

RPI – FWI – 73-17

RENSSELAER **Fresh**  
**Water**  
**Institute**

AT LAKE GEORGE



THIRD ANNUAL REPORT  
RENSSELAER FRESH WATER INSTITUTE AT  
LAKE GEORGE (FWI)

FWI 73-17

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## GENERAL CHARACTER OF THE FRESH WATER INSTITUTE

Although advances continue to be made by many organizations to halt further deterioration of our environmental resources, certain basic questions remain largely unanswered. These include:

1. How does the pollution process transform a "clean" lake or stream into a "polluted" one?
2. How can this process be slowed/reversed?
3. In what quantities can the aquatic environment assimilate the by-products of human activity without upsetting its ecological balance?

The northeastern area of the United States with its vast water resources has a tremendous asset at stake. More specific and documented answers to the environmental problems of this region are needed in order to preserve these resources.

Based upon the capabilities, research results and educational programs developed at the Rensselaer Fresh Water Institute at Lake George (FWI) - founded in 1967 - significant progress has been made toward obtaining complete answers to these questions. Such answers constitute an important source of technical and applied information.

The basic approach of the FWI in analyzing lake pollution is the in-depth study of the biological, chemical and physical interactions which occur in a given water body. The data produced are being used to develop more complete ecological understanding and mathematical models which will have the capability of forecasting future conditions which may result from various increased activities by man. Also, the models will be used in formulating alternatives available for preventing the further deterioration of a body of water and maintaining it at a predetermined level of quality.

At the present time, the FWI research program is not only multidisciplinary but multiinstitutional. Sixteen faculty are involved representing seven disciplines and five institutions. The research has been instrumental in evolving new directions for academic pursuits by graduate students within a multidisciplinary framework. This is illustrated in the development of

five new courses at Rensselaer. Twenty Rensselaer graduate students have received advanced degrees; currently, fourteen graduate students are working toward degrees.

### MULTIDISCIPLINARY APPROACH

The FWI has been able to merge and draw upon the special capabilities of several disciplines, which has been a key factor in its significant progress in the complex area of ecosystem analysis. The approaches of the various disciplines within the activities of the FWI are outlined briefly as follows:

1. Geology - is oriented toward environmental geology through paleoecologic and meteorologic studies which interface with mathematical modeling.
2. Environmental Engineering - offers experience and depth in treatment methodology and environmental control design. In addition, this curriculum at RPI has been historically concerned with the effects of waste discharges upon the environment.
3. Operations Research and Statistics - applies statistics to industrial problems and to ecosystem analysis via mathematical modeling.
4. Biology - demonstrates a geo-microbiological orientation plus a combination of biochemistry, field biology and molecular biology.
5. Chemistry - is involved in the study of natural and man-induced distribution of heavy metals through analytical, physical and ligand chemistry.
6. Systems Engineering - applies mathematical modeling to socio-political areas such as recreation, transportation and natural resource management planning.
7. Economics - uses this discipline to determine effective natural resources utilization via quantitative techniques.

### APPLIED RESEARCH TECHNOLOGY

These seven disciplines have been coordinated and applied in order to develop the following areas of research emphasis:

### Ecosystem Analysis

The investigation of the biological, chemical and physical processes associated with natural and man-modified ecosystems. These efforts will continue to be synthesized into scientific theories and predictive models of behavior necessary to develop efficient mechanisms for environmental management.

### Environmental Health

An analysis of the causes and transmissibility of environment associated and induced diseases affecting man and other biological life. These proposed studies will lead to the establishment of control criteria for the prevention of such diseases.

### Socio-Political

Approximately 6,000 persons at four New York State lakes have responded to an FWI environmental quality survey. Conducted over the past three years, its objective is the development of a comprehensive data-bank of socio-economic, perception and user lake information. This information assists FWI researchers in further understanding the importance of water quality in relation to human perspective and in maintaining and improving lake environments in relation to this perspective.

### Land Management

This effort is primarily concerned with the impacts of land management practices upon freshwater bodies in the northeast. Frequent attendance and testimony at environmental impact hearings are also implied with this effort.

### Municipalities

FWI staff have given considerable time and will be in a position to provide data concerning environmental effects to municipalities not having or in the process of improving wastewater treatment facilities.

