

D.C. WRRRC REPORT NO. 27



**UNIVERSITY
OF THE
DISTRICT OF COLUMBIA**



**water resources
research center**
WASHINGTON, DISTRICT OF COLUMBIA

**ANNUAL REPORT
FISCAL YEAR 1980**

ANNUAL REPORT

Fiscal Year 1980

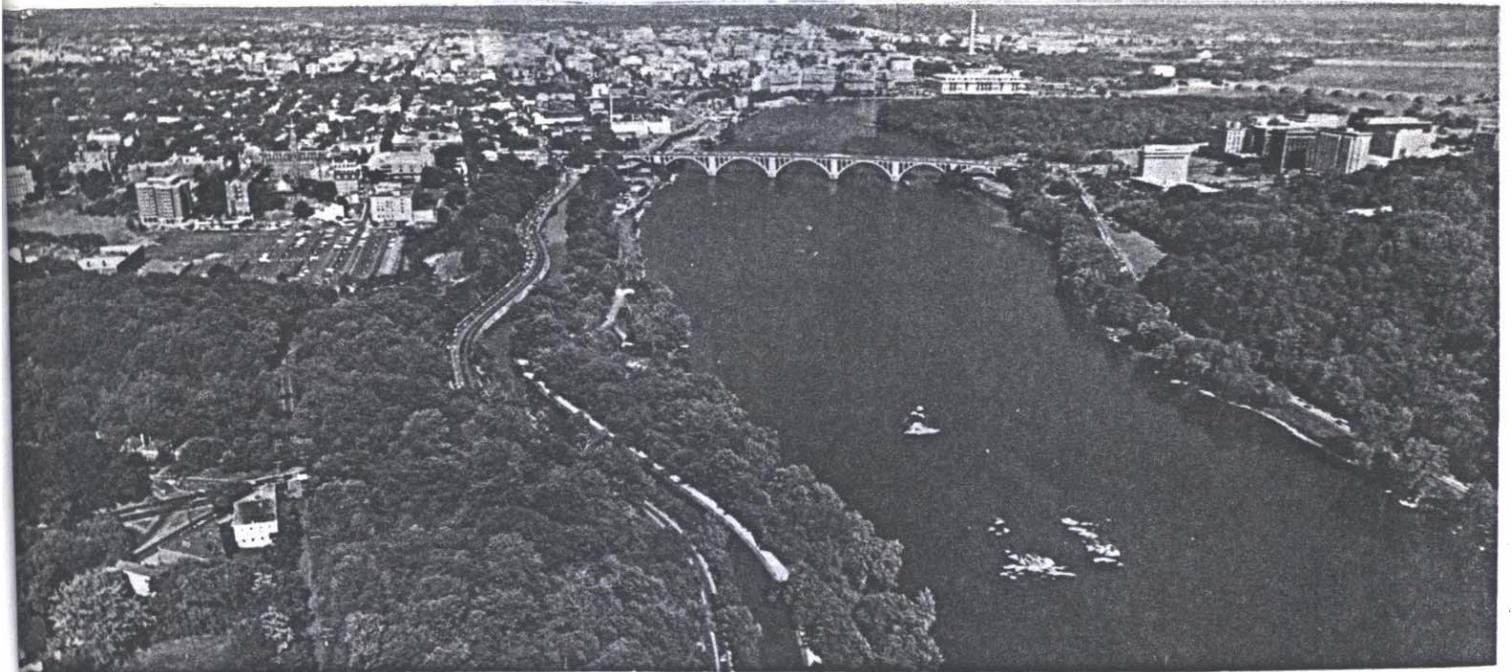
DC WATER RESOURCES RESEARCH CENTER

University of the District of Columbia

The Programs and activities described herein were supported in part by funds provided by the Office of Water Research and Technology, The U.S. Department of the Interior, Washington, D.C. as authorized by the Water Research and Development Act of 1978 P.L. 95-467.

TABLE OF CONTENT

	Page
I. DIRECTOR'S REPORT.....	1
II. RESEARCH OF THE CENTER	11
"Urban Aquaculture of Rainbow Trout (Salmo Gairdneri)".....	12
"Enzymatic Analysis of Nutrients in Water-Phases I & II"	17
--Special Projects	20
III. TRAINING AND EDUCATION	28
IV. THE RESEARCH ADVISORY COUNCIL AND THE TECHNICAL EVALUATION COMMITTEE	41
V. PERSONNEL	46
VI. ATTACHMENT FINANCIAL FORMS OW ₂ , OW ₃ , OW ₄ , OW ₅ and OW ₁₀	48



The Potomac in
the Washington, D.C. area



Dr. Mamadou H. Watt, Director

I. DIRECTOR'S REPORT

THE D.C. WATER RESOURCES RESEARCH CENTER

Director's Report Fiscal Year 1980 by

MAMADOU H. WATT

THE DISTRICT OF COLUMBIA WATER PROBLEMS

The Potomac and Anacostia Rivers and Rock Creek provide the District of Columbia with an average abundance of water for many uses. The "flashy" nature of these rivers and their multiple uses have serious impacts on the water quantity and quality in the D.C. area.

Water quantity problems for the District of Columbia are being intensely studied by the U.S. Army Corps of Engineers, Baltimore District, the Interstate Commission on the Potomac River Basin and regional task forces. Despite the efforts of these and other agencies, there is still need for research in water conservation.

The District of Columbia faces many diverse water quality problems. The combined sewer overflow study sponsored by the D.C. Department of Environmental Services as required by EPA under the NPDES Permit and Control Order issued to the District for Blue Plains Wastewater Treatment Plant is a comprehensive prescription for immediate and long term corrective measures. As for non-point source pollution control, The Metropolitan Washington Council of Governments has started a comprehensive program for monitoring non-point sources of pollution in diverse sections of the Washington area.

The United States Environmental Protection Agency, the D.C. Department of Environmental services and The Interstate Commission on Potomac River Basin are monitoring D.C. water quality on a regular basis. However, toxic and hazardous substances in D.C. have not been adequately investigated. D.C. waters have been found to contain toxic substances. There is a need for a comprehensive investigation to provide base line data on which to base discharge permit limitations and other management decisions and programs.

