

# University of Hawai'i at Mānoa LIBRARIES



## Interlibrary Loan Program

Hamilton Library, Room 101 ♦ 2550 McCarthy Mall ♦ Honolulu, HI 96822

Phone/Voicemail: 808-956-5956 (Lending) / 808-956-8568 (for UHM patrons)

Fax: 808-956-5968

Email: [lendill@hawaii.edu](mailto:lendill@hawaii.edu) (Lending) / [libill@hawaii.edu](mailto:libill@hawaii.edu) (for UHM patrons)



**NOTICE:** The copyright law of the United States (Title 17, U.S.C.) governs the making of photocopies or other reproductions of copyrighted materials. Under certain conditions specified in the law, libraries and archives are authorized to furnish a photocopy or reproduction. One of these specified conditions is that the photocopy or reproduction is not to be “used for any purpose other than in private study, scholarship, or research.” If a user makes a request for, or later uses, a photocopy or reproduction for purposes in excess of “fair use,” that user may be liable for copyright infringement. This institution reserves the right to refuse to accept a copying order, if, in its judgment, fulfillment of the order would involve violation of copyright law.



**BEST AVAILABLE COPY**

TD  
223.8  
R33

REGIONAL FIVE-YEAR RESEARCH  
AND DEVELOPMENT PLAN FOR  
PERIOD 1982-1987

PACIFIC NORTHWEST/OCEANIA REGION

Submitted by Directors of the Water Resources Research Centers/Institutes  
of Alaska, Guam and Micronesia, Hawaii, Idaho, Oregon and Washington.

November 1, 1980

## INTRODUCTION AND STATEMENT OF GOALS

Although it is extremely difficult to generalize research objectives for a region as diverse as the Pacific Northwest/Oceania region, a set of broad research priorities has been developed. Specific priorities of each center/institute are embedded in those broad objectives. However, intensity of effort will vary between the centers/institutes for each of the priorities.

This five-year comprehensive plan for conducting research and information dissemination has been prepared to serve the research needs of the region and the Nation in the field of water and related land resources. As part of a national program sponsored by the U.S. Office of Water Research and Technology and an integral part of the mission of each center/institute it addresses a three-fold purpose of research, instruction and service. The basic objectives of the research plan and the goals of the region are as follows:

1. To promote research that is relevant to state and regional needs with emphasis on economic resource development, preservation and enhancement of environmental quality, and social well-being of people with concern for conservation of water and related land resources.
2. To stimulate, coordinate, and provide leadership for research in the established units of the Universities. Such research should utilize an interdisciplinary approach involving personnel in an efficient manner; thereby meeting a goal of performing an educational function by giving opportunity for training of students.
3. To cooperate with and serve local entities, state and federal government agencies in carrying out their responsibilities concerned with water and related land resources and to provide for involvement of the public in identifying research needs.
4. To assist current and potential researchers in proposal preparation, contract negotiations and report writing.
5. To provide for dissemination of the research findings in an expeditious and comprehensible manner to local, state, regional and national users.
6. To seek ways of financing the needed research and program efforts and to encourage cooperation with regional research centers in conducting an efficient and productive research effort.

7. To foster and encourage continued development in basic understanding of water resources.

#### BROAD REGIONAL RESEARCH OBJECTIVES

1. Develop methodology for determining and evaluating instream flows.
2. Develop methodology for evaluating the impact of management plans and development on the quantity and quality of groundwater resources.
3. Identify and evaluate the effect of policies and laws pertaining to water allocations for native and federal reserved land utilization.
4. Determine impact of land and ocean resource utilization and development on coastal water quality.
5. Develop methodology for evaluating environmental and economic trade-offs due to resource development.
6. Investigate the impact of alternate energy development on water-resource management and supply.
7. Evaluate the effects of international and interstate laws on shared water resources.

#### SPECIAL PROBLEMS

1. Analyze physical, social, and institutional problems and issues affecting the ability to sustain current water uses with particular attention to survival of anadromous fisheries.
2. Conduct regular regional conferences, seminars, short courses as a means to dissemination of information.