### Special Courses

These will include treatment technology, management practices and

legal regulations to be offered for industry, other private groups, public officials and developers.

### IMPLEMENTATION OF RESEARCH EFFORTS

As the result of extensive research involving Lake George and to a lesser extent some other northeastern freshwater lakes, much has been accomplished in the following specific areas.

1. Long term algal sampling - has provided data which can aid in defining the effects of nutrients such as nitrogen and phosphorus on freshwater bodies.
2. Advanced wastewater treatment techniques - have been or are being developed for individual homes, small resort communities and municipal treatment works. In September, 1973, research entered the second year to develop a phosphorus removal scheme compatible with septic tank operation. Also, as the result of cooperation with consultants for Lake George Village, the equipment of its plant will be upgraded. In addition, due to FWI monitoring and data gathering at this plant, it may be selected in the near future by the Environmental Protection Agency (EPA) and the U. S. Army, Quartermaster Corps as a site for further FWI research in the area of soil systems which are being utilized for the land application of treated wastewaters.
3. Data analysis - compiling the above and all other data has led to the development by FWI researchers of an extensive data bank and related data analysis, data management and data handling techniques for large blocks of information. Regional, national and international organizations are interested in this information, and methods for efficient data transfer have been initiated. For example, the EPA is using FWI mathematical models for related water management programs.
4. The North American Project - the FWI has been selected by the EPA as one of the participants. Fifteen U.S. lakes (including Lake George) will be compared with some Canadian lakes. In turn, this information will be used to augment an earlier study of European lakes in order to

further advance knowledge regarding eutrophication causes and control methods.

5. Saratoga Lake - in comparison with Lake George which is oligotrophic/mesotrophic in certain areas, Saratoga Lake is eutrophic. Saratoga Lake is representative of many lakes in that it exhibits the unpleasant characteristics indicative of high nutrient loading including algal blooms, depletion of dissolved oxygen, odor and sludge rise due to gas information. Recreation possibilities are, therefore, greatly affected. Two solutions have been formulated and represent an initial attempt to restore a relatively large recreational lake (6.3 sq. mi.). Certain local citizen groups have proposed to install an aeration system which would replenish the dissolved oxygen level through adequate mixing. Effort is being devoted to determining the applicability of existing FWI models to analyzing Saratoga Lake as it exists and the effects of such proposed remedial measures for it.
6. The Adirondack Park - data gathering has been extended to include the Park (6.2 million acres) in cooperation with the newly established Adirondack Park Agency (APA). The FWI is providing technical assistance to APA in several areas, the most significant being the sampling of selected lakes throughout the Park in order to establish a Park data base. This data base will assist APA in establishing standards for project review specifically formulated for the proposed area to be developed. It is believed this unique cooperative endeavor between a state agency and a large research project at a private educational institution has the potential to serve as a national example in the area of environmental management.

#### PROGRAM STATUS - SUPPORT/% ALLOCATION AND ORGANIZATION CHART

In the six years which have passed since its inception, the FWI research program has expanded from an activity supported essentially by the RPI School of Engineering to a program-budgeted independent university activity. Support from public and private sources for 1972-73 was in the



order of \$365,000 and from RPI \$40,000. Its use on a percentage basis is shown on the following page.

The FWI administrative structure and research program is schematically illustrated in the organizational chart on page 8.

The current full time administrative and technical staff numbers eleven in addition to principal investigators and graduate students.