Other water resources problems are discussed in the Center's Five-Year Plan. They include: the impacts of urbanization and land use policies, the deterioration of sewage transport lines, the impacts of water disinfection methods, criteria for determining satisfactory local water quality standards, the effects and fates of nutrients on receiving water.

There are problems such as public awareness of water problems and training that are specific to the District. But a large number of the problems cannot be addressed by the District of Columbia alone. There must be an area wide cooperation between D.C. and its neighboring jurisdictions in Maryland and Virginia

THE CENTER'S MAIN THRUST

During the first part of fiscal year 1980, efforts were directed towards the reorganization and reactivation of the Center. The Research Advisory Council and Technical Evaluation Committee have been reactivated and new members added. Contact with D.C. area agencies and universities have been established.

The major effort during the first part of FY 1980 has been the preparation of the District of Columbia Five Year Water Resources Research Program Plan. To insure that the research program is responsive to the needs of the District, questionnaires were sent to a broad spectrum of people in the D.C. area who were actively involved in various aspects of water resources. The Center's Advisory Subcommittee for the Five-Year Plan whose members were selected from D.C. water related agencies, developed a list of problems from the results of the opinion survey respondents. These problems were ranked according to the priorities for the District and "researchability" for the Center. The completed document gives an overview of the D.C. Water Resources including geological, meteorological, biological and hydrological characteristics, and the surface and ground water resources. An analysis of the use of the water resources and a description of water related planning and development were presented. Copies of the document will be distributed to agencies, libraries, and researchers.

RESEARCH

Although only two projects were funded for FY 1980, many delinquent projects were completed during that year. Frank Carson and Helen Davies studied "The Use of Enzymatic cycling for High specificity and Precision in the colorimetric Analysis of Ammonia". They developed a new method for the colorimetric determination of ammonia in water. Their results generated interest in domestic and international research communities and in the Division of Drug Chemistry, Food and Drug Administration.



Prof. Harvey Lieber, author of the "Institutional Arrangements for Areawide Water Resources Management Planning in the Washington, D.C. Region. under the Federal Water Pollution Control Act Amendments of 1972". DC WRRRC Report #17

Dr. Michael A. Champ determined dissolved and particulate organic carbon concentrations in the Upper Potomac River Estuary in a study entitled "The Distribution, Transport, and Cycling of Dissolved and Particulate Organic Carbon in the Potomac and Anacostia Rivers in the Greater Washington Area". Dr. Champ studied also the influences of tidal activities and flood storm crests on these concentrations.

Dr. B. T. DeCicco studied "Removal of Eutrophic Nutrients from Wastewater and their Bioconversion to Bacteria Single Cell Protein for Animal Feed Supplements". He demonstrated that the bacterium *Alcaligenes eutrophus* is an efficient and effective remover of nitrogenous and phosphorus compounds from municipal wastewater. Further, the biomass from growth on wastewater proved to be a source of high quality protein for the growth of chicken.

A great deal of interest was generated from Dr. Harvey Lieber's study on "Institutional Arrangements for Areawide Water Resources Management Planning in the Washington, D.C. Region under the Federal Water Pollution control Act Amendments of 1972". The Center received a large number of requests of copies of the report from Local examined the Washington Area water resources planning under section 208 of the Clean Water Act. Dr. Lieber discussed the 208 plans accomplishments and failures. A summary of the report was presented as a cover page in the October 1980 issue of the Reporter, a monthly newsletter of the Interstate Commission on the Potomac River Basin.

The Muddy Waters of 208 Planning

Areawide water resources planning under Section 208 of the Clean Water Act has "lurched to an unclear climax," according to a major study of the process recently published by the Water Resources Research Center of the University of the District of Columbia.

The new study by Professor Lieber indicates that the 208 program in Washington produced results in what he calls "non-controversial" areas—data gathering, technical work, and cost saving ideas—shortfalls, Lieber writes "the f—"

Copies of the Lieber report, a highly readable document despite the title ("Institutional Arrangements for Areawide Water Resources Management Planning in the Washington, D.C. Region under the Federal Water Pollution Control Act Amendments of 1972")—are available from the Washington, D.C. Water Resources Research Center, University of the District of Columbia, Van Ness Campus, Washington, D.C. 20008. (Instead of the title, it may be easier to ask for Report Number 17.)

D.C. Water Research Center Revived

The D.C. Water Resources Research Center, publisher of the study of 208 planning described above, is undergoing a major revival. The center, located at the University of the District of Columbia's Van Ness center, was without a director for four years, until last year.

Dr. Mamadou H. Watt, an expert in fluid mechanics, was named director of the center last year, and launched an effort to complete several projects and begin preparing the five-year plan for the center.

The water center, like those in other states, is funded primarily through the U.S. Department of the Interior. It is currently involved in evaluating mathematical models of urban runoff, studying interconnection of water supply systems, and improving training in water resources. According to Dorothy Darden, the WRRC will be holding at least one symposium in the next year, probably dealing with a major Potomac issue.

Dr. Jose' A. Jones' work on "Urban Aquaculture of Rainbow Trout *Salmo gairdneri*" is still on progress. He is growing the trout fingerlings and will compare growth and survival rates of trouts grown in cages in the Potomac versus tank grown trouts.

Also in progress, Dr. Khalid Mahmood's project "An objective Evaluation of Urban Runoff Models" will attempt to develop an objective approach to evaluate and compare five urban runoff models. Models will be tested for several storms on a number of urban watersheds both in the Washington metropolitan area and elsewhere in the country.

Dr. R. C. Waters received a grant from the Center to conduct a 'research project on "Evaluation and Data Base Development Related to Regional Recreation Use Estimating Models for Water Resources Planning". The project started in mid FY 1980 and will be completed in 1981.