#### BUDGET

Funding for the Annual Cooperative Program has remained at \$110,000 per year per institute since FY 1975. Effects of inflation have been drastic. Although full funding is authorized at \$250,000 per institute per year, an appropriation at that level has never been achieved. As a result, the average number of research projects which has been funded each year per university has decreased from 12 to 6. Since these projects and research needs have not changed noticeably in depth or scope, research productivity has been cut in half. In addition, each center/institute has been required to increase its activities in reporting to OWRT, in disseminating information and in relating to state and regional agencies.

To maintain programs comparable to the 1970 level, annual funding for each institute must be increased to more than \$300,000. This figure represents the collective analysis of all Directors in a meeting on October 16, 1980.

A total five-year budget of \$60,000,000 would be required to adequately implement the identified research and development. Using the demonstrated ratio of OWRT to other funding of 1 to 5 (average for the region), an OWRT commitment of \$10,000,000 is necessary to implement successfully the five-year plans of the regional components.

### Appendices

Research summaries of six (6) centers/institutes.

## ALASKA

### PLAN SUMMARY

The Institute's research and development plan is listed below. Because of the inexactness of looking five years into the future, the problems can only be sketched in the broadest terms. In some cases, the problem is already being addressed by the Institute's program, and the plan reflects a continuing effort in that case. In others, we expect to develop a new research effort. It is difficult at this time to prorate the amount of money between the plans and precisely provide the timing of the research effort over the five-year period. As always, the largest deterrent to this type of long-range planning is the availability of funds. Unless a certain portion of funds beyond the basic allotment can be reasonably assured, it becomes nearly impossible to plan for some imaginary set of funds. Besides funds received from OWRT, the Institute will continue to be successful in receiving funds from other federal agencies such as NOAA, the National Science Foundation, the Office of Surface Mining, the Department of Energy and state agencies such as the Department of Natural Resources, the Department of Transportation and Public Facilities, and the Alaska Power Authority.

The problems to be researched are:

1. Mining. As a result of the renewed interest in placer gold mining (primarily in the area between Anchorage and Fairbanks), an overwhelming problem has developed with the removal of silt from the process water in an economically viable way. Better methods of removal must be developed, and the real ecological effect on streams must be clearly understood.
2. Petroleum Industry. This continues to dominate the economic activity of the state and will continue to do so with the development of new petroleum discoveries. Our primary effort here is to continue fundamental hydrologic research to better understand the hydrologic processes that affect oil-field development and the appurtenant construction activities, and to understand the impact on coastal ecosystems.

3. Flood Control. A prime problem in all areas of the state (and in conflict with all development activities) is flood protection. There still needs to be a better understanding of design criteria for predicting floods. Given the unique circumstances of Alaskan hydrology, we need ways to use the existing data base with better efficiency, and to construct flood works to minimize impact on the river morphology and ecology.
4. Petroleum Industry. The Alaska natural gas pipeline will be the next large petroleum development in Alaska, and this project will be very important economically to the nation as a whole. There are two severe problems that are likely to result in either overdesign or inefficiencies on the pipeline if they are not adequately addressed. Frost heave, and ground and stream overflow icing present real hazards to the engineering integrity of the line. There is a need for more basic water research in the mechanics of water movement near the surface of frozen ground.
5. Agriculture. A great amount of state resources is being directed towards large-scale agricultural development. It appears that these projects may be a success, but there is a possibility of impact through direct soil manipulation and use of pesticides on the adjacent aquatic ecosystems. Because large agricultural development in far northern climates is not widespread, some effects could be unique; it could become quite important to exactly understand their nature.
6. Urban Areas. With a slow leveling out of the state's population, more resources will be devoted towards more complete urban development. Some problems include wetland control, storm runoff management and the omnipresent problem of water supply. Perhaps the largest critical problem of urban areas is an adequate supply of water. The most critical part of this problem is an economical way to remove large amounts of silt often found in Alaskan waters, particularly those that have as their source glaciers at higher elevations of the basin.
7. Fishing Industry. Alaska's commercial and freshwater game fisheries have an important and unique place in the state's social

and economic structure. One critical problem has been the conflict of fish passage in the vicinity of roadways, particularly the extensive use of culverts in areas where important game or commercial species exist.

