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Alternatives for a National Water Resources Research Center and Information Clearinghouse

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Prepared by the

Chesapeake Research Consortium

for the

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ALTERNATIVES

FOR A

NATIONAL WATER RESOURCES RESEARCH CENTER

AND

INFORMATION CLEARINGHOUSE

A Report
Submitted to
The Council on Environmental Quality

by the

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EXECUTIVE SUMMARY

In the fall of 1983 Congress appropriated funds in Public Law 98-181 for the conduct of two studies to be carried out under the auspices of the Council on Environmental Quality (CEQ). The studies were to "consider and define" a National Center for Water Resources Research and "define and plan" a National Clearinghouse for Water Resources Information. This is the final report of those studies.

In conducting the research two major observations were made about the status of water research and information programs. First, water resources research is a mature field with large and diverse existing programs which are fragmented among a number of agencies, organizations and institutions. The rationale for creating a new center must recognize the nature of this existing situation.

Second, there are a number of information systems oriented towards either data or documents which, when viewed in the aggregate, appear to meet the information needs of the water resource community. However, many user needs are unmet because of individual user unfamiliarity with many of the separate water information systems. Although information exists, it is unavailable to many prospective users because of lack of awareness.

Three institutional arrangements are proposed for research functions and three for information functions (see below). The research options include incremental changes to improve the coherence of existing programs; a center to direct and support extramural research; and an institute to study interdisciplinary water research issues. Each option is intended to address a stated water research need. The information options involve implementation of specific recommendations for improving current institutional arrangements; a National Water Information Referral Center; and a national, regional and state clearinghouse system incorporating research needs assessment.

The options proposed are not mutually exclusive. Each research center meets a prescribed need and thus sufficient justification exists for all three to be established simultaneously. Research and information functions could also be combined within a single organizational entity.

The options developed for meeting information needs do not perform distinct, isolated functions. They are really steps along a gradient of services running from improved coordination among existing systems, through a center for referring users to existing information sources, to a clearinghouse system for actually obtaining information from existing sources for clients. A national water information referral system could readily evolve into a national water information clearinghouse which then could, on a time phased basis, serve as the coordinating center for regional and/or state water information clearinghouses.

During the course of the study a number of persons in the water resources research and information community were interviewed about their views on the center and clearinghouse and others offered written comments to the CEQ during and after public meetings on the study. It was found that there was little agreement within the research community on the need to be met by a new center or the preferred institutional arrangement. This does not imply that the proposed research centers are without some public support, only that no apparent consensus exists on any one option. Similarly, some public and agency support was obtained for parts of all three information options. A consensus among public reviewers, however, favored a national water information referral center as the preferred clearinghouse option.

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Summary of Options for a National Water Resources Research Center and National Water Resources Information Clearinghouse

National Water Resources Research Center

1. Improving Current Institutional Arrangements

Proposes establishment of a National Advisory Committee on Water Resources Research. The Committee would be responsible for maintaining a comprehensive and up-to-date description of the many national water research programs and disseminating information about these programs.

2. Extramural Research

Proposes a National Water Resources Research Center that would augment existing water research through the allocation of federal funds to universities and other non-federal institutions. The Center would target funds to important subject areas that transcend or cut across existing mission programs.

3. Focused Research Institute

Proposes the establishment of a National Water Resources Research Institute which would facilitate interdisciplinary study of major water resources issues facing the nation.

National Water Resources Information Clearinghouse

1. Improving Current Institutional Arrangements

Proposes revision of OMB Circular A-67; interconnection of major water related data bases; establishment of centers of competence; establishment of a water research-in-progress information system; upgrade of the capability of the National Referral Center in the water area; and addition of specific water expertise to the Congressional Research Service.

2. National Water Information Referral Center (NWIRC)

Proposes establishment of a referral center to serve as an initial point of contact for seekers of water information and to perform simple bibliographic services.

3. National/Regional/State Water Information Clearinghouse System

Proposes establishment of a national and state clearinghouse system, with regional centers in those areas with compelling need and a common bond between states, to obtain information for clients, provide information synopses and analyses of water resource issues, and develop a statement of research needs based upon a function of requests to the clearinghouses.

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GLOSSARY OF ACRONYMS

AGRICOLA	On-line catalog and index of the National Agricultural Library-USDA
AQUALINE	On-line information system of the Water Research Centre, Medmenham, Buckinghamshire, England
BLOSIS PREVIEWS	On-line information system of Biosciences Information Services, Philadelphia, PA
CEQ	U.S. Council on Environmental Quality
CISID	Congressional Information Sources, Inventories and Directories
COE	Army Corp of Engineers
CRC	Chesapeake Research Consortium
CRIS	Current Research Information System - USDA
CRS	Congressional Research Service - Library of Congress
CSIN	Chemical Substances Information Network - CEQ
DIALOG	DIALOG Information Services, Inc.
DOC	U.S. Department of Commerce
DOI	U.S. Department of the Interior
ENVIROLINE	On-line information system of the Environment Information Center, Inc., New York, NY
EPA	U.S. Environmental Protection Agency
FY	Fiscal Year
GAO	U.S. General Accounting Office
INFOTERRA	United Nations Environmental Program's International Referral System
NAWDEX	National Water Data Exchange - USGS
NEDRES	National Environmental Data Referral Service - NESDIS
NESDIS	National Environmental Satellite, Data, and Information Service - NOAA
NCAR	National Center for Atmospheric Research
NOAA	National Oceanic and Atmospheric Administration - DOC
NRC	National Referral Center - Library of Congress
NTIS	National Technical Information Service - DOC
*NWIRC	National Water Information Referral Center
*NWRRC	National Water Resources Research Center
*NWIC	National Water Information Clearinghouse
OMB	Office of Management and Budget
OSTP	Office of Science and Technology Policy
OTA	Office of Technology Assessment
OWDC	Office of Water Data Coordination - USGS
OWRT	Office of Water Research and Technology - DOI
PL	Public Law
RECON	Remote Console (Department of Energy's On-line Bibliographic Data System)
RFP	Request for Proposal
*RWIC	Regional Water Information Clearinghouse

SMSA	Standard Metropolitan Statistical Area
SSIE	Smithsonian Science Information Exchange
STORET	Storage and Retrieval for Water Quality Data - EPA
*SWIC	State Water Information Clearinghouse
UCAR	University Corporation for Atmospheric Research
UNESCO	United Nations Educational, Scientific, and Cultural Organization
U.S.C.	U.S. Code
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey - DOI
WATERNET	On-line information system of the American Water Works Association, Denver, CO
WATSTORE	National Water Data Storage and Retrieval System - USGS
WRSIC	Water Resources Scientific Information Center - USGS

* Acronyms developed by this study.

ACKNOWLEDGEMENTS

During the course of this study 36 Federal offices, departments or agencies, 35 State Water Resources Research Institutes, 16 other State agencies, 3 universities, 4 international organizations, and 16 private organizations were contacted (a list is appended). We appreciate the information provided by these organizations on such short notice.

We thank the following individuals who were particularly helpful in providing insight into the present institutional arrangements and functions in the field of water resources research and information and in sometimes sharing with us their thoughts for improving the efficiency of their organizations' operations. The evaluation of an agency's effectiveness and recommendations for changes in current institutional arrangements are, however, the sole responsibility of the Principal Investigators.

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Mr. Frank Carlson
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Mr. Philip Dopkowski
Mr. Melvin D. Edwards
Mr. John Feulner
Mr. Robert R. Freeman
Mr. Raymond A. Jensen
Mr. T. W. Johnson
Mr. Phillip Lindenstruth
Dr. Orrie Loucks
Mr. Bob Madancy
Mr. David W. Moody
Mr. John Myers
Mr. Michael O'Hara
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Mr. Porter E. Ward
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Organizations Contacted During This Study

Federal Agencies

Council on Environmental Quality
- Chemical Substances Information Network

Department of Agriculture
- National Agricultural Library
  - AGRICOLA
- Agricultural Research Service
- Cooperative State Research Service
  - Current Research Information System
- Forest Service
- Soil Conservation Service

Department of Commerce
- National Oceanic and Atmospheric Administration
  - National Environmental Satellite, Data, and Information Service
    - Assessment and Information Services Center
      - National Environmental Data Referral Service
    - National Oceanographic Data Center
  - National Marine Fisheries Service
  - National Weather Service
- National Technical Information Service

Department of Defense
- Army Corps of Engineers
  - Institute of Water Resources
  - Civil Works in Hydraulics and Hydrology

Department of Energy

Department of Housing and Urban Development

Department of the Interior
- Bureau of Land Management
- Fish and Wildlife Service
  - National Wetland Inventory
    - Wetland Plant Species Data Base
    - Wetland Values Data Base
- Geological Survey
  - Water Resources Division
    - National Water Data Exchange
    - National Water Data Storage and Retrieval System
    - Office of National Water Summary and Long Range Planning
    - Water Resources Scientific Information Center
    - Office of Water Data Coordination
- National Park Service
- Natural Resources Library
- Office of the Secretary

Environmental Protection Agency
- STORET User Assistance Section
- Office of Information Resources Management
- Office of Water Monitoring