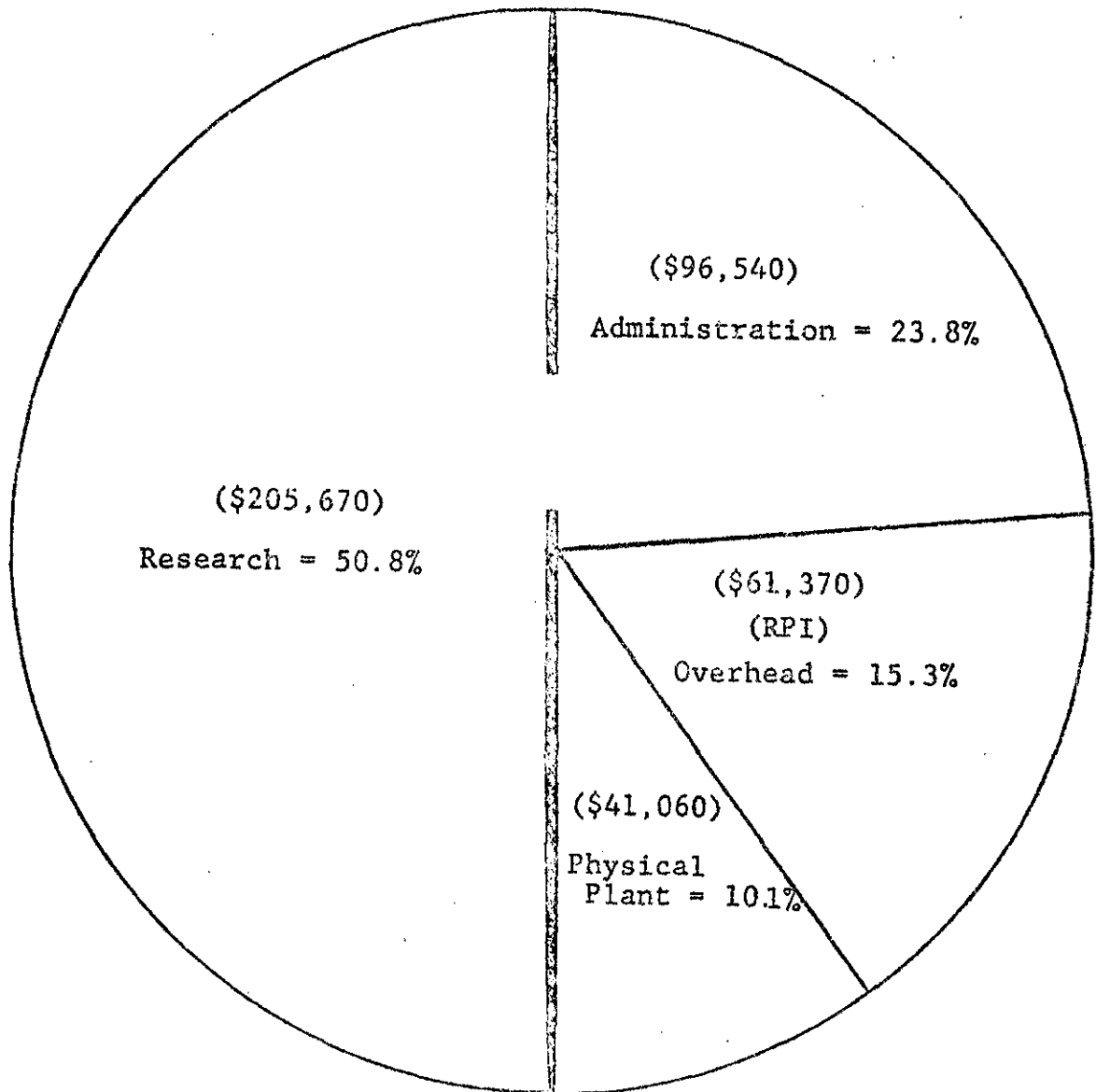
Current FWI laboratory facilities at Lake George are centered in two buildings and a trailer which provide 3,800 square feet of space. Complete instrumentation is available which is utilized by FWI staff and associates on a twelve month basis. The function of the FWI staff, facilities and equipment is to support the activities of the multidisciplinary research team described previously. The total value of buildings and equipment is in the order of \$300,000.

#### TECHNICAL REPORTS

The following reports were produced in the period July 1972 - June 1973.

<u>FWI Report No.</u>	<u>Description</u>
72-14	An Analysis with Conclusions Concerning <u>The Sylvan Beach Breakwater Pier</u> at Oneida Lake. J. J. Jesuele, K. Jack Kooyoomjian and R. F. Rio.
72-15	Initial Survey for Viruses in Lake George. J. J. Ferris.
72-16	<u>FIND</u> - <u>F</u> reshwater <u>I</u> nstitute <u>N</u> umeric <u>D</u> atabase. J. S. Fisher, R. C. Kohberger and J. W. Wilkinson.
72-17	Seasonal Variation in the Plankton and Periphyton Diatoms of Lake George, N. Y. S. L. Williams and N. L. Clesceri.
72-18	<u>ADLIB</u> - <u>A</u> bstract <u>D</u> ata <u>LI</u> brarian, A Bibliographic Retrieval System for Data Set Abstracts with Interaction with the FIND System. J. Nagy, R. C. Kohberger and J. W. Wilkinson.

