

**PUERTO RICO  
WATER RESOURCES AND ENVIRONMENTAL  
RESEARCH INSTITUTE  
REQUEST FOR PROPOSAL  
FY 2008**

**WATER RESOURCES RESEARCH GRANT  
STATE PROGRAM  
under Section 104B of the  
Water Resources Research Act of 1984, as Amended**



**APPLICATION PACKAGE  
DUE DATE: DECEMBER 3, 2007, 4:30 PM**

## INTRODUCTION

This Request For Proposals (RFP) is issued as part of the programs under the Water Resources Research Act (P.L. 101-397) administered by the US Department of Interior through the Water Resources Division of the US Geological Survey (USGS). Section 104 of the Water Resources Research Act directs the Secretary of the Interior to administer program grants to Institutes and Centers established within the States and certain other similar jurisdictions for research, education, and training that will assist the Nation in augmenting its water-resources science and technology. Responsibility for administration of this program has been delegated to the USGS.

Research proposals submitted under this RFP are intended to address water resources problems of state and regional significance. The research priority areas for Puerto Rico are listed below. Proposals will not be considered in the following cases:

1. Proposals submitted by an applicant that has not met reporting requirements on a previous award by the USGS.
2. Research on effects of the health involving human subjects or their surrogates.
3. Research involving oceanography (Estuarine research proposals are suitable).

This document provides guidance to the academic community for the preparation of proposals for the Institute's annual research program with the US Geological Survey. The procedure this year will be: (1) to request proposals, (2) to solicit evaluations by the Institute's External Advisory Committee (EAC) for relevance to the stated research priorities and technical contents, (3) to request a numerical rating of the proposals meeting the requirements of priority needs, and (4) selection of best proposals (number of proposals will depend on fund availability).

## I. PROGRAM OBJECTIVES

Section 104(b) of the Water Resources Research Act of 1984 requires the Institutes or Centers to:

1. "Plan, conduct, or otherwise arrange for competent research that fosters (A) the entry of new research scientists into the water resources fields, (B) training and education of future water scientists, engineers, and technicians, (C) the preliminary exploration of new ideas that address water problems or expand understanding of water and water-related phenomena in Puerto Rico, and (D) the dissemination of research results to water managers and the public, and
2. "Cooperate closely with other colleges and universities in Puerto Rico that have demonstrated capabilities for research, information dissemination, and graduate training in order to develop an island wide program designed to resolve State and regional water and related land problems." The Act also requires each institute to:
3. "Cooperate closely with other institutes and other organizations in the region to increase the effectiveness of the institutes and for the purpose of promoting regional coordination."

Applications submitted under this Announcement are to be in furtherance of these objectives.

## II. PUERTO RICO WATER RESOURCES RESEARCH PRIORITIES

Research and technology transfer will be concentrated on the following areas, in order of priority:

1. **Watershed and Water Sources Management:** Includes conservation strategies, source protection, optimization of water sources, deforestation and reforestation, and riverine zones among others.
2. **Drinking Water Quality Research:** Fluoride as a health agent, control of Trihalomethanes and other disinfections byproducts, TMDL procedures and development, epidemiological studies of water borne illness, effectiveness of water treatment processes.
3. **Recycling and Reuse of Used Water:** The use of wastewater for irrigation and artificial recharge, recycling of used water for human consumption, characterization of wash flows from water treatment plant filters, and vulnerability of water bodies to assimilate used waters.
4. **Climatologic Effects on Water Resources:** Global changes and their effects on water resources, local and regional effects (the Antilles), modeling.
5. **Design of water treatment processes for private systems in small communities:** Design and construction of simple, economic and easy to operate systems, disposition of treated water and its effects on effluents.
6. **Aquatic Ecosystems:** Flow conditions (quantity, quality, etc.) for aquatic ecosystems support, use of aquatic communities as river quality indicators, ecosystem values and health, and others.
7. **Water Distribution Systems:** Water losses in hydraulic networks, hydraulic modeling of water quality and quantity in distribution systems, pressure distribution, and water demand determination.
8. **Erosion and Sediment Transport:** Causes, characterization, control, and management of sedimentation in dams and water reservoirs. Innovative design of water intakes with sedimentation problems, control of sediment transport in construction projects, river banks and channel erosion, and local scour in bridges
9. **Development of Education Programs:** Water conservation, water resources and environment protection.
10. **Surface Water Studies:** Morphological studies on gravel and sand extraction and canalizations, Characterization of urban runoff, river restoration.
11. **Groundwater Research:** Availability of water, development of strategies for the north coast unconfined and artesian aquifers, optimization of water withdrawal from aquifers, quantitative management plan for aquifers, salt water intrusion, safe yield, pollutant transport and flow modeling, development of new methodologies for groundwater treatment with high contents of iron and manganese.
12. **Definition, Effects and Prediction of Droughts:** Optimization of water reservoirs and dams operation during extreme dry periods, modeling of droughts, public perception, economic effects, prevention and preparedness.
13. **Programs and Strategies for Reforestation and Their Effects on Low Flows:** Changes in land management and their effects on low flows.
14. **Research on Natural Disasters:** Effects of earthquakes on natural resources, the water treatment and water distribution infrastructure, landslides, and floods.
15. **Estuaries and Associated Wetlands:** Modeling of estuaries and associated wetlands, strip and mixing zones, hydrology and hydraulics, water quality.
16. **Use of sinkholes in the north coast as drainage systems:** Disposal of street and highway runoff and water from other anthropogenic sources, hydraulics, intake capacity, protection structures.
17. **Water Infrastructure for Tropical Areas:** Design criteria for storm water and wastewater drainage systems, energy losses, manhole hydraulics.
18. **Water supply from small wells in alluvial valleys:** Implications of the new regulations for

disinfections on well in Puerto Rico, impact of withdrawals on nearby water bodies, head water protection, operation and management by communities.

### **III. APPLICANT ELIGIBILITY**

Awards are available only to faculty members and investigators of recognized higher learning institutions in Puerto Rico pursuant to the provisions of Section 104 of the Water Resources Research Act of 1984, as amended.

### **IV. CONFLICT OF INTEREST**

An applicant may not permit any federal employee to use his or her position for a purpose that is or gives the appearance of being in conflict of interest, either by giving the applicant an unfair advantage or by a desire for private financial gain.

### **V. APPLICATION DUE DATE**

The applicant shall submit its application to the PR Water Resources and Environmental Research Institute no later than **December 3, 2007, 4:30 pm.**

### **VI. PROPOSAL DELIVERY INSTRUCTIONS**

All proposals must be delivered by Internet. You may access the National Institutes on Water Resources' home page by going to <http://niwr.net/> and scrolling down to "Log in to ERAS subsystems (104B, 104G, Annual Report, ...)." In the new screen, go to "104(B) System." Then follow the on screen instructions. You must be registered as a researcher associated with the Puerto Rico Water Resources and Environmental Research Institute before entering any information concerning your proposal. Registration is done through the link "Registration" on the first screen.

Each application shall be prepared and submitted in accordance with the specific instructions provided at the website. Submission will require two distinctly different actions: (1) submission of specified information as text directly into a web form and (2) "depositing" at the website document files containing detailed descriptions of the work being proposed. These files may be prepared using the word processing software of choice, but must be translated to PDF format prior to being deposited (detailed instructions for preparing and submitting these files, and verifying their submission are provided at the website).

Please note that the due date for proposals submission is DECEMBER 3, 2007, 4:30 PM (PR time). The Institute will NOT accept hand delivered proposals. You may call the Institute for clarification of these instructions at (787) 833-0300 or (787) 832-4040 exts. 3781, 3753.

## VII. FUNDS

As of the date of this Announcement, federal funds have not yet been appropriated for this program. The Government's obligation under this program is contingent upon the availability of appropriated funds.