TECHNOLOGY TRANSFER

Under the Technology Transfer/Information Dissemination Program organized a symposium on "Water Supply Present-and-Future" in May 1980. .This symposium was organized in conjunction with Water Conservation Week activities. Speakers from the D.C. area water resources agencies addressed topics on the water supply system of Washington, D.C. and the D.C. regional water treatment plant. The Corps of Engineers made a presentation on the long range water supply plans for the Washington metropolitan area and the Office of Water Research and Technology gave an overview of the national water research program. There were about 35 attendants to the symposium. The Center has also cooperated in

the organization of another symposium "Non-point Pollution Control Tools and Techniques for the Future". This symposium was organized by the Interstate Commission on the Potomac River Basin, and held in June 11-13, 1980 in Gettysburg, Pennsylvania.

The Center is still in the lack of staff to carry out all Technology Transfer/Information Dissemination activities the Center would like to develop. The Center has not yet started publishing newsletter or holding regular seminars. It is the Center's intent to close this gap in the future.

OTHER ACTIVITIES AND ACCOMPLISHMENTS

The Center attempts to fill in for the areas not addressed by its principal investigators yet of importance to its goals to be responsive to the District water resources research related needs. It is for this reason that two projects were conducted in the Director's office.

The first of these projects was on "A Curriculum Development for Water Supply and Wastewater Operation, Maintenance and Management". The intent of this project was to assist the University of the District of Columbia to reactivate its water resources curriculum. The course descriptions and objectives were revised along with the support materials, i.e., laboratory equipment, textbooks, audio visual aids During that project the Center conducted a short survey of employment opportunities for water treatment plant operators in the Washington metropolitan area.

The second study concerned "Water Supply Interconnections: Institutional Factors". Basics and historical examples of Interconnections were described

and an analysis of the institutional factors concerning the proposed finished water interconnection between the Washington Aqueduct Division, the District supplier, and the Washington Suburban Sanitary Commission, the supplier of Montgomery and Prince George's counties in Maryland. These two projects are described more in detail in pages 24 through 27.

During the fiscal year particular efforts were made to increase the visibility of the Center. The Center increased its contact with local officials and academia, its staff member participated in local regional and out-of-town meetings. Some of the principal investigators testified at public hearings and presented lectures. Additionally, the Center held an exhibit at the fall ICPRB public meeting on "The state of the Potomac: 1980" at St. Mary's City, Maryland.

Finally, a few noteworthy remarks concerning the Center include: the joining of the National Water Data Exchange (NAWDEX) and the nomination of the Center's Director as a Commissioner of the District of Columbia to the Interstate Commission on the Potomac River Basin (ICPRB).



Water Research - The Present and the Future

Symposium

May 13, 1980 1 - 6 p.m.



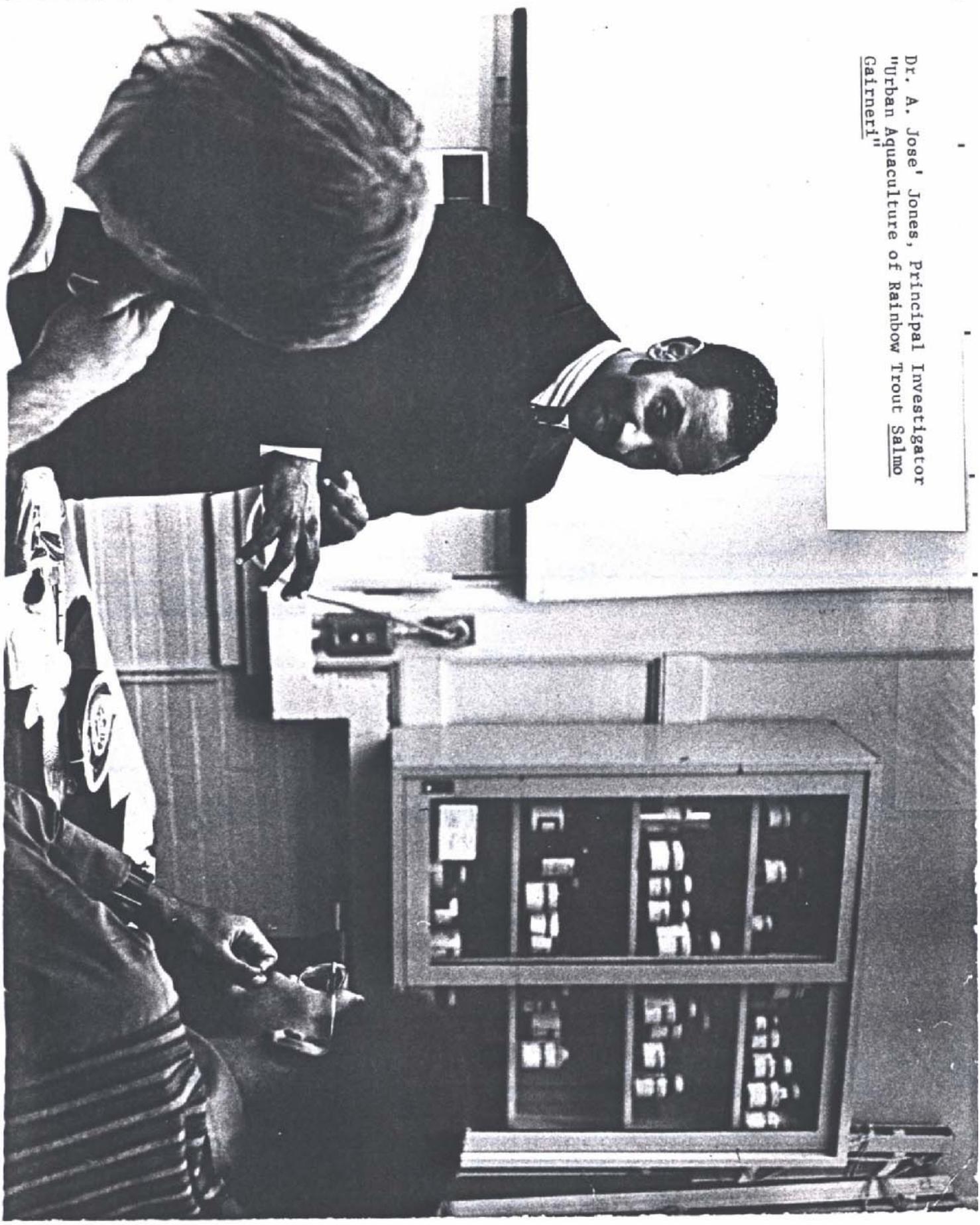
University of the District of Columbia
Van Ness Campus
4200 Connecticut Avenue, N.W.
Washington, D.C. 20008
Student Lounge, Building 38, 2nd Level