8. Fish Hatcheries. Several years ago, the State of Alaska embarked upon a program of improving the potential for fisheries through a massive construction of state-sponsored fish hatcheries and through the permitting of private hatchery operations. Two critical problems in this area are the proper selection of hatchery sites, and a provision for an adequate water supply. There are also certain problems to be faced with the treatment of hatchery water and the disposal of fish hatchery wastes.
9. Power and Energy Production. The State of Alaska has embarked on a wide-ranging program of alternative and conventional energy development. A large-scale program has led to numerous hydropower investigations for both small and large sites. Many of the sites have peculiar circumstances relating to the hydrology of the area; a clear understanding about coastal northern hydrology is needed, particularly as it relates to hydropower production. Also, a number of problems need to be addressed dealing with the forces and characteristics of ice and snow as they relate to hydropower production in northern climates. The state's high-tide variation has led to a continuing interest in tidal power plants (many of which have unique hydraulic and hydrologic problems dealing with both cold weather and a large amount of silt in many estuaries). Many alternative energy projects require consideration of their water resource aspects, including large-scale coal development and aquifer thermal energy storage.

#### SUMMARY

The Institute of Water Resources has compiled this report to set forth its plan for water resources research and development for the next five years. The 9-point research program is based on the notion that the state expresses

its needs through its economic and social activity. The petroleum industry is the predominant activity in the state at the present time, and a number of the Institute's research programs will be directed towards aiding that industry in its continuing petroleum development. However, we will also focus on the more traditional areas of forestry, agriculture, fisheries, power and energy development, as well as urban and village development. We do not find a need at this time to devote research to wilderness or recreational activities. The Institute will endeavor to carry out research that can best be done in the University environment and will continue to collaborate with other researchers and regions. We will pay particularly close attention to the continually-changing needs of state and local agencies within Alaska.

## GUAM AND MICRONESIA

### PLAN SUMMARY

The purpose of this report is to briefly summarize the water problems in Guam and Micronesia as well as the five-year research and development plan proposed to address some of the problems.

The water research priority areas of the WRRRC, summarized below, are the same as the water problem areas (with the exception of desalting).

#### Research Priorities of the WRRRC for FY 82-86

Location	Primary	Secondary	Tertiary
Guam	a) groundwater yield	a) baseline water quality data b) impact of pollutants on receiving water quality	a) water demand b) potential conflicts over surface water use c) feasibility of low-head hydroelectric power generation
Saipan	a) groundwater yield	a) baseline water quality data	
Micronesia	a) training b) water available for consumption c) groundwater yield d) receiving water quality	a) operation of waste water treatment plants b) domestic conservation	

The five-year research program is consistent with these priority areas. The major program effort on Guam and Saipan is devoted to groundwater. OWRT-funded research will include Guam studies of the northern aquifer geology, seawater intrusion and dispersion phenomena, and modeling techniques. Management studies funded by the WRC will deal with hydrogeologic data gathering and modeling of groundwater-flow systems. In Micronesia, the major program effort is devoted to improvement of the quantity and quality of water available for consumption, to training, and to studies of receiving water quality.

Next in emphasis on Guam is research dealing with the effects of surface activity on ground-water quality. Research projects are planned dealing with the effects of septic tanks, urban runoff, and agricultural chemicals. In Micronesia, secondary emphasis is placed on water conservation and alternate methods of waste-water treatment/disposal.

Problems of tertiary importance are quite diverse. Examples of proposed research projects are the determination of the economic feasibility of low-head hydroelectric power generation, the effectiveness of trickle irrigation on Guam as a water conservation measure, and prediction of future water demand.