PERCENTAGE ALLOCATION OF SUPPORT



# FRESH WATER INSTITUTE ORGANIZATION CHART - 1973

RESPONSIBILITIES

DEVELOPMENT OF POL-  
ICIES/ACCOUNTABILITY

ADMINISTRATIVE AND  
RESEARCH POLICY  
DEVELOPMENT/PRODUCTION

CONSULTATIVE  
BODY

POLICY DEVELOP-  
MENT/PRODUCTION

PROGRAMMING OF  
OPERATIONS

APPLIED RESEARCH  
RESULTS

PROVOST  
S.E. WIBERLEY

DIRECTOR  
N.L. CLESCERI

FWI ADVISORY  
COMMITTEE

ADMIN. SERVICE

TECH. PROGRAM

MANAGER  
J.S. HEYWOOD

RESEARCH COORD.  
J.J. FERRIS

PHYSICAL PLANT  
W.E. BATCHELDER

LABORATORY DIR.  
S. KOBAYASHI

ENVIRONMENTAL  
PROTECTION AGENCY

ADIRONDACK PARK  
AGENCY

NYS DEPT. OF  
ENVIRONMENTAL CONS.

LAKE GEORGE  
VILLAGE

21 RESEARCH PROJECTS

RESPONSIBILITIES

POLICY DEVELOPMENT  
PRODUCTION

PROGRAMMING OF  
OPERATIONS

RESEARCH PROGRAM-  
MING & DEVELOPMENT

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<u>FWI Report No.</u>	<u>Description</u>
72-19	Chemical Nutrients in Lake George. D. B. Aulenbach
72-20	Role of the Heterotrophic Microflora in the Cycling of Materials. L. S. Clesceri.
72-21	Lake George, N. Y. Hydrology, 1971-1972. R. Lytle and N. L. Clesceri.
72-22	Mineral Cycling: The Humic Materials of Lake George, A Preliminary Study (July 1, 1972-August 31, 1972). S. Kobayashi.
72-23	Aquatic Modeling Data Analysis and Data Management at Lake George, New York. R. A. Park, J. W. Wilkinson, J. A. Bloomfield, R. C. Kohberger and C. Sterling.
72-24	A Model for Aquatic Microbial Decomposition. L. S. Clesceri, J. A. Bloomfield, R. V. O'Neill, H. H. Shugart and R. Booth.
72-25	Annual Report - Rensselaer Fresh Water Institute at Lake George (FWI).
72-26	Hydrologic Study of Lake George, New York. E. M. Colon, D. Eng. Thesis, 1972.
72-27	Ecosystem Modeling for Lake George, N. Y. F. DiCesare, J. Bloomfield and R. A. Park.
72-28	Postglacial Diatom Changes in Lake George, N. Y. A. DelPrete, Ph.D. Thesis, 1972.
72-29	Lead Time Hydrologic Investigation at Lake George, N. Y. R. Lytle, E. M. Colon and N. L. Clesceri.
72-30	Organic Nutrient Factors Effecting Algal Growths, Final Report: U. S. Environmental Protection Agency. N. L. Clesceri.
72-31	Program of the Rensselaer Fresh Water Institute at Lake George. J. J. Ferris
72-32	Sources and Sinks of Nitrogen and Phosphorus: Water