- A. The amount available in FY 2008 for this RFP is anticipated to be approximately \$20,000 by project.
- B. Proposals should be for research and information transfer projects 12 to 36 months in duration and shall not request Federal funding exceeding \$60,000 (\$20,000 per year).
- C. Multiyear projects will be funded a year at a time. Funding in subsequent years will be contingent upon availability of funds and satisfactory performance. No guaranty is made upon funds availability and continuation of a project.
- D. Projects begun with prior year funds may be continued provided that each year is based on a revised proposal that incorporates a report of progress to the date of revision. A concise statement including data and analysis of research progress in the previously funded period, which demonstrate acceptable progress on the research project (not to exceed 10 pages single spaced), should be submitted within 30 days preceding the close of each 12 month budget period.
- E. The non-federal share must be \$2.00 for every \$1.00 federal. If the applicant requests academic release time (faculty members only), the proposal must be accompanied by an agreement letter from the department head or authorized official. Any other in-kind share must be accompanied by an agreement letter from an authorized university official. The 1:2 Federal-non-Federal fund matching ratio must be met on each grant award period.
- F. Funds available to the applicant from other sources (both Federal and State appropriations) may be used as matching funds as long as the proposal is accompanied by an official letter from the granter confirming the shared amount. In the event that State appropriations are not adequate to cover the non-Federal share, other contributions must be generated.
- G. Matching funds may contain indirect costs and non-federal salaries and benefits. The applicant's negotiated indirect cost rate (NICR) may be applied to both qualifying federal and non-federal direct costs, and the result used to satisfy part of the matching requirement under the non-federal share. The NICR shall not be applied to tuition and equipment costs.
- H. Charges Allowable to Federal Funds.
  - a) Costs will be allowable in accordance with OMB Circular A-21, revised, "Cost Principles for Educational Institutions," on file in your university's contract office.
  - b) The portion of benefits paid to individuals cannot exceed the proportion of their salaries paid from the grant.
  - c) Indirect costs may not be charged on Federal funds provided by the Department of Interior; however, they are chargeable to the total direct costs (etc.) and should be shown in the non-Federal column of the Budget Breakdown form. Federal funds shall not be used to pay indirect costs. The Geological Survey will accept indirect cost rates approved by the cognizant agency in accordance with OMB Circular A-88. A copy of the approved rate agreement or other approving documentation must be attached to proposals from universities or colleges other than the University of Puerto Rico.

## VIII. PROJECT DURATION

Projects may be from one to three year duration. Those with duration greater than one year will be approved for continuation of funding contingent upon: (1) the continued availability of funds to the Institute and (2) a revised proposal that demonstrates satisfactory progress for the previous year toward meeting the project's stated objectives. It is very important, therefore, that each year of multiyear projects stands by itself.

All projects will have a start date of March 1, 2008. Projects may be designed to run beyond February 2009 (multiyear projects), provided that they contain a reportable element with conclusive findings to be included in the FY 2008 program report. Funding in subsequent years will be contingent upon availability of funds and satisfactory performance.

The period of performance for the projects will be March 1, 2008, through February 28, 2009. Short (1-2 pages) quarterly reports are required, and PIs will submit draft copies of completion reports to PRWRERI no later than May 4, 2009 for peer review.

## IX. PROPOSAL REVIEW AND SELECTION PROCESS

1. Proposals will be received and sent for evaluation to the Institute's External Advisory Committee. Results of this evaluation will be forwarded to the director of the Institute. A copy of the evaluation standard form is enclosed (Exhibit 1). The External Advisory Committee uses this form in its evaluation and ranking process.
2. Advised by these evaluations, the director will select the top proposals (number of proposals will depend on funds availability).
3. The following criteria will be used:

Technical merit (quality)	40%
Applicability (importance)	30%
Novelty (new approaches)	10%
Competence of PIs	10%
Educational and training opportunities	10%

4. Time line will be as follows:

October 22, 2007	The Institute issues the Request for Proposals.
December 3, 2007	Proposals due at the website.
December 7, 2007	Proposals sent to the External Advisory Committee
December 21, 2007	Local selection process completed.
January 11, 2008	PRWERRI send Institute's proposal to USGS.
March 1, 2008	Projects begin
June 2, 2008	1 <sup>st</sup> Quarterly reports due in the Institute office.
September 1, 2008	2 <sup>nd</sup> Quarterly reports due in the Institute office.
December 1, 2008	3 <sup>rd</sup> Quarterly reports due in the Institute office.
February 28, 2009	One-year projects end.

March 2, 2009	4 <sup>th</sup> Quarterly reports due in the Institute office (all projects).
May 4, 2009	Draft project completion reports due for peer review.
May 29, 2009	Technical and editorial review completed.
June 15, 2009	Final completion report due in the Institute office.
June 30, 2009	Annual program report submission to the USGS.