## HAWAII

### PLAN SUMMARY

Concern with water resource problems in Hawaii extends into prehistoric times, when a complex system of irrigation facilities and water rights emerged from the ancient Hawaiians' development of agriculture. In the present century, the people of Hawaii experience enough periods of excessive or poorly-managed groundwater extraction, occasional drought, restrictions on use or sheer unavailability at the desired place and time to realize that the state's water resources must be used or conserved in accordance with their true values for agricultural, industrial, commercial, and municipal purposes, as well as for providing for future continuation of water uses.

The plan is structured around four major problems faced by water resources planners, operating agencies, and, ultimately, the public. The most pressing of these is water supply or, more specifically, the impending overdraft of the islands' basal groundwater aquifers. A related set of issues concerns water quality, especially of the coastal areas. Third is the elusive problem of identifying proper and efficient values for in-stream uses, such as recreation and aesthetics, and flora and fauna habitats. Finally, Hawaii's legislature is under a constitutional mandate to write new laws and to establish new agencies to deal with water allocational problems. The details of these legal and institutional reforms will affect the Hawaii water resources situation for many years, yet will remain uncertain in many of their effects.

Because of its long tradition, strength, and experience in assisting in solving water resource problems in Pacific and Asian areas, the Hawaiian WRRC will continue to work with operative agencies to formulate policies and programs, as authorized under PL 95-467, for all three new Pacific island groups and for any sub-tropic and tropic insular communities in the Pacific and Asian region.

### RESEARCH PRIORITIES

1. Overdraft of Basal Groundwater Aquifers
  - A. Identification of causes, scope, and mechanisms
  - B. Minimization of demand on aquifer
  - C. Maximization of aquifer capacity
  - D. Management of water supply system

2. Coastal Water Quality and Resource Enhancement
  - A. Control of the generation of water quality factors
  - B. Treatment and removal of water quality factors
  - C. Disposal and assessment of impact
  - D. Water reuse and generation or recovery of resources from wastes
3. In-stream Uses and Values of Water
  - A. Identify and inventory in-stream and out-of-stream uses
  - B. Out-of-stream uses
  - C. Ecological criteria
  - D. Recreation and aesthetic values criteria
  - E. Other in-stream criteria
  - F. Legal and management considerations
4. State Water Allocation System
  - A. Identify pre-existing rights of use by usage, custom, and tradition, and relevant circumstances defining the right
  - B. Identify "minimum" to "expected" supply levels by source
  - C. Establish a use permit system

#### FUNDING CONSIDERATIONS

Adequate funding for research and development is essential to implement the Five-Year Plan. The intent of addressing the funding requirements and financing considerations is not so much the accuracy of forecasting the funding requirements and the thoroughness in identifying all potential means of financing--both of which are highly speculative and of questionable value; rather, the true intent is to spotlight the importance of sustained and adequate financing that is essential to produce information through research to help solve specific and relevant water problems.

With many reservations, the cost estimate for the Five-Year Plan comes to approximately \$18 million, including approximately \$4 million for research facilities that include many research water wells and one desalting demonstration plant. They represent the total need rather than only those needs by WRRC. The breakdown of the total five-year cost for each of the four major research problems is in million dollars; 10.32 for overdraft, 4.64 for quality, 2.45 for in-stream, and 0.80 for allocation --- for a total of 18.21. The CIP cost alone includes \$4.29 million for the overdraft problem. When grouped by year rather than by research problems, the costs in million \$ are 7.68 for year 1, 5.10 for year 2, 3.00 for year 3, 1.24 for year 4, 1.19 for year 5; the CIP cost for the overdraft

problem is distributed 3.39 for year 1 and 0.90 for year 2.

The cost estimates must be regarded at best as a meaningless exercise. The figures presented are nebulous at best and misleading at worst. However, they do suggest a general order of magnitude and serve as a point of departure.