- P R O G R A M -

- OPENING REMARKSDr. Henakay H. Watt, Director
Water Resources Research Center
- INTRODUCTION OF THE PRESENTANT, ETC...Dr. Anyce C. Buck, Dean
College of Life Sciences
- WELCOME ADDRESSMr. Leslie C. Carter, President
University of the District of Columbia
- INTRODUCTION OF SPEAKERSDr. Mamadou H. Watt
- "The Washington Aqueduct Water
Supply System"Mr. Harry C. Mays, Chief
Washington Aqueduct Division
- "Blue Plains Wastewater Treatment
Plant"Mr. Jean Levesque, Administrator
Water Resources Management Authority,
Department of Environmental Services
- B R E A K -
- "Metropolitan Washington Area
Water Supply Study"Mr. Robert Fayer, Community Planner
U. S. Corps of Engineers
- "The Research Program of the
Office of Water Research
and Technology"Dr. Marjoe O. Fritel, Water Resources
Research Specialist
Office of Water Research and Technology
U. S. Department of the Interior
- CLOSING REMARKSDr. Mamadou H. Watt

II. RESEARCH OF THE CENTER

Dr. A. Jose' Jones, Principal Investigator
"Urban Aquaculture of Rainbow Trout Salmo
Gairneri"



Status Report on Project No. A-007-DC
Urban Aquaculture of the Rainbow Trout Salmo gairneri

A. RESEARCH PROJECT ACCOMPLISHMENTS

Although the project was supposed to begin on August 1, 1979 administrative red tape and the fact that the Aquaria to be used had to be custom made in California and shipped to this institution, the project could not begin until June 1980. This upset the entire growth time table.

Three hundred rainbow trouts were picked up from the Department of the Interior Fish Station in Warren, Pennsylvania on June 21, 1980. All of the trout fingerlings were weighed and measured at the beginning of the experiment to determine the growth rates of the fish. Oxygen concentrations were taken daily and total bacteria counts were determined to be used as a yardstick of impending tank contamination. The fish were fed with Purina Trout Chow which they took enthusiastically.

At first no visibly noticeable increase in size could be detected. After two (2) months, there was a ten-fold gain in weight by the fish. They are now totally acclimated to the tanks and move to the feeding station whenever the tanks are approached. The average length of the fingerlings at the beginning of the experiment was six centimeters and at present is eighteen centimeters. This represents a tremendous growth rate.

Initial results indicate that raising trout in a urban setting is highly feasible. There have been some unexpected problems which could destroy or alter the entire experiment. The electricity cut off over the weekend, killing half of the experimental organisms. This mishap led us to have the laboratory rewired to put the tanks on different electrical lines.

It was also discovered that the cost factor for holding tanks could be greatly reduced if tanks were constructed of marine plywood coated with fiber glass or tar and kept in building (rooms) of 10⁰C rather than purchasing refrigerated tank. Of course the building would have to be supplied with auxiliary emergency electrical power.

B. APPLICATION OF RESEARCH RESULTS: NONE

C. PUBLICATION: NONE at the present time

D. PROJECT STATUS:

Because this project was inadvertently delayed six (6) months, it cannot be completed by December 31, 1980, but must continue in 1981.

E. WORK REMAINING AND PROGRESS COMTEHPLATED DURING NEXT YEAR:

At the present rate of growth the fish should be to "marketable size" in sixty (60) days. Additional fish must be acquired to replace those lost when the electricity failed. The fish will be distributed among volunteers who will eat them and complete a questionnaire provided.

Some fish will be transferred to the Potomac River where they will live in cages during the colder months. Their growth rates will be compared with the tank-reared fish. Another group will be acclimated to salt water and both their growth rate and disease resistance will be compared to the control group.

ANNUAL REPORT -- ANNUAL COOPERATIVE PROGRAM OR MATCHING FUND PROGRAM PROJECT

OWRT PROJECT NO. <u>B-009-DC</u> AGREEMENT NO. 14-34-0001- <u>807</u> FCCSET RESEARCH CATEGORY: <u>V-A</u>	<u>PROJECT TITLE:</u> Enzymatic Analysis of Nutrients in Water - Phase I
--	--

NAME AND LOCATION OF UNIVERSITY WHERE PROJECT IS BEING CARRIED OUT:

Department of Chemistry
 The American University
 Washington, D. C. 20016

<u>PROJECT BEGAN --</u> MONTH: <u>October</u> ; YEAR: <u>1977</u>	<u>TO BE COMPLETED --</u> MONTH: <u>September</u> ; YEAR: <u>1979</u>
--	--

<u>PRINCIPAL INVESTIGATORS</u>	<u>DEGREE</u>	<u>DISCIPLINE</u>
Dr. Frederick W. Carson	Ph.D.	Chemistry

<u>STUDENT ASSISTANTS^{1/}</u>	<u>DEGREE HELD (IF ANY)</u>	<u>DISCIPLINE OR ACADEMIC BACKGROUND</u>
Helen W. Davies	M. S.	Chemistry

^{1/} LIST ONLY THOSE STUDENTS SERVING AS RESEARCH ASSISTANTS IN A PROFESSIONAL SENSE. DO NOT INCLUDE HOURLY WAGE EARNERS SUCH AS LAB DISWASHERS HERE BUT INCLUDE THEM IN FORMS OW-2, 3, AND 5. INCLUDE POST-DOCTORAL STUDENTS IF NOT SERVING AS PROFESSIONAL INVESTIGATORS.