## **X. APPLICATION REQUIREMENTS**

- A. The applicant shall have its matching funds (\$2.00 Non-Federal for every \$1.00 Federal) committed at time of application submittal to the Institute. Commitment means that the application shall contain an institutional cost-sharing agreement (letter) signed by an official authorized to commit the applicant to all or part of the matching share or a third party, in-kind contribution signed by an official authorized to commit the third party.
- B. Matching funds shall be obligated during the period of performance.
- C. The matching requirement should be met during each 12-month budget period.
- D. Matching funds may contain indirect costs.
- E. The length of the project period shall not exceed 3 years, with discrete 12-month budget periods.
- F. The Institute will consider research proposals only from faculty members or affiliates at institution of higher education in Puerto Rico.
- G. The Institute shall not accept proposals from any applicant who has not met reporting requirements for projects funded by a prior formula grant administered by the Department of the Interior.
- H. INDICATE WHETHER THE APPLICATION IS FOR A NEW OR CONTINUING PROJECT.

## **XII. APPLICATION INSTRUCTION**

The contents of the application shall be prepared in accordance with the following instructions.

- A. Research Proposals. Each proposal shall consist of the following 20 elements. Items numbered 1 through 12 are to be entered in the web form provided at the website. (See example at Exhibit 2)
  - 1. Title. Concise but descriptive.
  - 2. Project Type. Choose from the following: Research, Information Transfer, Information Management System, Education, or Other (please specify).
  - 3. Focus Categories. Choose a maximum of three focus categories from the list provided (Exhibit 3), with the most preferred focus category first.
  - 4. Research Category. Choose from the following the one category that most closely applies: Social Sciences, Ground-water Flow and Transport, Water Quality, Biological Sciences, Engineering, or Climate and Hydrologic Processes.
  - 5. Keywords. Enter keywords of your choice descriptive of the work (see Exhibit 4)
  - 6. Start Date. Enter the actual beginning date for the project.

7. End Date. Enter the estimated end date for the project.
8. Principal investigator(s). Provide name, academic rank, university, email address and phone number of the principal investigators.
9. Congressional District of the university where the work is to be conducted. Enter N/A here.
10. Abstract. Provide a brief (one-page) description of the problem, methods, and objectives in the space provided at the Internet site.
11. Budget Breakdown, as requested by the web form (See Exhibit 6).
12. Budget Justification, as requested by the web form (See Exhibit 7).

Items 13 through 20 are to be "deposited" as a file document in PDF format at the website. Note: This document shall not exceed 10 single-spaced pages - 12 point font, exclusive of resumes (item 20). Upon submission of your application components, the entire package will be available in PDF format for your inspection and final approval. You are responsible for verifying the approval, including compliance with the 10-page limit. If editing is required, you must edit the problem document(s) using your word processor and resubmit that application component.

13. Title. Please use the same title as was entered in the web form under item 1, above.
  14. Statement of regional or State water problem. Include an explanation of the need for the project, who wants it, and why.
  15. Statement of results or benefits. Specify the type of information that is to be gained and how it will be used.
  16. Nature, scope, and objectives of the project, including a timeline of activities.
  17. Methods, procedures, and facilities. Provide enough information to permit evaluation of the technical adequacy of the approach to satisfy the objectives.
  18. Related research (Research projects only). Show by literature and communication citations the similarities and dissimilarities of the proposed project to completed or on-going work on the same topic.
  19. Training potential. Estimate the number of graduate and undergraduate students, by degree level, who are expected to receive training in the project (See Exhibit 5).
  20. Investigator's qualifications. Include resume(s) of the principal investigator(s). No resume shall exceed two pages or list more than 15 pertinent publications.
- B. Budget Breakdown. Submit a detailed budget as presented in the form of Exhibit 6. The budget shall include the line items presented below. Indicate the amount of cost sharing for each element: If the applicant is proposing a project of more than one year duration, include lump sum costs for other years at the bottom of form. The applicant will submit the budget using the web form provided in the website.
- C. Budget Explanation: Submit a detailed description of each budget item in the corresponding web form. Include calculations on how your figures were arrived at and any information necessary to understand your budget.