Two recommendations on financing appear in order. First, greater ACP annual appropriations than \$110,000 is absolutely necessary. In fact, the full \$250,000 as authorized should be requested from the U.S. Congress by OWRT at the earliest possible time. The request can be justified by the needs demonstrated in the 5-year plans. In the case of the Hawaii WRRRC, the total annual research funding received has run on the order of \$600,000 in recent years of which \$350,000 came from non-federal sources. If the ACP monies were appropriated and made available on the basis of demonstrated ability to meet the ratio of \$2 federal to \$1 non-federal, Hawaii could considerably expand its research funding base towards accomplishing the Five-Year Research Agenda. Second, long-term contributions for applied water research by state and local water agencies which stand to benefit should be bolstered.

## IDAHO

### PLAN SUMMARY

Five (5) categories of concern were identified. These involve the water-related research and technology transfer needs pertaining to energy, irrigated agriculture, environmental considerations, institutional and social matters, and water conservation.

Limited faculty time and funding are constraints which demand placing priorities on the various problems that need to be addressed. Concurrently it must be recognized that the talents of researchers cannot change markedly and alternatives for study must be available to develop realistic programs. Discussion on various inputs from the plan indicate the following are priority research considerations that should be approached at the University of Idaho.

1. Update and improve methodologies for studying tradeoffs between various uses of water particularly the competition between in-stream and diversion type uses and relating this to the decision making process. Develop acceptable units for measuring tradeoffs.
2. Develop new and more sophisticated of river and reservoir management models for operational studies of power generation within a broad framework of multiple purpose uses of water and define relation between the water supply and an equitable flow of the benefits.
3. Evaluate water stress on plants and deficit water supply for irrigation management and planning including the physical, economic, and social impacts of water shortages.
4. Develop improved technology and information transfer programs to facilitate management of pollution from non-point sources including erosion, adverse impact of recreation users, forest and range uses of watersheds, and irrigation return flow as well as domestic waste disposal.
5. Develop improved technology for studying the ground water resources of the State including methods for extraction of the water and ways of determining the safe and economic limits of that development.

6. Develop improved techniques for defining instream flow requirements and develop better criteria for relating flow requirements to stream physical characteristics particularly in areas with minimal streamflow measurement data.
7. Evaluate the impact of volcanic ash fallout from Mt. St. Helens eruption on the watershed, stream and lake systems to determine ways of coping with such catastrophies and to help in rehabilitation efforts.
8. Evaluate the physical, economic and institutional impacts of alternative water conservation policies particularly studies of changes in the extent of irrigation diversions with different agricultural and reservoir operational practices.
9. Evaluate water right policies and laws particularly in federal, state, and interstate conflicts. Identify possible legal changes in water rights administration that will provide more efficient use of water for economic development, preservation and enhancement of environmental quality and social well being of people.
10. Evaluate institutional and attitude problems related to further small scale hydro development in Idaho. Particularly problems of financing, management, ownership and operation of new plants.
11. Investigate chemical waste disposal in its broadest connotation as it impacts particularly the surface and ground waters of the State including means of monitoring chemical wastes over long periods of time and over extensive geographic areas.

A plan must always be flexible to meet changes in conditions and availability and interests of researchers. In reviewing all new proposals, applicability and approach should be weighed against the requirement that the research place emphasis on economic resource development, preservation of environmental quality, and concern for the social well-being of people. A balanced mix of these objectives has been sought in listing the priority research problems. Hopefully, a more committed thrust will be a concerted effort for studies of ways to achieve conservation of water and related land resources.

## OREGON

### PLAN SUMMARY

The purpose of the water resources research plan for Oregon for the period 1982-1987 is to analyze the major problems in the state and indicate the role that the Water Resources Research Institute intends to play in helping to alleviate or solve the problems. It is hoped that the document will serve as a ready source of information on state water resource activities and the Institute's five-year research program.

Major present-day water-related problems involve seasonal, geographic and year-to-year maldistributions between water supply and competing water uses. There is recurring water shortage and excessive runoff. In addition, overall shortages occur in arid areas east of the Cascade mountains. Multiple-purpose reservoir storage is significant in balancing some of the seasonal maldistributions in most river basins. But while solving some problems, dams create other problems, particularly for fishery resources. In addition to water quantity problems, there are numerous water quality problems in many areas, these generally being associated with depleted streamflows and contaminated return flows.