NARRATIVE STATEMENTS

(REFER TO THE ATTACHMENT TO THIS FORM OW-1)

See three-page attachment.

ANNUAL REPORT -- ANNUAL COOPERATIVE PROGRAM OR MATCHING FUND PROGRAM PROJECT

OWRT PROJECT NO. <u>B-011-DC</u> AGREEMENT NO. 14-34-0001- <u>9062</u> FCCSET RESEARCH CATEGORY: <u>V-A</u>	<u>PROJECT TITLE:</u> Enzymatic Analysis of Nutrients in Water - Phase II
---	---

NAME AND LOCATION OF UNIVERSITY WHERE PROJECT IS BEING CARRIED OUT:

Department of Chemistry
 The American University
 Washington, D.C. 20016

PROJECT BEGAN -- MONTH: <u>October</u> ; YEAR: <u>78</u>	TO BE COMPLETED -- MONTH: <u>september</u> ; YEAR: <u>80</u>
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<u>PRINCIPAL INVESTIGATORS</u>	<u>DEGREE</u>	<u>DISCIPLINE</u>
Dr. Fredrick W. Carson	Ph.D.	Chemistry

<u>STUDENT ASSISTANTS^{1/}</u>	<u>DEGREE HELD (IF ANY)</u>	<u>DISCIPLINE OR ACADEMIC BACKGROUND</u>
Helen W. Davis	M.S.	Chemistry
Patricia L. Rogers	B.S.	Chemistry

^{1/} LIST ONLY THOSE STUDENTS SERVING AS RESEARCH ASSISTANTS IN A PROFESSIONAL SENSE. DO NOT INCLUDE HOURLY WAGE EARNERS SUCH AS LAB DISWASHERS HERE BUT INCLUDE THEM IN FORMS OW-2, 3, AND 5. INCLUDE POST-DOCTORAL STUDENTS IF NOT SERVING AS PROFESSIONAL INVESTIGATORS.

NARRATIVE STATEMENTS
 (REFER TO THE ATTACHMENT TO THIS FORM OW-1)



Dr. Frederick W. Carson, Principal Investigator
"Enzymatic Analysis of Nutrients in Water"

Frederick W. Carson

September 30, 1980

PROJECT B-009-DC OWRT ANNUAL REPORT 1980

NARRATIVE STATEMENTS

Enzymatic Analysis of Nutrients in Water - Phases I & II

(A) RESEARCH PROJECT ACCOMPLISHMENTS

DETERMINATION OF AMMONIA IN WATER BY ENZYMATIC CYCLING

An abstract of our work, which was reported at the January 23, 1979 meeting of the Baltimore-Washington Section of the Society for Applied Spectroscopy and at the University School of Medicine, Debrecen, Hungary on June 1, 1979 follows. A complete report entitled "Condensed Report on the Use of Enzymatic Cycling for High Specificity and Precision in the Colorimetric Analysis of Ammonia" has been submitted to the Water Resources Research Center at the University of the District of Columbia.

ABSTRACT

A new method for the colorimetric determination of ammonia in water by enzymatic cycling has been developed. It is simple and precise in the range of 10 to 10 M ammonia concentrations. The sensitivity could be extended well below the 10 nmol per sample limit of determination of the assay described by suitable modifications of the procedure. The ammoniaspecific glutamate dehydrogenase reaction is followed by an enzymatic cycling reaction to provide controlled amplification of the response to ammonium ion. The cycling reaction product, a tetrazolium formazan, has a conveniently-measured visible absorption maximum at 600 nm. When the established procedure is followed, plots of absorbance vs. original ammonium ion concentration are linear, with correlation coefficients of 0.997 to 0.9998. The coefficient of variation was 2% for a series of replicate measurements on samples containing 4.41×10^{-6} M ammonium ion. Standard solutions may be carried through the procedure to construct a calibration curve for the determination of unknown concentrations. Only volumetric equipment and a spectrophotometer or colorimeter are required. The analysis time per sample is 3 h. All solutions may be prepared in advance and are stable for at least two weeks.

(B) APPLICATION OF RESEARCH RESULTS

Martha N. Jones of the Centralized Environmental Laboratory, Department of Biology, East Carolina University, Greenville, North Carolina 27834 has written to the Principal Investigator. She is interested in exploring alternative methods for determining ammonia in water which offer greater sensitivity, more stability, and fewer interferences than the standard methods now being used.

Dr. Proveen David Dass of the Department of Physiology and Biophysics, Shreveport Medical Center, Louisiana State University, Shreveport, Louisiana has discussed this work with the Principal Investigator. He is interested in applying it to enzyme kinetic studies of two newly isolated glutaminases from rat kidney.

Dr. L. Tron of the Department of Biophysics and Dr. L. Muszbek of the Department of Clinical Chemistry, University School of Medicine, 4012 Debrecen, Hungary have expressed interest in the enzymatic cycling aspects of this work.

Dr. Walter R. Benson, Director, Division of Drug Chemistry, Food and Drug Administration, HFD-420, 200 C Street, Washington, D.C. 20204, has discussed the possibility of extending the method to drug analyses with the Principal Investigator.

(C) PUBLICATIONS

1. H. W. Davies, "Determination of Ammonia in Water by Enzyme Cycling," Abstracts of the January 23, 1979 Meeting of the Baltimore-Washington Section of the Society for Applied Spectroscopy.
2. H. W. Davies, "Determination of Ammonia in Water by Enzymatic Cycling," M. S. Thesis, The American University, 1980.
3. F. W. Carson and H. W. Davies, "Use of Enzymatic Cycling for High Specificity and Sensitivity in the Colorimetric Analysis of Ammonia," Water Resources Research Center, University of the District of Columbia, Van Ness Campus, Washington, D.C. 20008, Report No. 18, April, 1980.
4. F. W. Carson and H. W. Davies, "Condensed Report on the Use of Enzymatic Cycling for High Specificity and Precision in the Colorimetric Analysis of Ammonia," Water Resources Research Center, University of the District of Columbia, Van Ness Campus, Washington, D.C. 20008, Report No. 20, October, 1980.

