Center	
DOI	Geologic Survey	Modeling of Estuaries and Groundwater	Groundwater Estuaries			
	Bureau of Reclama- tion	Weather Modification		X		
		Reservoir Operation Studies	Res.-Water Supply Man.	X		

DEPT.	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
		Reservoir & Aquaduct Sizing	Res.-Water Supply Man.	X	
		Salinity Modeling	Water Quality	X	
		Flow Predictions for Operational Projects		X	
Bonneville Power Admin.		SSARR COSSARR	Streamflow Simulation & Reservoir Regulation		COE
		Many Reservoir Ops. Programs			
Environmental Protection Agency		Large number of specific purpose water quality models	Water Quality	X	
Tennessee Valley Authority		Urban Flood	Economic Ana.	X	
		HUD - Flood Insurance	Economic Ana.	X	
		Phytoplankton Program	Water Quality	X	
		Carbon 14 & Chlorophyll Productivity Analysis	Water Quality	X	
		New Backwater	Flood Fore.	X	
		Flood Assembly & Prediction	Flood Fore.	X	
		Natural & Regulated Flood Estimation	Flood Fore.	X	
		Flood Hydrograph	Flood Fore. River Hydraul.	X	
		Flow Frequency	Res.-Water Supply Man.	X	
		Tenn. Flow Volumes	River Hydraul.	X	

STATE	AGENCY	MODEL NAME	APPLICATION	ORIGIN OF MODEL	
				IN HOUSE	OTHER
TVA - Cont.		Modified Reservoir Routing	Res.-Water Supply Man.	X	
		Simulation of Open Channel Hydraulics	River Hydrau	X	
		Simulation of Open Channel Hydraulics Junction	River Hydrau	X	



APPENDIX L

COMPUTERS IN WATER RESOURCE USE BY FEDERAL AGENCIES

Appendix L lists the computers used by each federal water resource agency, indicating utilization (whether shared or dedicated), location if not in-house, total use in hours per week, and percentage of total utilization for water resource activities.

# COMPUTERS IN WATER RESOURCE USE BY FEDERAL AGENCIES

STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs/wk)	% of total utilization for water res. activities
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY		
USDA	Agricultural Research Service	CDC 7400	X			Tucson		
		IBM 360/75	X			Idaho Nuclear		
		IBM 360/65 1130	X			New Orleans		
		CDC 6600	X			Tucson		
		Sigma 7 IBM 360/40	X			Vermont		
		IBM 370/168	X			Ohio, Washington, D.C.		
		UNIVAC 1108	X			Fort Collins		
	Soil Conservation Service	IBM 360/75	X			Pt. Worth, New Orleans 168		
		IBM 370/168	X			Washington, D.C.		\$2-3000 mo. on CPU time
		UNIVAC 1108	X			Fort Collins		
		<sup>2</sup> IBM 360/50	X			Kansas City		
	Forest Service	Outside contractors						

STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs/wk)	% of total utilization for water res. activities
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY		
		UNIVAC 1108	X		X	Fort Collins	2 shifts/day	Unknown
		CDC 3100's	X		X			Some
Army	COE No. Pac. Div.	GE 225-437 system (11)	X		X			
		TBM 360/50	X		X		168	30
		IBM 1800	X		X			
		GE 4020	X	1	X			
		CDC 1700	X		X			
	COE Lower Miss. Valley Div.	2 Honeywell GE 635	X		X			
		GE 437/225 system	X		X			
		CDC 7600	X			Berkeley	~80	
	COE Hydrologic Engr. Center	UNIVAC 1108			X		~25%	
		a few CDC 6600 s CDC 7600 Corps GE in Vicksburg			X		~75%	

ECOSYSTEMS INTERNATIONAL INC.

STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs/wk)	% of total utilization for water res. activities
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY		
	CCE Norfolk, Va. Dis.	Honeywell G-43 Digital			X			10 hrs/mo
DOI	Geologic Survey	IBM 360/91				Watson Research Center, IBM, N.Y.		
		IBM 370/155			X	Reston, Va.	2 shifts/day	58%
		IBM 360/91				John Hopkins Applied Physics Lab		
		IBM 360/65			X	Washington, D.C.		
		CDC 7600 & others						
	Bureau of Reclamation	CDC Cyber 70/70	X			Engineering & Research Center, Denve.	20 hrs/day	n/a
	Bureau of Sport Fisheries & Wildlife	Developing computer capability						
Commerce	NOAA	IBM 1130 (11)			X	River Forecast Centers		
		IBM 1620				Silver Spring		

STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs/wk)	% of total utilization for water res. activities
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY		
	E.P.A.	IBM 1130			X	Charlottesville		
		IBM 1130			X	Durham		
		IBM 360/50			X	Durham		
		IBM 1130			X	Dallas		
		IBM 1130			X	Ada		
		IBM 360/30			X	Cincinnati		
		IBM 1130			X	Cincinnati		
		IBM 1130			X	K.C.		
		IBM 1130			X	San Francisco		
	Fish and Wildlife Service	IBM 360/20			X	Laurel, Md.		
		IBM 1130			X	Ann Arbor		
		PDP 12			X	Columbia, Mo.		

STATE	AGENCY	COMPUTER	UTILIZATION		LOCATION		TOTAL USE (Hrs/wk)	% of total utilization for water res. activities
			SHARED	DEDICATED	IN HOUSE	ORGANIZATION & CITY		
	B.P.A.	CDC 1700			X	Portland, Ore.		
		CDC 6400			X	Portland, Ore.		
		IBM 1401			X	Portland, Ore.		
	T.V.A.	IBM 370/165			X	Chattanooga, Tenn.		
		IBM 360/30			X	Knoxville, Tenn.		
		IBM 360/50			X	Knoxville, Tenn.		