1. Salaries and wages. Identify the individuals and categories of salaries and wages, estimated hours or percentage of time, and the rate of compensation proposed for each individual or category. (Tuition remission and other forms of compensation paid as or in lieu of wages to students performing necessary work are allowable provided that the tuition or other payments are reasonable compensation for the work performed and are conditioned explicitly upon the performance of necessary work.) If the rate of pay shown is higher than the current rate of pay, include an explanation.
2. Fringe benefits. Propose rates/amounts in conformance with normal accounting procedures. Explain the cost and the basis of the rate computations. Indicate whether the rates are used for application purposes or whether they are fixed or provisional rates for billing purposes.
3. Supplies. Indicate separately the amount estimated for office, laboratory, computing, and field supplies. Provide detail on any specific item, which represents a significant portion of the proposed amount.
4. Equipment. Identify non-expendable personal property having a useful life of more than 1 year and an acquisition cost of more than \$5,000 per unit. If fabrication of equipment is proposed, list parts and material required for each, and show costs separately from the other items. Furniture is not allowed.
5. Services or consultant. List the contemplated consultants (including sub-recipients), the estimated amount of time required, and the quoted rate per day or hour. State whether the consultant rate is the same as that received for similar services under other Government awards.
6. Travel. All estimated costs should be itemized showing the number of trips required, type of trip (field, scientific meeting, or conference attendance), the destination, the number of people traveling, the per diem and local reimbursement rates allowed by the applicant, and any miscellaneous expenses for each trip. (Note: All travel is to be in accordance with the established travel policy of the applicant's institution. A copy of the applicant's institutional travel policy may be attached).
7. Other direct costs. Itemize the costs not included elsewhere, e.g., shipping, telemetry, computing, equipment use charges, age dating, or other services. Provide breakdowns showing how the cost was estimated, e.g., computer time should show the type of computer, the estimated time of use, and the established rates.
8. Indirect costs. Specify the indirect costs rate in the non-Federal column only based on the applicant's approved rate agreement. An amount equivalent to what the indirect costs would have been under the Federal portion may also be included as match under the indirect cost in the non-Federal portion.

Cost Category. Allocate Federal and non-Federal costs.

(a) Direct Costs.

Direct costs are those costs which can be identified specially with a particular research project, an instructional activity, or any other institutional activity which can be directly assigned to such activities relatively easily with a high degree of accuracy.

Identifiable benefit to the research work, rather than the nature of the goods and services involved, is the determining factor in distinguishing direct from indirect costs of research agreements. Typical transactions chargeable to a research agreement as direct costs are the compensation of employees for the performance of work under the research agreement, including

related staff benefit and pension plan costs to the extent that such items are consistently treated by the educational institution as direct rather than indirect costs; the costs of materials consumed or expended in the performance of such work; and other items of expense incurred for the research agreement, including extraordinary utility consumption. The cost of material supplied from stock or services rendered by specialized facilities or other institutional service operation may be included as direct costs of research agreements provided such items are consistently treated by the institution as direct rather than indirect costs and are charged under a recognized method of costing or pricing designed to recover only actual costs and conforming to generally accepted cost accounting practices consistently followed by the institution.

(b) Indirect Costs (non-Federal share only). Indirect costs are those that have been incurred for common or joint objectives and therefore cannot be identified specifically with a particular research project, an instructional activity, or any other institutional activity. At educational institutions such costs normally are classified under the following functional categories:

1. General administration and general expenses;
2. Research administration expenses;
3. Operation and maintenance expenses;
4. Library expenses; and
5. Departmental administration expenses.

Note: Indirect costs are allowed under the non-Federal cost category only.

9. Total estimated cost. Total items (a) through (h).

- D. Matching Funds Commitment Letter. The application shall contain an institutional cost-sharing agreement (letter) signed by an official authorized to commit the applicant to all or part of the matching share or a third party, in-kind contribution signed by an official authorized to commit the third party.
- E. Negotiated indirect cost rate agreement. Attach a copy of the approved negotiated indirect cost rate agreement. (Applies to applicants from institutions other than the University of Puerto Rico system)

### **XIII. SPECIAL TERMS AND CONDITIONS**

1. Adherence to reporting requirements. A recipient's failure to submit the required reports/documents in a timely manner may result in the withholding of payment, in termination of the award, and/or in the delay or non-issuance of a new award.
2. Adherence to the Original Research Objectives and Budget Estimates. Any commitments or expenditures incurred by the Recipient in excess of the funds provided by this award shall be the responsibility of the Recipient. Expenditures incurred prior to the effective date of this award cannot be charged against award final funds unless provided for in this award.
3. Dissemination of Results. The Recipient is encouraged to disseminate research result promptly to the scientific community. The Institute encourages the Recipient to publish project reports in scientific and technical journals. The Institute and the US Government may publish, reproduce, and use all technical data developed as a result of this award in any manner and for any purpose, without limitation, and may authorize others to do the same.