Federal Energy Regulatory Commission
General Accounting Office
    Accounting and Financial Management - Congressional Sourcebook Series
Government Printing Office
Library of Congress
    Congressional Research Service
    National Referral Center
National Science Foundation
Office of the Federal Coordinator for
    Meteorological Services and Supporting Research
Tennessee Valley Authority

State Water Resources Research Institutes

Arkansas	Indiana	Montana	South Dakota
Arizona	Iowa	Nebraska	Tennessee
California	Kansas	Nevada	Texas
Colorado	Kentucky	New Hampshire	Utah
Connecticut	Maine	New Mexico	Virginia
Delaware	Michigan	North Carolina	Washington
Florida	Minnesota	Oklahoma	West Virginia
Idaho	Mississippi	Oregon	Wyoming
Illinois	Missouri	Pennsylvania	

Other State Agencies

Arkansas Department of Soil and Water Conservation
Connecticut Department of Natural Resources
Florida Department of Environmental Regulation
Illinois Environmental Protection Agency
Louisiana Department of Environmental Quality
Louisiana Department of Transportation and Development
Minnesota Water Allocation Engineer's Office
New Jersey Department of Environmental Quality
New Mexico State Engineer's Office
New York Bureau of Water Resources
Oklahoma Water Research Bank
South Carolina Department of Water Resources
Texas Natural Resources Information System
Texas Department of Water Resources
Washington Department of Ecology
Wyoming District Engineer's Office

Private Organizations

Acid Rain Information Clearinghouse
Acquisition Institute
American Rivers Conservation Council
American Water Works Association

Conservation Foundation
Environmental Defense Fund
Freshwater Foundation
League of Women Voters
National Conference of State Legislators
National Water Alliance
National Water Resources Association
National Waterways Conference
National Water Well Association
Public Service Research
Upper Mississippi River Basin Association
Water Pollution Control Federation

International

British Embassy, Scientific Attache
Canada, National Water Research Institute
Center for International Environment Information
The International Environmental Information Network
U.S. National Focal Point

University

The Florida State University
Department of Urban and Regional Planning
University of Kansas
Kansas Applied Remote Sensing Program
Virginia Polytechnic Institute and State University
Department of Agricultural Engineering
Department of Biological Sciences

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INTRODUCTION

In the fall of 1983, Congress appropriated funds in Public Law 98-181 for the conduct of two studies to be carried out under the auspices of the Council on Environmental Quality (CEQ). The studies were to assess the feasibility of establishing (1) a national center for water resources research and (2) a national clearinghouse for water resources information. The analysis for each of the studies was to be conducted in two phases. In Phase I a number of alternative designs for each center would be proposed and in Phase II three of these for each center would be critiqued and analyzed in detail.

The Chesapeake Research Consortium (CRC) was contracted to undertake the studies and submitted the required Phase I Report to the CEQ on May 4, 1984. The CEQ held a public meeting on the studies on May 22, 1984 in Washington, D.C. after distributing the report for comment to about 100 individuals and organizations with an interest in the subject. Following review of these comments, on June 1, 1984, the CEQ directed the CRC to prepare detailed analyses for three specific options for a national water research center and three for a national clearinghouse for water information. These are identified in Table 1. A draft report containing these analyses was submitted to the CEQ on July 31, 1984. The draft report was widely circulated for comment by the CEQ, and a series of public hearings was held in New Orleans (August 22), Denver (August 24) and Washington D.C. (August 27). Following these meetings, the CEQ summarized the comments made at the hearings and those submitted in writing. CRC was provided with a copy of all comments and CEQ's summary. This report reflects changes made as a result of those comments and is the final report for the project.

TABLE 1

Summary of Options for a National Water Resources Research Center and National Water Resources Information Clearinghouse

National Water Resources Research Center

1. Improving Current Institutional Arrangements

Proposes establishment of a National Advisory Committee on Water Resources Research. The Committee would be responsible for maintaining a comprehensive and up-to-date description of the many national water research programs and disseminating information about these programs.

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GUIDELINES FOR THE STUDY

The scope and form of this project were prescribed in several ways. The authorizing legislation directed the CEQ to contract for studies to: 1) consider and define a National Center for Water Resources Research; and 2) define and plan a National Clearinghouse for Water Resources Information. The CEQ developed a Scope of Work to guide these studies wherein it was stated that the overall purpose of the research was to "evaluate the need for, and develop descriptions and critiques of, possible ways to organize and implement responsive institutions with the required capabilities." The specific objectives of the studies called for assessing the need for the center and clearinghouse and evaluating alternative missions and institutional designs for each. An analysis as to whether the research and information functions identified could best be satisfied by new institutions or by changes in existing institutions was also required.

In responding to the Scope of Work requirements set forth in the Request for Proposals, the Chesapeake Research Consortium indicated that its approach would be based on the development of national needs in water resources research and information, and comparing these to the capabilities of existing institutions. The proposal specifically provided that one option to be examined under Phase I was that the existing mix of water research and information programs may be preferable to the establishment of any new institution'. Thus, the basic question posed by both the CEQ statement of objectives and the CRC proposal was the extent to which new institutions could best address and satisfy the nation's needs for water resources research and information.

Phase I of the study required CRC to propose a number of options for both the research and information functions. CEQ was responsible for obtaining public and agency comments on these options and selecting three options for research centers and three options for information clearinghouses. In Phase II CRC was required to develop institutional arrangements, organizational characteristics and a critical review of each of these selected options. CRC was not charged with recommending a preferred option.

For the purposes of this study, water resources were considered in the broadest sense to include ground water, surface water and estuarine waters. Water resources information included atmospheric water (e.g. rainfall, snowfall), water characteristics (e.g. data on amount, location, flow, quality, movement, and pathways), usage (e.g. consumption and discharge), and institutional factors (e.g. water rights, allocations, regulations, policies).

Water uses were also considered in a broad context, including but not limited to, irrigation, agriculture, recreation, navigation, and water supply for industrial, commercial, residential and municipal uses, and the factors affecting water use such as flooding, water emergencies,

drought, conservation, pollution control and increasing water yield. It also includes the range of academic disciplines concerned with aspects of water resources, such as engineering, biological sciences, law, political science, sociology and economics.

APPROACH

During Phase I, extensive literature searches of the water resources research and water information fields were conducted through The DIALOG on-line information system. Specific data bases searched included BIOSIS PREVIEWS, NTIS, Water Resources Abstracts, WATERNET, Aquatic Science and Fisheries Abstracts, AQUALINE, CRIS/USDA, AGRICOLA, Dissertation Abstracts and ENVIROLINE. These searches focused on statements of research needs, information needs and approaches to meeting these needs. Documents located through these searches were reviewed along with those on the extensive list of documents in the CEQ Scope of Work and other reports located during the study. In addition, the CRC Board of Consultants developed an independent list of research and information needs through a nominal group technique.

A third approach to developing statements of needs was through interviews with persons in the water research, water management and water information communities. These persons included federal agency representatives, public interest group representatives, information clearinghouse operators, state water institute directors, university researchers, private water professionals and public officials. Thirty two state water institute 5 year plans were examined in detail along with a number of federal agency plans and existing programs.

The project principal investigators attended public workshops on the topic of a National Water Research Center and a National Water Information Clearinghouse in La Jolla, California, and St. Paul, Minnesota, sponsored by the National Water Alliance. At these meetings the principal investigators had extensive interaction with a wide range of water professionals.

Based upon information developed from literature surveys, interviews and reviews of agency documents, the principal investigators developed a number of "straw man" options, and the philosophical basis for these options, for presentation to the Board of Consultants in two meetings in April 1984.

In addition three federal agencies, EPA, USGS and the U.S. Army Corps of Engineers provided continuing critical review during Phase I (and later in Phase II).

The outcome of this activity was the identification of a number of generic needs which were proposed to the CEQ in our Phase I report. These were expressed as mission statements and were accompanied by general institutional arrangements for accomplishing each mission.

In Phase II of the study, we reviewed the public comments provided to the CEQ on the Phase I report with particular emphasis on those comments made on the options that the CEQ directed us to analyze in detail. We contacted by phone most persons who had offered such

comments and discussed their views on the options. The array of comments and views was reviewed by the CRC Board of Consultants and discussed at a two-day workshop in June of 1984. A consensus was reached at that time on the general direction and content of the options under consideration.

Where there was disagreement, or where a particular matter required further analysis, one or more of the consultants was directed to conduct a detailed investigation of the substantive aspects of the issue. Portions of a preliminary draft of the final report were reviewed by some of the consultants. Their comments were considered in preparing the July 31, 1984 draft final report to CEQ. In addition, aspects of the preliminary reports were discussed with a number of persons in the water research community.

Comment received on the draft final report, along with a summary and analysis of these comments prepared by CEQ, was used to prepare this final report.

ANALYSIS OF OPTIONS FOR A NATIONAL WATER RESOURCES RESEARCH CENTER

Overview

In our analysis of the three options for a national water resources research center, we have been influenced by several factors related to the historical development and current status of the water research field.

The first is that a sizeable water research effort already exists in federal and state agencies, universities and colleges, and the state water research institutes and the private sector. Current federal expenditures alone are in excess of $300 million annually, and we estimate that in the past decade well over $2 billion has been spent for water research. For this reason, proposals for major new initiatives must be weighed against the existing array of water research programs.