FWI Report No.Description

- 73-1 Quality Management of Lake George (N. Y.) D. B. Aulenbach and N. L. Clesceri.
- 73-2 Sources of Nitrogen and Phosphorus in the Lake George Drainage Basin: A Double Lake. D. B. Aulenbach and N. L. Clesceri.
- 73-3 Lake George Site Overview: Progress in Ecosystems Analysis for the Lake George IBP Site, 1971-1972. N. L. Clesceri.
- 73-4 Effects of Exhaust from Two-Cycle Outboard Engines. W. W. Shuster.
- 73-5 A User's Guide to ADLIB - Part I. J. Nagy, J. S. Fisher, R. C. Kohberger and J. W. Wilkinson.
- 73-6 A Preliminary Investigation Regarding the Effects of Lubricating Oil on Viral Infectivity. J. J. Ferris.
- 73-7 Primary Productivity of Rooted Macrophytes in the Littoral Zone of Lake George. C. W. Boylen.
- 73-8 Perception of Water Quality by Select Respondent Groupings in Inland Water-Based Recreational Environments. K. J. Kooyoomjian and N. L. Clesceri.
- 73-9 Nutrient Inputs to a Lake and the Effects Upon Water Quality. D. B. Aulenbach and N. L. Clesceri.
- 73-10 Organic Carbon in Sediments of Lake George, N.Y.: Relation to Morphology of Lake Bottom, Grain Size of Sediments, and Man's Activities. M. S. Schoettle and G. M. Friedman.
- 73-11 Synthesis Process Report Decomposition. L. S. Clesceri.
- 73-12 Phosphorus Removal from Wastewaters: A Cost Analysis. I. J. Kumar and N. L. Clesceri.
- 73-13 A Concentration Technique for Measurement of Substrate Incorporation by Microflora in Lake Water. L. S. Clesceri and B. J. Gerber.

<u>FWI Report No.</u>	<u>Description</u>
73-13	Aquatic Modeling in the Eastern Deciduous Forest Biome, U. S. International Biological Program. J. A. Bloomfield, R. A. Park, D. Scavia and C. S. Zahorcak.
73-14	Effect of Man's Activities on Distribution of Trace Elements in Sub-Bottom Sediments of Lake George, New York. M. Schoettle and G. M. Friedman.
73-15	Thirty-five Years of Use of a Natural Sand Bed for Polishing a Secondary Treated Effluent. D. B. Aulenbach, J. J. Ferris, N. L. Clesceri and T. J. Tofflemire.
73-16	Programs and Objectives. J. S. Heywood.

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FWI FUNDING - 1972-1973

<u>Sponsor</u>	<u>Project</u>	<u>Amount</u>	<u>Program Component</u>
International Biological Program	15 projects	\$ 207,805	Ecosystems Analysis
New York State Science and Technology Fnd.	Phosphorus Removal Within Individual Septic Tank Systems - Phase I	\$ 20,000	Land Management
Environmental Protection Agency	Effects of Outboard Oil Emissions on Fresh Water	\$ 50,000	
Anonymous	Unrestricted	\$ 50,000	Land Management/General Support
Anonymous	Unrestricted	\$ 3,735	General Support
The 1907 Foundation	Unrestricted	\$ 10,000	Municipalities
The Knapp Fund	Unrestricted	\$ 10,000	General Support

<u>Sponsor</u>	<u>Project</u>	<u>Amount</u>	<u>Program Component</u>
International Biological Program (Supplementary)	Data Management and Ecosystems Modeling	\$ 34,860	Ecosystems Analysis
National Science Foundation Institutional Grant	Effect of Oil on Virus Survival	\$ 1,000	Environmental Health
Rensselaer Polytechnic Institute	Restricted	\$ 39,500	General Support
		<u>\$ 405,000</u>	

### LOOKING AHEAD

Since 1967 a principal portion of the FWI studies has dealt with ecosystem analysis. Two years ago, effort was intensified in providing technical assistance to local municipalities, especially Lake George Village. In addition to municipalities, involvement of this nature was initiated during 1972-1973 with state organizations such as the Lake George Park Commission of the New York State Department of Environmental Conservation and the Adirondack Park Agency. These efforts continue and are expected to increase in scope, especially regarding the Adirondack Park Agency. In the years ahead, these activities will be supplemented by expanded involvement concerning land and water management, environmental health, and special course offerings for industry and public officials. The FWI believes it is uniquely qualified to provide assistance in solving land and water management problems by unobtrusively gathering data and offering advice based upon them where appropriate. The ongoing philosophy of the FWI is to utilize basic research (ecosystems analysis, etc.) and integrate that information with engineering and socio-political data which will lead to practical improvements in areas having environmental problems.

### REPORT PREPARATION

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 Typing: Victoria R. Lee  
 Printing: Fresh Water Institute