4. Violation of Award Terms. If the Recipient has materially failed to comply with the terms of this award, the Institute may suspend, terminate, or take such other remedies as may be legally available in the circumstances.

PUERTO RICO WATER RESOURCES AND ENVIRONMENTAL RESEARCH INSTITUTE  
 UNIVERSITY OF PUERTO RICO AT MAYAGÜEZ  
 P.O. BOX 9040  
 MAYAGUEZ, PUERTO RICO 00681-9040

FY 2008 PROPOSAL EVALUATION FORM

Project Number: \_\_\_\_\_

Amount Requested: \_\_\_\_\_

Principal Investigator(s):

Title:

1. Is the water problem addressed significant? (30%) Score \_\_\_\_\_  
 (Excellent 30, Very Good 25, Good 20, Average 15, Fair 10, Poor 5, Unacceptable 0 )

Comments:

2. Is the research proposal of high quality? (40%) Score \_\_\_\_\_  
 (Excellent 40, Very Good 34, Good 28, Average 22, Fair 15, Poor 8, Unacceptable 0)

Consider the following points in your evaluation (1) clarify of objectives, (2) methodology to conduct the research, and (3) reasonableness of the scope of the project for the time and budget allotted.

Comments:

2. Does the proposal contain new approaches  
 or a novel solution to the water problem addressed? (10%) Score \_\_\_\_\_  
 (Excellent 10, Very Good 8, Good 6, Average 5, Fair 3, Poor 1, Unacceptable 0)

Comments:

PRWRERI Proposal Evaluation Form (continued)

4. Is the principal investigator and/or his research team qualified to carry out the proposed research? (10%) Score \_\_\_\_\_  
(Excellent 10, Very Good 8, Good 6, Average 5, Fair 3, Poor 1, Unacceptable 0)

Comments:

5. Does the proposal make appropriate provision for the training of future water resources professionals? (10%) Score \_\_\_\_\_  
(Excellent 10, Very Good 8, Good 6, Average 5, Fair 3, Poor 1, Unacceptable 0)

Comments:

OVERALL EVALUATION (sum of section scores) Score \_\_\_\_\_

ADDITIONAL COMMENTS (continue on reverse if necessary)

REVIEWERS SIGNATURE \_\_\_\_\_

REVIEWERS NAME \_\_\_\_\_ PHONE \_\_\_\_\_

ORGANIZATION \_\_\_\_\_

ADDRESS \_\_\_\_\_ DATE \_\_\_\_\_



## Exhibit 3

**FOCUS CATEGORIES**

ACID DEPOSITION	ACD
AGRICULTURE	AG
CLIMATOLOGICAL PROCESSES	CP
CONSERVATION	COV
DROUGHT	DROU
ECOLOGY	ECL
ECONOMICS	ECON
EDUCATION	EDU
FLOODS	FL
GEOMORPHOLOGICAL & GEOCHEMICAL PROCESSES	G&G
GROUND WATER	GW
HYDROGEOCHEMISTRY	HYDGEO
HYDROLOGY	HYDROL
IRRIGATION	IG
LAW, INSTITUTIONS, & POLICY	LIP
MANAGEMENT & PLANNING	M&P
METHODS	MET
MODELS	MOD
NITRATE CONTAMINATION	NC
NONPOINT POLLUTION	NPP
NUTRIENTS	NU
RADIOACTIVE SUBSTANCES	RAD
RECREATION	REC
SEDIMENTS	SED
SOLUTE TRANSPORT	ST
SURFACE WATER	SW
TOXIC SUBSTANCES	TS
TREATMENT	TRT
WASTEWATER	WW
WATER QUALITY	WQL
WATER QUANTITY	WQN
WATER SUPPLY	WS
WATER USE	WU
WETLANDS	WL

### Keywords

Note : The keywords describe areas of interest as related to water; e.g. "Cooling" refers to water as used in cooling. "Fertilizers" implies the effect of fertilizer on water characteristics, etc.