A second factor is that water research is not a new and emerging field but one that is relatively mature. Although such a statement is difficult to substantiate quantitatively, there is some evidence to support this contention. One indicator is the number of professional journals devoted to various aspects of water. The list of journals abstracted by the Water Resources Scientific Information Center (WRSIC), contains over 100 published in the United States that directly deal with water and many others that contain water related articles. Another is that a generation of persons who are now at or near retirement have spent their entire professional careers in water research. Over the past three decades a number of persons have achieved major scientific stature as a result of their water research activities. Finally, the field has been large enough, and of such significance, that it has produced many efforts to rationalize the research planning and management process to better focus on national needs. The conduct and organization of water research have been the subject of numerous studies and reports, and while many of them have been critical of the way in which the national water research agenda has been organized, the attention devoted to the topic suggests a relatively well-developed field. This is not to suggest that no significant water research issues remain, only that the field has developed a substantial body of information, many organizations and institutions already exist for the conduct of research, and that under these circumstances the justification for a new organization is more difficult than it might have been 25 years ago.

A third factor has to do with the identification of national water research needs and how they are being met through federal and state programs. Starting with the Senate Select Committee Report in 1961[1] and the Committee on Water Resources Research Report in 1966[2], a number of studies have identified needs and priorities in national water resources research. The needs identified have changed somewhat over the years,

but there is a high degree of similarity in the various studies. Examination of the Office of Water Research and Technology (OWRT) 1981 Report on the Five Year Water Research Priorities of the States[3] also shows that most of these national issues are also important at the State level. Moreover, the great majority of these needs are receiving active attention in the water research community. According to the 1981 National Research Council review of the five-year federal water research plan[4] only one priority area (institutional arrangements for water allocation) was not being addressed to some degree by one or more agencies.

A final factor that has influenced our analysis is the trend that appears to be developing in water planning, development and research. The traditional federal water resource development program of the post World War II years is fading and primary responsibility for future water resources development and management is likely to be shifted to state and local governments.[5] Future water issues appear to be less involved with water development and more concerned with subjects such as conservation, use and reallocation of water, and water quality. Such issues have substantial social, legal, economic, and institutional dimensions and, thus, it follows that research in these areas ought to receive higher priority than it has in the past. The National Research Council study of national water research[6] reached a similar conclusion and we believe that their findings continue to be valid.

OPTION 1: IMPROVING CURRENT INSTITUTIONAL ARRANGEMENTS

This option proposes establishment of a National Advisory Committee on Water Resources Research. The Committee would be responsible for maintaining a comprehensive and up-to-date understanding of the many national water research programs and disseminating information about these programs.

Introduction

In the Phase I Report, the CRC proposed a mission which maintained the existing system of national water resources research, with no changes except as might occur over time in response to new research needs. It was suggested that the existing array of agencies and programs provided a comprehensive and generally effective program of water research although it had some deficiencies.

For Phase II of the study, the CEQ directed the CRC to explore this option further and to propose incremental changes in existing institutions that would address certain of the deficiencies noted in existing programs. These included increasing the timeliness and efficiency of research, integrating research findings, providing for periodic review of programs and priorities, rewarding cooperative research, and identifying ways in which the fragmented research programs of the federal government can be made more effective. The CEQ also indicated that improvements could include institutional arrangements that enhanced research needs assessment, coordination and information. However, CEQ did not request the CRC to examine institutions that would deal specifically with the direct coordination of federal water research programs.

Approach

Much of the basic information needed to assess this option was compiled as background for the Phase I report, including data on federal agency and state institute research programs, material from a number of previous studies of water research, and interviews with persons in the water research community. This information has been supplemented by an analysis of one key water research subject area, non-point source pollution, to ascertain the existence of, and reasons for, the perceived deficiencies in water research that the CEQ suggested for consideration under this option. In addition, recent legislation and studies in water research were reviewed to draw some inferences about how water research is seen in the national perspective and in the context of recent actions by the Congress.

Perceived Deficiencies in Existing Federal Programs

A number of earlier studies have stated that deficiencies exist in the collective federal agency water research effort. In order to find a basis for correcting these deficiencies, we sought to determine how they might arise within the context of a water subject area that cuts across several agencies. Research in non-point source pollution was selected because it is one area in which our staff had technical expertise, because a number of agencies were conducting research on various aspects of the problem, and because it has been identified as an important national issue.[7] We focused the analysis on the programs of four agencies conducting such research, the Environmental Protection Agency, the Forest Service, the Agricultural Research Service, and the Bureau of Land Management. (It is recognized that other agencies have also conducted non-point source pollution research.) Our findings are summarized in the following discussion.

Case Study of Non-point Source Pollution Research.

The array of agency research activities related to non-point source pollution, and the extent to which these agencies were seeking to achieve efficient, timely, and non-duplicative programs was examined. We found that a number of mechanisms have been used to provide for interagency planning and coordination. One is the establishment of Joint Policies which address information exchange, technical assistance, and regulatory and management issues associated with specific problems. For example, the Forest Service and the Environmental Protection Agency established a Joint Policy in 1976 on non-point source pollution research and regulatory management needs. This policy laid the foundation for a series of subsequent cooperative activities including the completion of a handbook on water resources evaluation of non-point sources and a state forest agency training package. A Memorandum of Understanding concerning continuing working relationships between the Forest Service and the Environmental Protection Agency was updated in 1982 and is effective through 1987.

Interagency memoranda have also been developed for addressing research effectiveness in general and assigning responsibilities for planning, conducting, and communicating research results. The Department of the Interior and the Department of Agriculture issued such a joint memorandum addressing research activities in seven sub-agencies in 1980 and, as a result, an interagency steering committee was established in 1981. In addition to these, there have been numerous formal and informal briefings by individual agencies. In some cases (e.g. Forest Service), representatives of other agencies participate in that agency's research planning and evaluation of proposals. Other agencies also participate in the Forest Service research program review conducted by the central office staff. Similarly, various interest groups often are involved in the process of defining research programs

and evaluating the need for a specific research proposal. The Agricultural Research Service and Forest Service utilize this approach.

An effort at overall coordination of non-point source pollution programs was initiated in 1984 with the convening by the Environmental Protection Agency of an interagency task force to develop an agency-wide strategy to address non-point source problems. The ultimate outcome of this activity is anticipated to be a policy and strategy to address such problems and a Memoranda of Understanding to support this strategy. One of the issues that has been discussed is the requirement for clearer delineation of research needs.

Another means of shaping research direction is through the budgetary process. For example, the Office of Management and Budget and the Congress have affected several major changes in the research program of the Environmental Protection Agency. In 1975 the Congress directed the Environmental Protection Agency to conduct a major five-year research effort on Chesapeake Bay which included non-point source research. However, no new funds were appropriated, and this directive resulted in substantial re-direction of the Agency's overall research and development program. Similarly, in 1979 the Office of Management and Budget was instrumental in shifting ongoing non-point source research from the Environmental Protection Agency's regional laboratories to the Soil Conservation Service. Of course budget reductions over the past four years have forced substantial alterations in the water research agenda of some federal agencies. It is not being suggested here that Congressional or Office of Management and Budget actions have been unwarranted, only that such actions can, from the agencies' perspective, complicate the planning process for sustaining a long-term research program.

Thus, in the course of our study we were able to identify a number of formal and informal research coordination mechanisms that have been developed by these four agencies to avoid overlap and duplication and to promote collaborative approaches to non-point source pollution research. The question is whether these arrangements have resulted in an effective and integrated research program. It is possible that a centrally-directed, interagency approach might have been adopted in the mid-1970's when much of the research first began which could have resulted in a more focused effort. The existing interagency task force on acid rain is such an example. However, persons who have commented to us have indicated that the task force has made slow progress and that such a formal approach to coordination does not necessarily guarantee that research is carried out in the most timely and effective manner possible. As a result, we question whether non-point source pollution research would have been further advanced with such an approach. Moreover, to be effective the research strategy requires a number of different kinds of studies in a variety of physiographic regions. This would require a multi-agency program and it is likely that a centrally-

directed effort would not have resulted in a program very much different from the one which actually occurred.

It is recognized that there are limitations to interagency coordination efforts. In some instances coordination amounts to "lip-service," and fundamental agency objectives are not likely to be significantly altered. Similarly, major re-direction of funding or programs seldom occurs without Congressional and/or Office of Management and Budget mandates. However, it appears that the existing institutions have taken actions which have resulted in marginal improvements in the overall non-point source pollution research program. The major impediment to achieving the goal of a truly coordinated effort is the complexity of the task. To be effective, coordination must assure that: 1) individual investigators and program leaders are in contact with each other to avoid overlap or duplication at the initial stages of research planning; 2) research results are reported in a central place and in a way that the findings may be compared; 3) there is central administrative control of multiple agency budgets; and 4) agency representatives are informed about each other's plans and programs. Given the different mandates of the many agencies involved in water research, it is unrealistic to expect that such a degree of coordination could occur in most circumstances.