5. F. W. Carson and H. W. Davies, "Detailed Report on the Use of Enzymatic Cycling for High Specificity and Precision in the Colorimetric Analysis of Ammonia," Water Resources Research Center, University of the District of Columbia, Van Ness Campus, Washington, D.C. 20008, Report No. 20, October, 1980.

6. H. W. Davies and F. W. Carson, "Use of. Enzymatic Cycling for High Specificity and Precision in the Colorimetric Analysis of Ammonia," Environ. Sci. Technol., submitted.

(D) PROJECT STATUS

This project has been completed.

(E) WORK REMAINING AND PROGRESS CONTEMPLATED DURING NEXT YEAR

This project has been completed. However, it is now apparent that the assay for ammonia developed in this work could be usefully employed in a micro-Kjeldahl method for total organic nitrogen and in an extended micro method for total nitrogen. A proposal along these lines is contemplated.

SPECIAL PROJECTS

Special projects were conducted in the office of the Director during the fiscal year 1980. They are:

1. "The District of Columbia Five-Year Water Resources Research Program Plan 1982-1987" DC WRRC Report No. 24

2. "A Curriculum Development for Water Supply and Wastewater Operation, Maintenance and Management" DC WRRC Report No. 23

3. "Notes on Water Supply Interconnections Institutional Factors" DC WRRC Report No. 22

Complete reports on these projects are available at the Center with the numbers listed above. Summaries are given in the following sections.

"The District of Columbia Five Year

Water Resources Research Program Plan 1982-1987"

summary

The purpose of this report is to describe the water resources situation in the District of Columbia, to identify its research needs, and to present a five-year research and development program plan for the D.C. Water Resources Research Center.

Chapter II of the report addresses an overview of the D.C. water resources, including the geological, meteorological, biological and hydrological characteristics, and the surface and ground water resources. An analysis of the use of the water resources is presented in Chapter III. A description of water related planning and development activities is presented in Chapter IV. As a result of an opinion survey of a broad spectrum of area citizens active in water resources issues, the D.C. water resources problems were categorized and prioritized. These problems and a description of related agency activities are presented in Chapter V. Chapters VI and VII give priority problems and their justification, and the five-year goals and objectives including funding requirements and schedule.

The Five-Year Program Plan

The development of the five-year goals and objectives will allow the Center to use its funds in a most efficient manner. While in the past, the Center funded research at the will and interest of the investigators, this plan proposes prioritized research objectives. There is a large pool of qualified researchers

in the D.C. area, but more funding is needed either through the OWRT or other sources to enable the Center to tackle all identified water resource problems.

The input to the process of identification and priority ranking of the problems and a further analysis of the activities of the D.C. area water related agencies have yielded the following research needs:

Water Quantity:

Water conservation in the District

- (1) surveys of plans and studies
- (2) design of implementation legislation
- (3) public education
- (4) economic demand studies

Water Quality:

- (1) effect of D.C. urban land use on water resources
- (2) major study describing corrective measures for deteriorating water transport lines
- (3) evaluation of water quality monitoring programs for D.C. waters
- (4) investigations to provide baseline data on toxic and hazardous substances on which to base discharge permit limitations
- (5) impacts of current disinfection methods of wastewater treatment systems
- (6) effects of residual chlorine on the Potomac Estuary biota
- (7) effects and fates of nutrients on receiving D.C. waters

Related Problems:

- (1) technology transfer of sludge management techniques to D.C. agencies
- (2) calculations of inflows and infiltration to sewage lines
- (3) cost effective methods to improve water quality
- (4) effect of land treatments for existing wastewater treatment facilities
- (5) study of "soft" technologies as alternatives to expensive wastewater treatment technology
- (6) criteria for determining satisfactory local water quality standards
- (7) definition of the District's water management structure and responsibilities

Projects specific to the District and of management nature will be given special attention and will be conducted for the most part from the office of the Center Director. These projects include but are not limited to: technology transfer, information dissemination, manpower research, public awareness and training program development.

"A Curriculum Development for Water Supply
and Wastewater Operation Maintenance and Management"

Summary

It is proposed in this project, to revitalize the UDC's two-year water quality curriculum. Course objectives, course outlines and laboratory assignments, inventory equipment and materials are revised, and recommendations for better ways to implement these programs are made.

This project will contribute to increase the number of trained personnel and provide means to further operators' education through a well designed university curriculum. A complete evaluation of skills requirements for the Washington, D.C. water resources technicians will be invaluable to trainers and curriculum designers. Information exchange with employing agencies will enhance the relationship between the water industry and academia. Although indirectly, public awareness of the water resources status will increased.

The report is divided in two parts. Part A describes the key water quality courses as they are accepted at the University of D.C. with some updates and revisions where warranted. The courses are Chemical Analysis of Water, Properties of Fresh Water, Water Quality Management, Wastewater Technology I and Wastewater Technology II.

Part B indicates the academic support for the water resources courses. An inventory of the Department of Environmental Sciences Laboratory Equipment is provided. Reference books and audio visual material useful to the water resources training program are included. A survey of employment opportunities for water treatment plant operators in the metropolitan Washington area

revealed good employment opportunities for water treatment plant operators. As much as 70 jobs per year can be expected in the Washington area if no major changes in water resources management don't occur.

Employment opportunities for water resources technicians exists in the Washington area. It is therefore important for the University of D.C. to provide water resources training programs to the D.C. citizens to assist them in getting their share in this particular job market. With a few modifications the water resources curriculum offered at the Department of Environmental Sciences of the University of D.C. is suited for such a program. The Department is well endowed with laboratory equipment useful for water resources courses. The UDC learning center has numerous textbooks, audio visuals and other reference materials.

What is needed is a little support from the university administration to recruit good instructors, and to provide laboratory facilities for the program to move ahead. Like all other technical fields, promotional efforts to attract the students towards water resources must be made. Field work could be obtained in cooperation with D.C. agencies such as the D.C. Regional Water Treatment System and the Washington Aqueduct Division which have shown in many instances their willingness to provide assistance.