- |                             |                            |                                 |
|-----------------------------|----------------------------|---------------------------------|
| A                           | 28. Biological Control     | 55. Data Analysis               |
| 1. Acid Deposition          | 29. Biological Treatment   | 56. Data Storage and Retrieval  |
| 2. Acid rain                | 30. Biomonitoring          | 57. Decision Model              |
| 3. Activated Carbon         | 31. Biotechnology          | 58. Demand Management           |
| 4. Activated Sludge         | 32. Birds                  | 59. Denitrification             |
| 5. Adsorption and Exchange  | 33. Boating                | 60. Desalination                |
| 6. Aeration                 | 34. Brackish Water         | 61. Developing Countries        |
| 7. Agriculture              | 35. Brines                 | 62. Disinfections               |
| 8. Algae                    | C                          | 63. Distillation                |
| 9. Alkaline Scale           | 36. Cartography            | 64. Distribution System         |
| 10. Anaerobic Treatment     | 37. Channels               | 65. Drainage                    |
| 11. Animal Waste            | 38. Chemigation            | 66. Drilling                    |
| 12. Aquaculture             | 39. Chlorination           | 67. Drought                     |
| 13. Arid Climates           | 40. Climate                | 68. Dynamic Programming         |
| 14. Aquatic Plants          | 41. Cloud Seeding          | E                               |
| 15. Aquifer Characteristics | 42. Coastal Engineering    | 69. Earth Dams                  |
| 16. Aquifer Parameters      | 43. Coastal Zone           | 70. Economics                   |
| 17. Atmospheric Models      | 44. Computers              | 71. Ecosystems                  |
| 18. Atmospheric Processes   | 45. Conflict Managements   | 72. Education                   |
| B                           | 46. Conjunctive Use        | 73. Energy Budget               |
| 19. Bacteria                | 47. Conservation           | 74. Energy Use and Conservation |
| 20. Basalt Hydrology        | 48. Contaminant Transport  | 75. Environmental Sanitation    |
| 21. Base Flow               | 49. Conveyance Systems     | 76. Epidemiology                |
| 22. Bays                    | 50. Cooling                | 77. Estuaries                   |
| 23. Beaches                 | 51. Crop Water Use         | 78. Estuarine Modeling          |
| 24. Benefit-Cost Analysis   | 52. Crustaceans            | 79. Eutrophication              |
| 25. Benthos                 | D                          | 80. Evaporation                 |
| 26. Biodegradation          | 53. Dairy Waste Management | 81. Evapotranspiration          |
| 27. Bioindicators           | 54. Dams                   |                                 |

**Keywords**

F	111. Hydrobiology	139. Land-Water Interactions
82. Fertilizers	112. Hydrogeology	140. Law
83. Fish Ecology	113. Hydrologic Models	141. Leaching
84. Fisheries	114. Hydropower	M
85. Flood Control	115. Hypothermia	142. Marketing
86. Flood Plain Management	I	143. Marinas
87. Fluid Flow	116. Ice	144. Marine Resources
89. Fluid Mechanics	117. Impoundments	145. Marshes
G	118. Indian Water Issues	146. Mathematical Models
90. Geochemistry	119. Industrial Wastewater	147. Membranes
91. Geographic Information Sys.	120. Infiltration	148. Microclimatology
92. Geomorphology	121. Information Dissemination	149. Mineralogy
93. Geophysics	122. Insecticides	150. Mining
94. Geothermal Power	123. Insects	151. Model Studies
95. Glaciers	124. Institutional Relationships	152. Moisture Uptake
96. Great Lakes	125. In-stream Flow	153. Mountain Lakes/Streams
97. Groundwater Hydrology	126. Inter-basin Transfers	154. Multiple-Objectives Planning
98. Groundwater Management	127. Invertebrates	N
99. Groundwater Modeling	128. Ion Exchange	155. Navigation
100. Groundwater Movement	129. Irrigation	156. Nitrogen
101. Groundwater Quality	130. Irrigation Management	157. Numerical Analysis
102. Groundwater Recharge	131. Irrigation Scheduling	158. Nutrients
H	132. Irrigation System	O
103. Hazardous Waste	133. Isotopes	159. Oil-Water Interfaces
104. Health Effects	K	160. Open Channels
105. Heal Budget	134. Karst Hydrology	161. Operation Research
106. Heavy Metals	L	162. Optimization
107. Herbicides	135. Lagoons	163. Organic Compounds
108. History	136. Lakes	164. Osmosis
109. Hydraulic Structures	137. Land Use	165. Oxidation
110. Hydraulics	138. Landscape Management	166. Ozonation