In regard to intra-agency research on non-point source pollution, we found that a substantial effort is being devoted to planning, coordination and evaluation. The Bureau of Land Management and the Forest Service have central monitoring of all research activities and this information is supplied to the Department of Agriculture's Current Research Information System (CRIS) which is available to many other agencies. The Bureau of Land Management system is also used to monitor the funding of research and for aid in establishing research priorities. In addition, the Forest Service staff manuals and the Bureau of Land Management guidance materials are available to help in the preparation of research proposals and in seeking cooperative research opportunities outside the agency.

In summary, the case study of non-point source pollution suggests that there do exist reasonable efforts on the part of the agencies we examined to bring about a degree of shared planning and involvement in each other's research activities. It is true that non-point source research is fragmented among a number of agencies and that a centralized and focused effort may have resulted in a more coherent national research program. However, this is primarily a result of the fact that a number of agencies conduct such research pursuant to their own mandates and missions and are responsible to different Congressional committees. The lack of continuity in non-point source research that we observed seemed to stem from major budget decisions that were made for reasons other than specific concern for water research. In this regard, as long as agency budgets and programs are subject to resolution in the

political arena, it is certain that such problems will continue. Agency water research cannot be isolated from the political process.

Research Coordination

We have suggested in the foregoing discussion that focusing on coordination to resolve perceived limitations in federal water research may not be productive. However, as previously mentioned, dissatisfaction with the federal water research program was expressed in the 1981 reports of the National Research Council[8] and the Comptroller General[9]. Both reports referred to the need for improved coordination of the federal programs as mandated in the 1964 and 1978 Water Research Acts but did not propose specific changes in the university based program. They also provided evidence that a better research management system would be required if the coordination objectives of the 1978 Act were to be met and made several recommendations for improved coordination of the Federal water research effort. However, because Congress repealed the 1978 Act in Public Law (PL) 98-242 without reenacting the provisions calling for coordinating federal research programs, it can be construed that Congress no longer considers coordination among the Federal agencies to be a primary objective.

Another deficiency in research programs under the present institutional arrangements that has been frequently stated is their apparent inability to anticipate and produce timely solutions to important water problems. This was used most recently in the 1983 Office of Technology Assessment report[10] as a basis for arguing that the present federal system of water research management is inadequate. The report suggested three categories of actions that need to be taken to improve water research programs to permit sustainable agriculture in U.S. arid and semi-arid lands: 1) providing for an expanded role in decision-making for scientists, water users, universities, and the public at large, 2) strengthening Congressional decision-making, and 3) improving specific programs of other federal and state government agencies. To overcome deficiencies in existing institutions that hinder accomplishment of these objectives, the Office of Technology Assessment report suggested that Congress should consider establishing a National Center for Water Resources Research to provide a coherent and coordinated mechanism for the Nation's university research programs in water resources and water resource management for problem-solving and policy-making. This recommendation was one of the factors which led to the Congressional directive in PL 98-181 for the preparation of this report.

Subsequently, by enacting PL 98-242 (The Water Research and Development Act of 1984) by a wide margin over the President's veto, the Congress has given a strong signal that there is a national consensus for continuation of the water resources research program in the state universities in a form similar to the program which has existed over the 20 years since passage of the Water Resources Research Act of 1964.

Although dissatisfaction with the university based research program, as previously authorized by the Water Research and Development Act of 1978, was shown by the actions of Interior Secretary Watt in 1981 when he recommended that Federal support for the program be terminated, his recommendation was ignored by the Congress, and funds were appropriated each year to continue the program at a modest level.

Conclusions

Most of the deficiencies perceived to be associated with federal water research efforts can be attributed to the limitations of multiple agency programs and diverse research efforts. Although there has been a sustained effort to create centralized research coordinating mechanisms to overcome these limitations (e.g. the Committee on Water Resources Research), all of these have failed to endure and, in PL 98-242, the congressional mandate for coordination of the federal programs appears to have been eliminated altogether. The relevant question for this option, therefore, is whether any incremental improvements in the existing federal water resources research program could be proposed and would be able to be implemented.

We propose that a major weakness in the existing arrangement is the fact that, at any given time, it is impossible to: 1) establish the content and scope of the overall national water research effort; 2) determine its progress over time; or 3) ascertain its future directions. We have observed in this study, as did the National Research Council in 1981, that it is exceedingly difficult to assess the scope and nature of federal water research on an ad hoc basis. The programs involved are complex and diverse. A listing of projects being conducted by individual investigators or agencies provides no useful information on the historical development of research agenda nor the factors that have led to their design. Without such information being available on a continuing basis, any assessment of the national water research effort is bound to be superficial and unproductive. More important, neither the Congress, the Office of Management and Budget (OMB), the general public, nor the agencies themselves have a summary of all the information needed to make such judgements. It is likely that this state of affairs is at least partially responsible for the concern expressed over water research in the Office of Technology Assessment report and by the National Water Alliance.[11]

We suggest, therefore, that a need exists for information which describes the scope and nature of the federal water research effort on a continuing basis and which can periodically assess the progress being made in this effort towards achieving goals for water research in the national interest. One way in which this could be accomplished with only a modest change in current institutional arrangements would be by the establishment of a National Advisory Committee on Water Resources Research. The Committee would be responsible for:

1) Maintaining a comprehensive nationwide, and up-to-date description of the many water research programs;

2) Disseminating information about, and periodically reporting on, national water research programs; and

3) Providing an information base which can be used to periodically review water research activities in the light of national water research needs and goals.

In terms of improvements to the existing institutional arrangements, we believe that the Committee could accomplish the following:

1. Establish a single national focus for water resources research.

2. Provide an information base for the Congress and the OMB for understanding the total national water resources research agenda.

3. Assist the water research agencies by making information available on the current status and future plans of other agency programs.

4. Provide information that could be used for periodic reviews of national water research programs and plans.

5. Facilitate the flow of information within the water research community.

Institutional Arrangements for a National Advisory Committee on Water Resources Research

Implementation Requirements

It is proposed that the National Advisory Committee have about 15 to 25 members broadly representative of the water research and user community including persons from federal agencies conducting water research, state and local government, the Congress, universities, and special interests (e.g. agricultural, mining, environmental) which are users of water research results. It would be assisted by a small staff. The Committee would publicize the information it gathers by submitting an annual report to the President and the Congress. Other occasional reports that would be useful include:

1) A directory of federal water research programs with a description of their areas of focus;

2) A matrix of water research subjects with cross reference to programs where that research is being undertaken (or for which no active research is on-going);

3) A summary of major research accomplishments or findings;

4) A description of new research initiatives;

5) A statement of major gaps in existing programs; and

6) A periodic description of non-federal research programs, such as those in the states, regional organizations, colleges and universities, and water associations.

The Committee would not require any new capital expenditures, and could be housed in any available office space. It should, however, be located in the vicinity of Washington, D.C., in order that the staff would be easily available to furnish information and testimony to the Congress as well as to the agencies of the executive branch of government. It could be established as an advisory committee under existing authority as soon as funds were made available, possibly as early as Fiscal Year (FY) 1985, or as a new statutory body in FY 1986.

The principal difficulty in implementing the committee is determining the most appropriate institutional setting. It could be established in a form similar to the Science Advisory Board of the Environmental Protection Agency created under the Environmental Research, Development and Demonstration Authorization Act of 1978 (42 U.S.C. 4365) or to the National Advisory Committee on Oceans and Atmosphere created by an Act of July 5, 1977 (33 U.S.C. 857). Other possibilities could be to establish it under the Federal Advisory Committee Act (5 U.S.C. App. I) as an advisory committee to the

Secretary of the Interior under the provisions of PL 98-242 or, preferably, to the Director of the Office of Science and Technology Policy. Alternatively, either of these officials could contract with the National Academy of Sciences to establish a committee to accomplish the same functions. This could be patterned along the lines of a committee which exists in the Academy to advise the Director of the U.S. Geological Survey, or its Space Science Board.

An Advisory Committee on National Water Resources Research established under the Federal Advisory Committee Act has the advantage of being easily implemented because it would not require new statutory authorization. This advantage is offset by the general lack of visibility of advisory committees, and the tendency of administrators to accept their advice only if it supports previously established views. An advisory committee set up under the Director of the Office of Science and Technology Policy might have greater visibility and credibility, but it is understood that there is a reluctance to have too many such bodies housed in the Executive Office of the President. Moreover, water resources research, although important, is but a small part of the overall research picture, and might not receive sufficient attention from the Office of Science and Technology director.

A Committee set up under a contract with the National Academy of Sciences could also be set up quickly and easily without further statutory authorization. There are many such committees within the National Academy of Science/National Academy of Engineering/National Research Council structure, they generally have a high degree of visibility and credibility and their reports are taken seriously by decision-makers. Appointees to Academy committees and boards almost invariably have very high standing among their peers. In our view, creating the Committee under a contract with the National Academy of Sciences would be the preferred approach to implementation, providing that the Academy agrees to the criteria for selection of the Committee members as discussed below under Operational Characteristics. The Committee's funds should be provided to the Academy through the Interior Department Appropriations Act.

Operational Characteristics

The Committee would be assisted by a small staff of about 15 persons to be headed by an Executive Secretary. An annual budget of approximately $1.0 million should be provided from federal appropriations for Committee and staff functions. Committee members could receive a stipend for the conduct of official business. They would also be reimbursed for related travel expenses. No special provisions for fiscal accountability or budget controls would be required because the Committee would be subject to the existing regulations of the National Academy of Science/National Research Council under contractual arrangements with the Department of the Interior.