The implementation of such a program is to be handled with consistent and continuous effort since the past experiences in the District were not successful. A sound program depends on the instructors for the large part but also on the students.

It is recommended to introduce an industry release program (sandwich course). Under this program, employees of the state, private or public sector are allowed to attend one or two semesters at a time after gaining release from their jobs.

Students should be encouraged to take the Registered *Sanitarian* license *examinations* of the Maryland Water and Sewerage Conference Licensing Board for Water and/or Wastewater Treatment-Plant Operators. The state of Maryland has reciprocity with many other states. The District of Columbia has no such licensing authority. The above board is responsible for the administration of the examinations by which qualified students may be granted their class C or D licenses. Although it is not mandatory that graduating students take this *examination*, the Department should strongly urge the graduates to do so. The license can be of great value to the graduates, no matter what they choose to do in water and/or wastewater fields.

Wide publicity of the course needs to be made in the related journals and the local newspapers. The office of student recruitment should also be helpful in this respect.

A local chapter of the Association of Water and Wastewater Plant Operators should be opened on the campus if none exists in this area. To improve their social image and give them a professional status.

"Notes on Water Supply Interconnections Institutional Factors"

Summary

One way to increase water supply reliability in a given area is through the construction of water supply interconnections. Few studies have addressed this particular means of water supply. But it is one of the most intricate and involved problems. It encompasses engineering, environmental, legal and management problems.

This report is focused mainly on institutional factors. The report is intended to provide some comprehensive overview of the potential benefits and problems associated with interconnections, with special reference to the Washington Metropolitan Area. A brief description of basic features and historical examples of water supply interconnections is given. Recently proposed interconnections are analyzed. The work consisted of consultation with government agencies, professional experts and a library search.

The Washington area, due to the number of jurisdictions involved, provides a good example of the potential problems to be overcome for achieving efficient regional water supply management. Finished water interconnections have been proven to be effective in providing extra reliability and more efficient allocations of existing supplies. Several interconnections, raw and finished, have been proposed for the Washington area since 1974, but none has gone beyond the proposal stage.

Some of these projects have been shown to be technically feasible and economically attractive. However, institutional factors appear harder to overcome. This report discusses some potential institutional obstacles to the implementation of interconnection projects.

III. TRAINING AND EDUCATION

ANNUAL REPORT - TRAINING AND EDUCATION ASPECTS
 OF THE WATER RESEARCH PROGRAM UNDER P.L. 95-467

University of the District of Columbia/ College of Life Sciences/ Env. S
 Name of University: Dept.
 (or College)

SUBMIT THE INFORMATION SPECIFIED BELOW FOR THE UNIVERSITY AT WHICH THE WATER RESOURCES RESEARCH INSTITUTE OR CENTER APPROVED UNDER P.L. 95-467 IS LOCATED, AND FOR OTHER UNIVERSITIES WITH WHICH THE INSTITUTE OR CENTER IS COOPERATING. KEEP THE STATISTICS ON ENROLLMENTS, NUMBER OF STUDENTS GRADUATING, EMPLOYMENT STATUS OF GRADUATES, NEW COURSES, ETC., SEPARATE FOR EACH UNIVERSITY. IT IS RECOGNIZED CERTAIN OF THE REQUESTED DATA ON STUDENTS MAY NOT BE READILY AVAILABLE. IF SO, PROVIDE BEST ESTIMATE FIGURES. IN OW-9, DATA ON STUDENTS ARE REQUESTED ONLY FOR THOSE STUDENTS WHO RECEIVED EMPLOYMENT AS RESEARCH PROJECT OR PROGRAM ASSISTANTS THROUGH THE P.L. 95-467 PROGRAM. IF EXTRA SPACE IS NEEDED, ADD PAGES AND NUMBER EACH CONTINUATION ITEM IN THE ORDER SHOWN BELOW.

A. Number of students receiving employment as research project or program assistants through the P.L. 95-467 program. (Include only those students, both continuing and graduating, paid wholly or in part with P.L. 95-467 funds during the past fiscal year.)

Category of Students	No. by Scientific Discipline or Major Field of Study (Engineering, Biology, Economics, etc. 2/	
	Scientific Discipline of Student	Number
(1) <u>Undergraduates</u>	<u>Environmental Sciences</u>	<u>2</u>
	<u>Civil Engineering</u>	<u>1</u>
	<u>Architecture</u>	<u>1</u>
	<u>Business</u>	<u>1</u>
	<u>Nursing</u>	<u>1</u>

2/ This refers to educational background prior to employment as research assistant on P.L. 95-467 projects--not to departments in which projects are being conducted.

B. Employment status of majors in water-related fields who graduated during the school year ending about June and who receive P.L. 95-467 support.

EMPLOYMENT STATUS	CATEGORY OF SCHOOL YEAR GRADUATE BY DEGREE OBTAINED			
	Bachelor's Degree	Master's Degree	Doctoral Degree	Total
1. No. employed in water-related positions in: Total-----	6			6
Federal Agencies-----	()	()	()	()
State & Local Agencies-----	()	()	()	()
University or College-----	()	()	()	(6)
Other - Including private enterprise-----	()	()	()	()
2. No. graduates returning to school for advanced degree-----				
3. No. going into military service-----				
4. No. unemployed or working in other fields-----				
5. No. status unknown-----				
6. Totals-----				6

C. Type of employment of those school year graduates who received P.L. 95-467 support and who are known to have gone into water-related positions.
 (Number should agree with total listed under item 1 of the preceding paragraph "B". Graduates enrolled for further course work or training should not be listed here as employed.)