The principal problem which emerges from an analysis of supply and demand is competition among users for the available water. Withdrawals will increase during the 1975-1985 period and will decline during the period 1985-2000. The decline is expected to occur principally in the manufacturing category because of improved techniques to re-cycle and conserve water. However, total water consumption will rise steadily from 1975-1985 and continue to rise at a slower pace up to 2000. The largest consumptive use will always be for irrigation purposes.

Other problem areas are:

- \* River water quality
- \* Lake and reservoir water quality
- \* Bays, estuaries, and wetlands
- \* Planning and management of water resources
- \* Forested watershed management.

The research program for the Institute will address itself to the following aspects of these problems:

- \* Water Use - water rights transfers; Columbia River water use; re-use of water in agriculture, municipal and industrial processes; water pricing policies.
- \* Ground Water - the ground water classification guidelines; ground water recharge.
- \* Bays, Estuaries, and Wetlands - biological responses in estuaries; effect of upstream flows on estuaries; survey of remaining wetlands.
- \* General - evaluate irrigation systems and methods of application; analyze recent changes in Oregon's water laws and institutions.

Included in the plan are budgets covering the aspects of these problems which the Institute will explore with funds provided annually by the Office of Water Research and Technology (OWRT), U.S. Department of the Interior. Naturally, water-related research at Oregon State University is also funded by other agencies, but it is not possible to forecast with any certainty the extent of such assistance for the period of 1982-1987. State assistance will continue at approximately \$36,000 annually to cover administrative expenses.

Obviously, the research objectives of the Institute cannot be realized solely with funds provided by OWRT. It would require more than the authorized level of \$250,000 for the Annual Allotment Program to carry out the same level of research for OWRT as was conducted in 1970. There is a great need for additional funding.

## WASHINGTON

### PLAN SUMMARY

The following major research priorities have been identified as a result of consideration of the water-related problems which have been or probably will be encountered by the State of Washington.

1. Effects of Mount St. Helens Eruption
  - A. Studies to evaluate the effects on fish populations in the surrounding rivers.
  - B. Evaluation of the effects on watershed characteristics, including groundwater supplies.
  - C. Basic studies regarding the mud flows and the mechanics of wave generation in reservoirs impacted by the flows.
  - D. Analysis of rehabilitation and restoration plans and programs.
2. Water Quantity Problems
  - A. Study and evaluation of the adequacy of instream flows and the demands for energy and irrigated agriculture.
  - B. Evaluation of the adequacies of present domestic supplies and supply systems.
  - C. Studies on dam safety and the feasibility of adding hydroelectric facilities to existing structures.
  - D. Basic studies on the mechanics of groundwater movement and pollution factors.
3. Water Quality Problems
  - A. Determination of effects of agricultural and forest management practices on receiving streams.
  - B. Identification of pollutants to groundwater aquifers and analysis of methods to control or eliminate contaminants.
  - C. Basic studies regarding habitat requirements to preserve and enhance stream fisheries.
  - D. Studies of the impact of small hydroelectric development.
4. Institutional Problems
  - A. Identification of needs for basic data in water management and planning for coastal estuaries, wetlands, river and streams, and groundwater..

- B. Examination of impact of reservation rights on federal lands and the potential for use of water on Indian reservations.
  - C. Study of alternative methodologies and institutional arrangements which may facilitate more water use.
  - D. Detailed studies of the conflict between federal and state agencies governing hydroelectric development, agricultural development, and survival of the fisheries.
  - E. Studies to evaluate the effectiveness of present state institutional frameworks affecting the use of water such as water rights, permit systems, and other existing water allocations.
  - F. Sociological studies relative to the public perception of water-use values.
5. Fisheries Problem
- A. Studies of mechanical means for by-passing juvenile salmon and steelhead around dams.
  - B. Studies of methods for rehabilitating fishery habitats.
  - C. Studies of the long-term effects of institutional policies governing catch and production rates of salmon.