The Committee should meet initially about six times per year and hold public meetings from time to time in various regions to obtain the views of persons in the water research and user community. It should determine the kinds of specific information that would be most useful in describing water research activities and programs and the most useful forms in which the information should be disseminated. The Committee's staff would be responsible for compiling and maintaining on a continuing basis, information which describes the total national water research program, including past work, research in progress, and proposed plans or new initiatives. The effort would require new data collection and compilations of other surveys. The staff would also answer requests for information, conduct conferences and workshops and maintain an active liaison with the agencies. Provisions should be made for exchange of staff with other agencies under the Intergovernmental Personnel Act. It is recommended that some of the staff should have doctoral level experience in the research programs being described so that they could understand the research process and interact effectively with the investigators involved.

Terms of Committee members should be at least three years and staggered to preserve continuity. It was previously indicated that the Committee should be broadly representative of the water research and user community. In appointing the Committee we recommended that the National Academy of Science/National Research Council seek to achieve representation from the following:

1. Federal agencies conducting water research.

2. Regional, state and local officials in water related agencies.

3. The Congress.

4. State water institutes and the university community at large.

5. Private sector scientists.

6. Private sector users (e.g. agriculture, mining, forestry).

7. Public interest groups.

Critical Review

The advantage of establishing a National Advisory Committee on Water Resources Research over other options considered in this report is that it builds on, and expands, the recent Congressional authorization for water research contained in PL 98-242. There would be a minimum of disruption to the momentum of ongoing programs. Representatives of all segments of the research community and the public would be involved in developing information about the nation's water research programs. Such information could be used to achieve greater relevance, continuity, and

scope in these research activities. The Advisory Committee could also provide the information necessary for developing a research agenda having greater efficiency (e.g. minimizing undesirable redundancy and duplication; providing for a clearer identification of regional vs. national, and applied vs. basic research). In addition, the broadly-based rotating membership of the Committee would maximize the opportunity for establishing a solid political basis for a long-term water research program.

On the other hand, the Advisory Committee would have no way of assuring that the information it produces is used, or even considered. Unless top-flight Committee members and staff were appointed, there would be more of the same repetitious review of water research programs that has characterized the field for the past decade, without generating the spark of enthusiasm that appears to be needed to transfer the program into an important part of the overall water resources picture.

On balance it must be recognized that no advisory committee, no matter how prestigious, would be able to provide for the integration and coordination of the broad scope of water research activities in the United States. It can, however, point the way, and because the Advisory Committee is a low cost option, it should be considered a low cost way to achieve a significant improvement in a field that has long been the subject of intense study, without any clear path to improvement having emerged.

Those interests seeking the establishment of a new and highly visible national water resources research center will not be satisfied with the advisory committee approach. Others will say that we already have too many ineffective advisory committees. But those who are seeking a cost effective means of receiving significant incremental improvements in the existing water research system might well espouse the creation of the Advisory Committee proposed here.

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OPTION 2: EXTRAMURAL RESEARCH

This option proposes a National Center that would augment existing water research through the allocation of federal funds to universities and other non-federal institutions. The Center would target funds to important subject areas that transcend or cut across existing agency mission programs.

Introduction

The CEQ has requested the CRC to critique a National Center which would establish research needs and priorities and provide funds on a competitive basis to proposals which address these priorities.

In order to support this option, we found it necessary to consider the need for an extramural program, to develop criteria to select priority research areas for such programs that would not overlap or duplicate agency research efforts, and to reconcile the design of a new independent extramural program with the provisions of Public Law 98-242 which already authorizes a potentially similar program in the Department of the Interior (DOI).

We came to several general conclusions that have influenced our approach to this option. They are as follows:

1. Budgets of some agency water research programs have declined in recent years. In discussions with various agency personel about potential research areas suitable for extramural funding, it was often pointed out that such subjects could be effectively addressed by the agencies if they had the necessary funds. However, as we indicated in Option 1, it can be inferred from the passage of PL 98-242 that augmented funding of water research will be directed towards university-oriented research. If mission-oriented agency programs do not receive continuing or increased support this may represent a incremental shift in national water research policy. (It is recognized that full funding of the PL 98-242 program was not achieved in FY 1985).

2. PL 98-242 authorizes an extramural research program in the Department of the Interior. If fully funded at authorized levels, the annual program budget would be $36 million for research, although $10 million of this amount is to be allocated directly to the state water research institutes. We examined a number of arguments for proposing a separate extramural program outside of the DOI but it was difficult to distinguish between the two programs and to justify the additional funds that would be required by a separate non-DOI program. Therefore, we have designed what we believe would represent an "ideal" extramural institution and then

indicated the kinds of changes that would be required in PL 98-242 (or actions by the Secretary of Interior) to make such an "ideal" institution viable in the context of that legislation. We are not implying here that DOI is necessarily the best "home" for an extramural national research program, only that at this time it seems preferable to other alternatives. This issue will be discussed again in the sections which follow.

Rationale for Extramural Research

As indicated above, it can be argued that augmentation of national water resources research could legitimately be focused on the mission-oriented federal agency programs. However, the rationale for an extramural program is that it would provide funding for important research topics that cannot be adequately addressed through existing mission-oriented institutions. Thus, an extramural program would:

1) marshall external expertise otherwise unavailable in existing programs;

2) quickly identify and respond to emerging problems;

3) address topical issues that overlap or cut across agency jurisdictions;

4) fund short-term programs where a rapid expansion and contraction of personnel would be required; and

5) target complex interdisciplinary issues for support.

The center which administers the extramural program should define the basic characteristics of the research it intends to solicit and support. In reaching that definition the following characteristics would be appropriate for a national center:

1) research funded should be in the "national interest," and criteria for defining such a program should be developed as one of the first actions of the board which governs the center;

2) priority should be given to more severe and urgent national problems with high potential benefits;

3) research on the social, legal, institutional and economic issues associated with the allocation and use of water should receive a high priority in the agenda of the center;

4) priority should be given to truly interdisciplinary research efforts;

5) except as noted in No. 6 below, funding should be directed to investigators in non-federal institutions (universities, state researchers and the private sector); and

6) consideration should be given to the occasional support of federal agency programs where supplemental funding would be needed to investigate or respond to an important research opportunity.

Institutional Arrangements for an Independent National Water Resources Research Center

Implementation Requirements

This Center would define relevant research needs on a periodic basis and fund extramural research. It would not require new capital expenditures for facilities and could be housed in rented or leased office space. The Center should be located in a region where access to other agency programs is good and where library and data sources for water literature are nearby. We believe that the Washington, D.C. area is the preferable location. If the Center is to be formed under provisions of existing legislation, it could begin limited operation in FY 1985. It is more likely that new legislation would be required, in which case full start-up would not occur until FY 1986.

Operational Characteristics

Administrative Structure. The Center would be independent of the mission agencies, so that it could maintain a broad national perspective in determining research goals. It would be governed by a Board and administered by a Director and staff. The Board would be broadly-based and include representation from federal agencies, the Congress, the academic community, state and local government, the state water institutes and society at large on a regional basis. It would be responsible for establishing priorities for research consonant with major interests and policy issues confronting the nation. Because the new Center is intended to focus principally on national needs, it would be the task of the Board to define these needs in keeping with the criteria for extramural research previously stated. In essence, the setting of priorities requires the definition of issues and problems confronting the Nation in the field of water resources and at the same time, assuring that certain fundamental issues or new directions in research are pursued.

A high-level Board representing the Executive and Legislative branches of the Federal government, as well as the water research community at large, including the States, has the capacity to set direction and priorities reflecting diverse views and interests which characterize the Nation. Moreover, the representative character of such a Board might help to assure continuity in the effort, an important element in attaining truly first-rate research.

Executive direction of the Center would rest with a Director chosen by the Board. It would be the function of the Director to administer the research program under the guidelines set down by the enabling legislation of the Center as interpreted by the Board. The Director and staff would be responsible for preparing Requests for Proposals pursuant to the policy direction given by the Board, arranging the review and funding of proposals, keeping abreast of progress being made on research

projects, maintaining liaison with other water research agencies, and providing for public information on behalf of the Center's programs. The Director would also have the authority to fund unsolicited peer-reviewed proposals.

On a periodic basis (e.g. every three to five years), the Board would be required to arrange, through an established process (e.g. National Academy of Science/National Research Council), an independent evaluation of the research program as a whole. This review would be conducted by competent individuals representing the full range of disciplines required to consider the breadth of the water research field.

Relationships to other Organizations. Although the Center is an independent institution, it is absolutely essential that it achieve close working ties to the federal agencies and state institutes conducting water research. This is necessary not only to maintain awareness of other research activities in order to prevent duplication, but also to seek out opportunities for cooperative and collaborative research endeavors. These relationships can be achieved by representation of such agencies on the Board and by the actions of the Director in establishing working ties to the water research community.

If this institution were called the National Water Resources Research Center, it would undoubtedly be the recipient of a substanital number of requests for water related information. Therefore, it would also need close working ties to water information sources. For this reason, it may be worthwhile to consider an administrative and organizational relationship and computer linkage with one or more of the existing water information institutions or with one of the clearinghouse options identified elsewhere in this report. The Center would, at a minimum, need a public information function and requisite staff.