Number of Graduates Engaged in Water-Related Work In:	CATEGORY OF SCHOOL YEAR GRADUATE BY DEGREE OBTAINED			
	Bachelor's Degree	Master's Degree	Doctoral Degree	Total
1A. Federal Agencies:				
a. Primarily Research-----				
b. Primarily Planning-----				
c. Primarily Development-----				
d. Primarily Operations-----				
e. Primarily Management-----				
f. Other or not known-----				
1B. State & Local Agencies:				
a. Primarily Research-----				
b. Primarily Planning-----				
c. Primarily Development-----				
d. Primarily Operations-----				
e. Primarily Management-----				
f. Other or not known-----				
1C. University or College: 3/				
a. Primarily Teaching-----				
b. Primarily Research-----				
c. Primarily Research & Teaching-----				
d. Other or not known-----				
1D. Other - Including Private Enterprises:				
a. Primarily Research-----				
b. Primarily Planning-----				
c. Primarily Development-----				
d. Primarily Operations-----				
e. Primarily Management-----				
f. Other or not known-----				
Totals-----				

Selected summary of above data — from the "Total" column:

- Research (1Aa, 1Ba, 1Cb, 1Cc & 1Da)-----
- Planning (1Ab, 1Bb & 1Db)-----
- Development (1Ac, 1Bc & 1Dc)-----
- Operations (1Ad, 1Bd & 1Dd)-----
- Management (1Ae, 1Be, & 1De)-----

3/Do not include here students working as research assistants and receiving course credits.

B. Employment status of majors in water-related fields who graduated during the school year ending about June and who receive P.L. 95-467 support.

EMPLOYMENT STATUS	CATEGORY OF SCHOOL YEAR GRADUATE BY DEGREE OBTAINED			
	Bachelor's Degree	Master's Degree	Doctoral Degree	Total
1. No. employed in water-related positions in: Total-----	0	1	1	2
Federal Agencies-----	()	()	()	(0)
State & Local Agencies-----	()	()	()	(0)
University or College-----	()	()	()	(2)
Other - Including private enterprise-----	()	()	()	(0)
2. No. graduates returning to school for advanced degree-----				0
3. No. going into military service-----				0
4. No. unemployed or working in other fields-----				0
5. No. status unknown-----				0
6. Totals-----	0	1	1	2

- C. Type of employment of those school year graduates who received P.L. 95-467 support and who are known to have gone into water-related positions.
(Number should agree with total listed under item 1 of the preceding paragraph "B". Graduates enrolled for further course work or training should not be listed here as employed.)

Number of Graduates Engaged in Water-Related Work In:	CATEGORY OF SCHOOL YEAR GRADUATE BY DEGREE OBTAINED			
	Bachelor's Degree	Master's Degree	Doctoral Degree	Total
1A. Federal Agencies:				
a. Primarily Research-----				
b. Primarily Planning-----				
c. Primarily Development-----				
d. Primarily Operations-----				
e. Primarily Management-----				
f. Other or not known-----				
1B. State & Local Agencies:				
a. Primarily Research-----				
b. Primarily Planning-----				
c. Primarily Development-----				
d. Primarily Operations-----				
e. Primarily Management-----				
f. Other or not known-----				
1C. University or College: 3/				
a. Primarily Teaching-----				
b. Primarily Research-----				
c. Primarily Research & Teaching-----				
d. Other or not known-----				
1D. Other - Including Private Enterprise:				
a. Primarily Research-----				
b. Primarily Planning-----				
c. Primarily Development-----				
d. Primarily Operations-----				
e. Primarily Management-----				
f. Other or not known-----				
Totals	0	0	0	0

Selected summary of above data — from the "Total" column:

Research (1Aa, 1Ba, 1Cb, 1Cc & 1Da)-----	0
Planning (1Ab, 1Bb & 1Db)-----	0
Development (1Ac, 1Bc & 1Dc)-----	0
Operations (1Ad, 1Bd & 1Dd)-----	0
Management (1Ae, 1Be, & 1De)-----	0

3/Do not include here students working as research assistants and receiving course credits.

B. Employment status of majors in water-related fields who graduated during the school year ending about June and who receive P.L. 95-467 support.

EMPLOYMENT STATUS	CATEGORY OF SCHOOL YEAR GRADUATE BY DEGREE OBTAINED			
	Bachelor's Degree	Master's Degree	Doctoral Degree	Total
1. No. employed in water-related positions in: Total-----	0	1	0	1
Federal Agencies-----	()	()	()	(0)
State & Local Agencies-----	()	()	()	(0)
University or College-----	()	()	()	(1)
Other - Including private enterprise-----	()	()	()	(0)
2. No. graduates returning to school for advanced degree-----				0
3. No. going into military service-----				0
4. No. unemployed or working in other fields-----				0
5. No. status unknown-----				0
6. Totals-----	0	1	0	1

- C. Type of employment of those school year graduates who received P.L. 95-467 support and who are known to have gone into water-related positions.
(Number should agree with total listed under item 1 of the preceding paragraph "B". Graduates enrolled for further course work or training should not be listed here as employed.)

Number of Graduates Engaged in Water-Related Work In:	CATEGORY OF SCHOOL YEAR GRADUATE BY DEGREE OBTAINED			
	Bachelor's Degree	Master's Degree	Doctoral Degree	Total
1A. Federal Agencies:				
a. Primarily Research				
b. Primarily Planning				
c. Primarily Development				
d. Primarily Operations				
e. Primarily Management				
f. Other or not known				
1B. State & Local Agencies:				
a. Primarily Research				
b. Primarily Planning				
c. Primarily Development				
d. Primarily Operations				
e. Primarily Management				
f. Other or not known				
1C. University or College: 3/				
a. Primarily Teaching				
b. Primarily Research				
c. Primarily Research & Teaching				
d. Other or not known				
1D. Other - Including Private Enterprise:				
a. Primarily Research				
b. Primarily Planning				
c. Primarily Development				
d. Primarily Operations				
e. Primarily Management				
f. Other or not known				
Totals	0	0	0	0

Selected summary of above data — from the "Total" column:

Research (1Aa, 1Ba, 1Cb, 1Cc & 1Da)	0
Planning (1Ab, 1Bb & 1Db)	0
Development (1Ac, 1Bc & 1Dc)	0
Operations (1Ad, 1Bd & 1Dd)	0
Management (1Ae, 1Be, & 1De)	0

3/Do not include here students working as research assistants and receiving course credits.

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