**Keywords**

P	196. Reservoir Management	226. Soil Erosion
167. Perched Water Table	197. Reservoir Modeling	227. Soil Microbiology
168. Percolation	198. Resource Development	228. Soil Physics
169. Pest Management	199. Resource Planning	229. Soil-Water Relationships
170. Pesticides	200. Reverse Osmosis	230. Solar Energy
171. Phosphorus	201. Riparian Vegetation	231. Solute Transport
172. Photosynthesis	202. Risk Analysis	232. Springs
173. Phreatophytes	203. Risk Management	233. Statistics
174. Physical Chemistry	204. River Basin Development	234. Stochastic Hydrology
175. Planning	205. River Beds	235. Stochastic Processes
176. Plant Growth	206. Rivers	236. Storm Water Management
177. Plant Pathology	207. Runoff	237. Streams
178. Plant Stress	S	238. Subsidence
179. Plant-Water Relationships	208. Saline Soils	239. Subsurface Drainage
180. Policy Analysis	209. Saline-Freshwater Interfaces	240. Surface Drainage
181. Pollutants	210. Salinity	241. Surface-Groundwater Relationships
182. Pollution Control	211. Sanitary Landfills	242. Suspended Sediments
183. Ponds	212. Saturated Flow	243. Synthetic Hydrology
184. Port Facilities	213. Seawater	244. Synthetic Organics
185. Power Plants	214. Sedimentation	245. Systems Analysis
186. Public Health	215. Seismology	246. Systems Engineering
187. Pumps	216. Septic Tanks	T
R	217. Sewer Systems	247. Thermodynamics
188. Rainfall	218. Shellfish	248. Tideland
189. Rainfall-Runoff Models	219. Shipping	249. Time-Series Analysis
190. Rainfall-Runoff Processes	220. Shore Birds	250. Tourism
191. Range Management	221. Shore Protection	251. Toxic Substances
192. Recreation	222. Sludge	252. Trace Elements
193. Reefs	223. Snow	253. Trace Organics
194. Regulatory Permits	224. Socioeconomic Issues	254. Tropics
195. Remote Sensing	225. Soil Chemistry	U

**Keywords**

255. Underground Storage Tanks	268. Water Harvesting	283. Water Use Data
256. Unsaturated Flow	269. Water Law	284. Water Use Efficiency
257. Urban Drainage	270. Water Levels	285. Water Use Monitoring
258. Urban Hydrology	271. Water Quality	286. Watershed Management
259. Urban Planning	272. Water Quality Control	287. Waves
260. Urban Water Systems	273. Water Quality Management	288. Weather Data Collection
V	274. Water Quality Modeling	289. Weather Forecasting
261. Viruses	275. Water Quality Monitoring	290. Weather Modification
W	276. Water Quality Standards	291. Weeds
262. Waste Disposal	277. Water Resources Development	292. Well Hydraulics
263. Wastewater	278. Water Reuse	293. Wetlands
264. Wastewater Irrigation	279. Water Rights	294. Wildlife Management
265. Wastewater Treatment	280. Water Softening	Z
266. Water Chemistry	281. Water Treatment	295. Zooplankton
267. Water Demand	282. Water Treatment Facilities	296. Zoning

## Exhibit 5

**TRAINING ACCOMPLISHMENTS****ACADEMIC LEVEL**

<b>FIELD OF STUDY</b>	Undergraduate	Master's Degree	Ph.D. Degree	Post Ph.D.	Total
Chemistry					
Engineering:					
Agricultural					
Civil					
Environmental					
Chemical					
System (industrial)					
Other*					
Geology					
Hydrology					
Agronomy					
Biology					
Ecology					
Social Sciences					
Computer Science					
Geography					
Law					
Resources Planning					
Other (specify)					

\_\_\_\_\_ **TOTAL**

\* Less than 5 students in any one field of study.