Operating Costs and Funding Sources. The total annual budget of the center is estimated to be about $20 million. Administrative costs would be approximately ten percent of the total budget or $2 million dollars annually. The primary source of support for the Center would be federal funds. However, it is conceivable that other sources might be available for certain purposes. For example, other public agencies or private sources may wish to use the Center as a vehicle for seeking competent investigators to address specific water research needs.

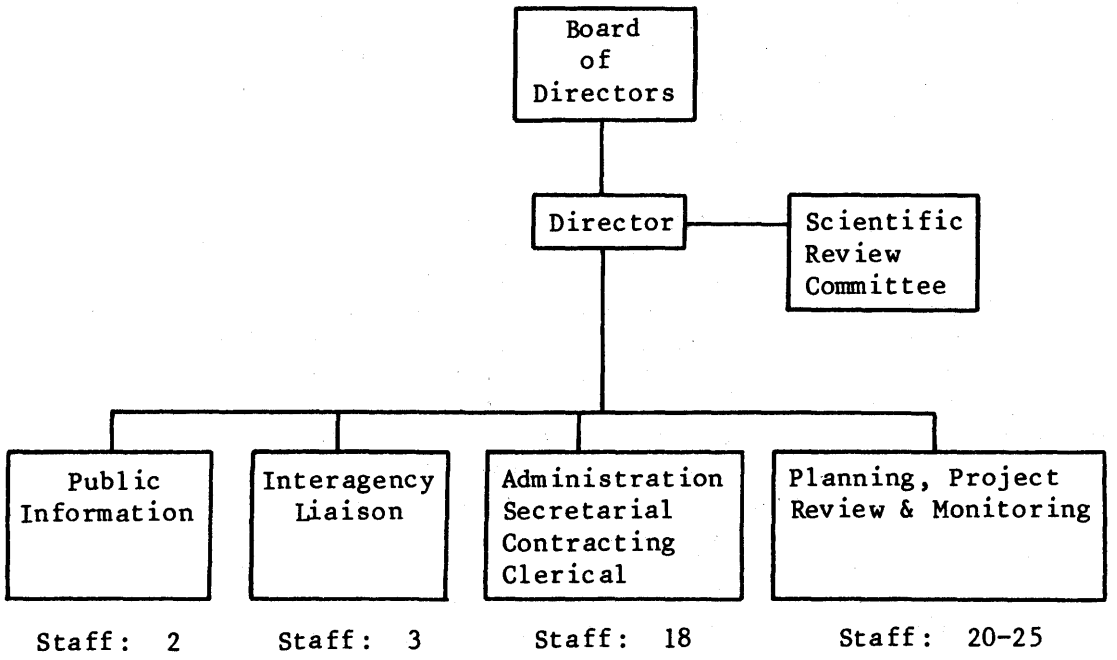
Fiscal Accountability and Budget Controls. The Center would be operated under the standard, well-established, federal procedures for fiscal accountability and budget controls. The Board would establish the general allocation of the budget to specific programmatic and research areas. The director and staff would exercise day-to-day fiscal controls through their administrative and grant and contract supervision functions.

Scientific Accountability. Two methods are proposed for achieving scientific accountability. For the program as a whole, a Scientific Advisory and Review Committee would periodically assess the program's scientific relevance, direction and productivity. For individual projects, the Center's staff would be responsible for preparing RFPs pursuant to the policy direction given by the Board, evaluating proposals, providing for their peer review, and monitoring research progress. The staff should also have some discretionary authority to fund unsolicited proposals, including those which involve the study of unusual or transitory phenomena.

Staffing size and structure. The Center would encompass the functions of administration and administrative support (e.g. grant and contract specialists), research planning and proposal review, interagency liaison, and public information. The administrative staff would largely be permanent although it is proposed that provisions be made for some rotation in the research planning, proposal review, and interagency liaison staff. Encouragement should be given for other agency personnel to be involved as well as persons from state government, the university community, and the private sector. A small number of temporary positions should be provided for post-doctoral or other investigators who have an interest in conducting studies on the water research planning and evaluation activities of the Center. The composition of the professional staff should be broadly representative of the range of subject matter to be considered in the Center's funding program. The proposed structure and size of the Center are shown in Table 2.

TABLE 2

Structure and Size of Staff of National Water Resources Center



Institutional Arrangements for a National Water Resources Research Center Under Public Law 98-242

The foregoing discussion outlined the principal elements of an "ideal" extramural water research center. Some of the elements of the "ideal" center appear to be similar to the past and present Office of Water Research and Technology (OWRT) program. The proposed center contains the state institutes, as does OWRT. Yet, this proposal is different in several critical ways. The proposed center establishes specific research objectives that are developed by an advisory board, solicits research from a broad research clientele through the use of requests for proposals, and provides active technical monitoring of research.

Thus, while this proposed center is different from the OWRT program, it has enough similarities that it should be considered within the context of PL 98-242. The recent passage of PL 98-242, in which Congress overrode the President's veto by an overwhelming majority, indicates political strength for the program. At the same time, the failure of Congress to appropriate funds for Sections 105 and 106 of the Act for FY 1985 leaves flexibility for funding the proposed center out of those sections until the next appropriate cycle.

We propose therefore that the entire program of research as stated in PL 98-242 be considered as a National Water Resources Research Center within the Department of the Interior. The Center would then encompass the substantive provisions of this legislation, particularly Sections 104, 105 and 106 which include the state water research institutes, the focused extramural matching grant program and the technology development program.

An alternative would be to move PL 98-242 from the Department of Interior (DOI), establish it elsewhere as an independent entity, and suggest new legislation to reflect more closely the "ideal" Center described above. This has some merit conceptually because the Center would then be independent of a mission agency or department. There are, however, several drawbacks. First, the state institutes and the water research community in general appear to be reasonably well satisfied with the relationships established over several decades with the DOI. It is expected that they would oppose the siting of the Center in a different institutional setting. Second, we were not able to identify another organizational affiliation that would be preferable. The Office of Science and Technology Policy (OSTP), the CEQ and the National Science Foundation were considered but each had significant limitations for administering the kinds of programs specified in PL 98-242. As indicated in the discussion of Option 1, there is a reluctance to add additional programs to the OSTP and a water resource research center in this setting would have relatively low visibility. The CEQ does not have a tradition of involvement in the full range of water research issues nor has it developed ties to the water research community. The

National Science Foundation has not, in recent years, been structured to provide for a broad-based policy Board or to fund, in one Directorate, the diverse program envisioned here. Also, in our review of the projects funded by the old OWRT and more recently by the Bureau of Reclamation, we were unable to discern a DOI "bias" in the range of issues addressed. Moreover, we find the provisions of PL 98-242 to be very broad with respect to the range of water research which is appropriate to the program. In this regard it is our view that the legislation could provide for all of the kinds of research that we believe should be supported by the center, including water quality and policy-related issues.

We suggest that Section 104 be maintained in essentially its current form and funding level. Section 105 should have the matching requirements removed to reflect the fact that research funded would be in the national interest even though the application or incidence of that research would be at the regional, state or local level. The criteria for the kinds of research that the Center intends to solicit and support in Section 105 should be those listed in the Introduction to this option. This section should be funded at the authorized level of $20 million. Section 106 should be included in the Center in its present form and at its authorized funding level.

PL 98-242 does not contain specific provisions for a Board. A broad-based agenda-setting Board is crucial to the operation of such an extramural program. The Board's activities should be coupled to the Center's research functions, since such a linkage would enhance the reality and the perception that the Center's research was focused on priority national issues. In addition, the Board would tend to enhance the Center's constituent base and to that extent it would assist in maintaining a greater degree of stability and permanence. Without such a Board, we doubt that the Center would represent a significant improvement over current institutional arrangements even though new research initiatives would be undertaken. It is our interpretation that although PL 98-242 does not explicitly provide for such a Board, nothing in the legislation would appear to prevent its establishment. We propose that the Secretary of the Interior appoint the Board's members in accordance with the composition previously stated, and assure the fact and appearance of impartiality by openness of operation and freedom from political and administrative pressure.

Implementation Plan

The principal issue in implementation of the Center is providing for its setting within the Department of Interior. It is understood that discussions are now occurring within the DOI on the administration of the PL 98-242 program but a final decision has not been made. We believe that several options should be considered. One is placing the Center as a separate office under the Secretary or the Assistant Secretary for Water and Science. This would create a somewhat

independent entity which may have greater flexibility in being able to administer the program free of any agency mission bias. On the other hand, the Center might have a greater degree of vulnerability because it would not be affiliated with one of the Interior agencies. The other alternative would be locating the Center in the Geological Survey. The principal drawback to this option, in our view, is that the Survey does not have a tradition of involvement in the social, policy, and institutional aspects of water research and has not considered these subjects to be within their mandate. However, the Survey does have a reputation for scientific excellence and these objections could possibly be overcome if the proposed governing Board was established and if the staff represented the range of disciplines required to manage the Center's broad research agenda. On balance, we tend to favor the Center's placement in the more independent setting under the Secretary or Assistant Secretary although the arguments for each alternative are equally reasonable. An inferior option, in our view, would be to have the Center's functions fragmented between several DOI agencies which would invalidate the Center's principal function of providing a focused research program.

The Center, because it would be located in the DOI, would not require new physical facilities or capital expenditures. It could be located in existing space within the Department in Washington, D.C. or in leased or rental quarters nearby. Implementation could begin in FY 1986 provided PL 98-242 is funded as authorized and provided no changes are necessary in the legislation to allow for the Center concept to be implemented.

There appear to be two primary constraints to development and operation of the Center. One is the probable difficulty of attempting to match this proposed institution to PL 98-242 and providing for its establishment in the DOI. This could be a complex task, particularly if the Department had already decided on a means of administrating PL 98-242 and if these decisions had to be substantially altered. Second, we have previously indicated the necessity to have a first-rate technical staff for the program. It may prove difficult to recruit such persons quickly and, thus, full implementation of the Center would take some time.

Operational Characteristics

Administrative Structure. For this alternative, the Center would be administratively located in the Office of the Secretary or the Assistant Secretary for Water and Science. The governing Board, appointed by the Secretary, would be responsible for establishing policy and providing research needs statements for the Center's research agenda. Day-to-day management of the Center would be the responsibility of the Director. A research advisory committee would periodically be established by the Board to assess the overall scientific merit of the program and to offer guidance on its future direction. It would be

critically important that the Center be, and be seen to be, an impartial representative of national problems and needs, not of the missions of any agency or cluster of agencies. The fundamental base for this would lie in the quality and stature of appointees to the Board and staff and its independence despite administrative location in DOI.

Relationship to Other Research Organizations. The need for established relationships with others in the national water research community was previously stated. With the Center located in the DOI, liaison with agencies in the Department and the states through the institute program should be enhanced. It is also essential, however, that ties be established with the other federal agencies conducting water research. This could be accomplished by providing for their membership on the Board, but the Director should also be charged with establishing such relationships on a working level. A staff function for vigorous and continuous interagency liaison is therefore recommended. As previously indicated, the Center should also have a public information capability and be able to directly access several of the existing water information systems.

Operating Costs and Funding Sources. Our original estimate of the funding necessary to make an extramural program viable and effective was $25 to $50 million annually. PL 98-242, as authorized, provides for $36 million including $10 million for the state institute program (Section 104); $20 million for the extramural research (Section 105); and $6 million for technology development (Section 106). We believe these amounts to be reasonable at this time and we also support the Section 107 provisions for a maximum of 15 percent of the total annual costs being allocated to administration.

Fiscal Accountability and Budget Controls. The same considerations could obtain here as in the independent Center discussion.

Scientific Accountability. We suggest the same methods for achieving scientific accountability as indicated previously.

Staffing Size and Structure. The information presented in Table 2 should also apply here.

Critical Review

Advantages and Disadvantages. The primary advantage of the Center is that it would fund nationally significant research outside of agency missions which would otherwise not be addressed in sufficient depth or in a timely way by existing institutions. As proposed here, the Center would augment and improve an existing program and would not require funds in excess of those already authorized. It would also result in a greater degree of public involvement in the development of water research priorities. Finally, the Center would provide for increased

participation by the university community in the overall national water research effort.

The disadvantages that we encountered were not related to justifying an extramural water research program but providing for its institutional setting. We found considerable sentiment for achieving a relatively independent status for the Center so that it would not be associated with any particular mission agency. At the same time, we recognized that it is important that the Center have a high degree of stability and for this reason an existing institutional base would be more desirable. The passage of PL 98-242 was a key factor in leading us to conclude that the DOI was the preferable site for the Center.

Ability to Integrate and Coordinate Other Research. It is unlikely that this Center will significantly alter or improve the state of coordination among federal agency programs. This is so because we do not envision the mandate of the Center including authority over other agencies' programs or budgets. However, the Center may influence the direction of the overall national effort through the activities of its Board in setting a national agenda for water research. In addition, the Center could be influential in augmenting existing research programs or bringing about more cooperative federal/university/private sector initiatives. It would clearly have a major role in fostering coordination in university-based water research efforts and to that extent would address one of the main issues raised in the OTA report.[12]

Cost Effectiveness. In evaluating the cost effectiveness of the Center, we assume that it will address nationally significant research needs which otherwise would not be addressed (or met in a timely way) under the existing institutional structure. To the extent that it meets those objectives, the Center could be seen as cost effective. Another consideration is whether a different approach to extramural funding would be more efficient. It may be, for example, that incorporating the Center in the National Science Foundation structure would be a lower cost option. However, other factors would have to be considered in this case because the Center concept, as expressed here, could not readily be adopted to the National Science Foundation's mode of operation (e.g. the priority-setting Board). Similar objections can be raised for the other institutional settings explored.

Improvements Over Existing Research Activities. In terms of the improvements in existing water research, we believe that the Center has to be structured so that the agenda-setting activities of the Board are coupled with its research function. In this way the research supported by the Center would continue to be focused on priority national issues. If this linkage is not achieved, we doubt that the Center would represent a significant improvement over the current system, even though new research initiatives would be undertaken.

It can be argued that the Center simply duplicates the former Office of Water Research and Technology (OWRT) program in the DOI and therefore represents no significant improvement in water resources research. We believe, however, that the Center has several significant differences with that program that are improvements in the way in which an extramural funding program is administered. They are presented in Table 3.

Political, Social and Economic Costs and Benefits. The Center, because it builds on an existing program, should have minimal political and social costs. As previously indicated, the economic costs are also small because the requisite funding has already been authorized. The chief benefits are that the Center would provide a focused research program that is responsive to national needs.

Impacts on Current Federal Activities. The impact of the Center on current mission oriented research can be viewed as negative, as previously indicated, because it represents a shift away from such research. However, we would expect the Center to aggressively seek cooperative research endeavors with agency research programs and to that extent it could have a beneficial impact. Moreover, if the Center's research agenda is carefully designed by the Board and staff, it would fund research topics which would not otherwise be addressed by existing programs. Also, the discretionary capability of the Director enables response to unforeseen research opportunities which could, in the long-run complement mission-oriented programs. Clearly, however, the Center would not usurp or replace any existent mission program.

Incentives for Private Sector Efforts. Opportunities are provided in this program for participation by private sector scientists who are eligible to submit proposals and receive grant awards. In addition, private sector interests would be represented on the governing Board.

Supporting and Opposing Opinions. As indicated in our Phase I report, we found little consensus in the water resources research community on the kinds of research institutions that were needed or the functions they would perform. It can be anticipated, therefore, that any one proposal will not be accorded universal approval (or opposition). This Center might be supported by those who favor an increased role for non-federal water research interest and by those who supported adoption of PL 98-242. It might be opposed by those who wish to see the PL 98-242 program remain as it was provided for in the legislation, not encumbered by the Center concept or the governing Board. It also might be opposed by some who would have strongly preferred an independent extramural program located outside the mission agency framework. Finally, there is some sentiment for substantially increasing the amount of non-federal water research funds available. In that regard, the amounts proposed for the Center may be perceived as inadequate. In general, however, the clientele of the Center are likely to be persons in the university-based and private sector water research

TABLE 3

Comparative Functions of the National Water Resources Research Center (NWRRC) and the Office of Water Research and Technology (OWRT) Program

Functions	NWRRC	OWRT
1. Predetermine broad categories of needed research.	Yes	Yes
2. Establish specific research goals by RFP's	Yes	No
3. Responsible to broad-based governing Board	Yes	No
4. Active monitoring of research in progress	Yes	No
5. Primarily oriented to the state institutes.	No	Yes

community, the state water institutes, and representatives of regions where water research issues of national significance can be addressed by the Center's programs.

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OPTION 3: FOCUSED RESEARCH INSTITUTE

This option proposes the establishment of a National Water Resources Research Institute which would facilitate interdisciplinary study of, and synthesis of information about major water resources issues facing the nation.

Introduction

In this option, CRC has been directed to examine the feasibility of establishing one or more research centers focused on broad national needs but with different subject matter scope. In considering such a center(s), the CRC was to document glaring research needs not covered by major research programs for which the research interests of several entities can be focused at a single location, or at which significant fiscal savings could result from sharing expensive equipment.

Our approach to this option was to identify subject matter areas for which a center appeared to be the most effective research strategy. In order to accomplish this, we first asked our consultant advisors to the project to develop a list of water research issues which, from their perspective, represented important national needs. This list of national research needs, generated by the nominal group technique and previous studies of the same subject[13], was reviewed in order to determine whether issues could be stated for which a focused center model would be an appropriate approach. In conducting that item-by-item review, we delineated two substantially different versions of a potential water research center. One, which we called the "research laboratory," was essentially the version defined in the CEQ directive to the CRC regarding Option 3. It was a site-specific, scientific laboratory which would include expensive equipment and would be staffed by an interdisciplinary group of scientists from traditional water disciplines (hydrology, geology, chemistry, biology, etc.). The research of the laboratory could be focused on such issues as modeling ground water systems or developing instream flow requirements for various species.

The second version of the center, which we called the "research institute," emerged as we examined the content and characteristics of the items on the list of national research needs. This entity would not be primarily oriented toward doing basic science on water resources. Instead, it would be staffed by an interdisciplinary group including not only various types of physical scientists but also engineers, economists, organizational and institutional researchers, and other social scientists. This institute would support research on such topics as institutional arrangements for dealing with non-point source pollution controls or conjunctive uses of surface and ground water.

We then examined the list of national research needs to identify those which "required" a national or regional research lab or which "required" a research institute. Our criteria for selection conformed to those enumerated in CEQ's directive to us for the Phase II study. Thus, to be included for either version, an item has to be "a glaring research need not presently covered by (existing) major research programs." An item also had to be such that it would be much better addressed (or more cost-effectively addressed) by being "focused at a single location," than by being researched at a number of different places. Lastly, in the case of the "research lab," to be selected an item had to involve "expensive research equipment" or facilities.[14] We interpret these terms to refer to facilities or equipment which could serve multiple users at a single location and thereby achieve economies of scale.

These are rather severe criteria. As we reviewed the list of items, we identified many (e.g. groundwater contamination, water reuse) that were serious problems and appeared to require scientific research and substantial additional financial resources to support that research. In a number of such cases it was also clear that the creation of a research center focusing on that subject would result in desirable interdisciplinary synergy. Furthermore, a new center might well provide the visibility and ability to acquire financial resources that would foster more rapid advancement of knowledge in that field. However, the question posed by this alternative was not whether the subject area required additional research and funding. Rather, the issue was whether a new organizational structure, either lab or institute, was needed to answer the research need. Our review of the list led us to observe that, in most cases, reasonably competent organizations, federal or others, already existed that were working on the problem. In such cases, the item was not selected as appropriate for a new lab or institute. A similar analysis using the same criteria was conducted by the project staff of the research needs identified in the 1981 National Research Council study.

The item-by-item analyses led to two conclusions: 1) no clear need was identified for a new research laboratory, although existing facilities, programs and organizations may well need some expansion or additional funding; and 2) a new research institute might be justified by the perceived need for synthesis of existing research and for increased emphasis on interdisciplinary and institutional research.

To test further the validity of the first conclusion, we discussed with a number of investigators various aspects of the topic of ground water research, which had been suggested to us as a focus for study by a permanent water research center. We found little support for the research facility approach because of the diversity of groundwater issues and because greater efficiencies could be achieved by targeting groundwater research in existing institutions or programs.

As indicated above, most of the water research subject areas that have been identified as important or of high priority are already being addressed to some extent by existing programs. Also, we found none for which a new facility or laboratory seemed the most cost effective and scientifically defensible strategy. There are water research subject areas which would profit from enhanced funding. However, a better approach would be to target these for support with an extramural program (as in Option 2) with funds directed to one or more existing institutions. Alternatively, enhanced funding of existing mission agency programs could accomplish the same purpose in certain cases.

Although we also were unable to identify particular subject matter for which an institute was clearly the most effective approach to research, there was agreement within our consultants group and support elsewhere in the water research community[15] for an entity that would 1) synthesize research results and their implications and 2) conduct interdisciplinary analyses of water issues of national significance that involve institutional, social and legal issues. Such analyses must be grounded in science and therefore such disciplines should be represented in the staff. But the "problem-solving and policy" oriented focus of such analyses[16] also requires the involvement of experts in law, engineering, the social sciences and the management disciplines. Therefore, the following discussion under this option is directed toward a new institute with the primary mission to conduct research on issues associated with water management and policy.

This option builds on a proposal in the Office of Technology Assessment (OTA) report[17] which apparently was partly responsible for the authorization of this study. That report asserted, "There is a lack of a national coherence and synthesis of university water-related research" and cited "arid/semi-arid-water resources" as a case in point. The OTA report made reference to the National Center for Atmospheric Research (NCAR) university consortium model of atmospheric research and proposed that "Congress could establish a National Center for Water Resources Research to provide a coherent and coordinated mechanism for the Nation's university research programs in water resources and water resource management for problem-solving and policymaking." There is some sentiment in the water resources research community for such a center as well as a belief that Congress would be receptive to the establishment of such a center by virtue of its funding this study.

This option builds on that concept, expanding and modifying it. Like the OTA proposal, it includes the synthesizing function and the interdisciplinary orientation. Furthermore, it would most probably be organized in the form of a university consortium, along the lines of the University Corporation for Atmospheric Research (UCAR). Like NCAR, the institute would perform multi-disciplinary research on generic problems not addressed by agency-oriented programs and cross-cutting both organizational and political boundaries. It too, would be insulated from "short-term political" and "problem-of-the-moment" pressures, and

would be an "objective, non-partisan and continuing source" of information. It would be a national water research center, but not a federal research center.

However, this option expands the scope of concern from university-related water research alone to encompass all segments of the water resources research community. Secondly, it modifies the subject focus. The OTA report proposes an "interdisciplinary program of basic and applied research on water resource and water-resource management, including strong programs in the natural sciences, engineering, and social sciences, such as resource economics and law as they pertain to water-resources programs." While the mix of expertise envisioned by this option is similar to that in the OTA report, the focus would be on application rather than basic science. The Center would not be a laboratory for "site-specific research" nor would it have "advanced and sophisticated research facilities."

Institutional Arrangements for a National Water Resources Research Institute

Implementation Requirements

Organizational Plan. It is likely that the Institute would be organized under a university consortium similar to that which operates NCAR. However, it need not necessarily be so. As in the case of NCAR, the Congress would make an appropriation to the National Science Foundation. National Science Foundation would, in turn, issue a request for a statement of qualifications open to any organization that believes it can qualify. Thus, any individual organization or combination of organizations, including universities, foundations, not-for-profit firms or for-profit corporations, could respond. The National Science Foundation request would make it clear that the successful responder would be the one which best demonstrated its qualifications to establish strong ties to the university community, and to utilize the expertise of the university community as well as public agencies and private industry. Other requirements, such as ready access to first class libraries, also will tend to work in favor of university-based consortia.

The rationale for passing the funds through the National Science Foundation rather than either appropriating them directly or passing them through a mission agency is to insulate the entity operating the Institute from direct political pressures and the specialized mission orientation of any particular agency. While the National Science Foundation's primary orientation to the conduct of basic science rather than social science or institutional research caused some of this project's consultants to question the efficacy of National Science Foundation as a conduit, that concern can be addressed by the enabling legislation. It would make clear the unique character of this Institute's mission and the general nature of the interdisciplinary mix of skills required.

Physical Facilities. The Institute requires only normal office space sufficient to accommodate its researchers and administrative or support staff. It would not necessarily require a new physical facility but could occupy an existing facility under a lease or rental arrangement.

Capital Expenditures. No capital expenditures are anticipated. Office space should be leased rather than constructed to avoid inflexibility and to permit efficient reduction in operation should the Institute prove unsuccessful. Computer capacity would be needed to conduct analyses, but the necessary equipment could be leased or time-shared. Computer and telecommunications links would be needed to tie the research staff into data bases and information systems elsewhere, including the National Water Information Referral Center or National Water Information Clearinghouse, if either were created.

However, the equipment necessary for those links should also be leased. Leasing not only would avoid complexities of amortization and joint ownership, but it also would permit rapid replacement of out-of-date equipment when obsolesence due to technological advances occurred.

Site Selection Criteria. Criteria for site selection would be set forth in the request for qualifications statement mentioned above. We suggest that the following possibilities be considered: 1) it may be important to put the Institute in a geographic location that would be attractive to the sort of outstanding professionals that would be in residence and for whom quality of life considerations might be crucial; 2) if a referral center or clearinghouse staffed by water professionals also were created, there might be some synergistic advantages in putting the Institute nearby; and 3) the Institute's staff would want direct access to a first class library, one of major univerity or Library of Congress quality.

Implementation Schedule. If the Institute were funded in FY 1986, full operation could be expected during FY 1987 at the earliest. The rationale for this estimate is as follows:

- CEQ report submission to the Congress (September 1984)
- Congressional consideration (Winter-Spring 1985)
- Earliest Congressional authorization and appropriation (Summer 1985)
- Issuance of request for qualifications (Early Fall 1985)
- Responses 3 months later (Winter 1985-86)
- Evaluation of submissions (including presentations and possible site visits) and selection of Institute operator, 3 months (Early Spring 1986)
- Assemble Board, Board picks Director (Spring 1986)
- Director hires core administrative staff, begins recruitment of professional staff (Late Spring 1986)
- Some professionals begin residency (Fall 1986)
- Other professionals arrive at end of Fall university semester. Institute Fully Operational (January 1987)

Constraints on Development and Operations. A number of potential constraints on the development and operation of this model are identifiable, including the following:

1) As suggested above, this is not an option that can have immediate effects. It will take more than two years to become fully operational.

2) The essence of this option is a small, highly expert core group of professionals together with a larger number of investigators who remain in residency only from one to five years. Such turnover results in variations over time in competencies and, perhaps, discontinuities in subject matter focus. The sorts of individuals envisioned as rotating staff are distinguished in their fields. They are unlikely to be interchangeable parts. Thus, for example, even if one political scientist who is an expert in institutional analysis is replaced with another who is equally distinguished, their approaches, favorite methodologies and subjects of particular interest may well be different. Part of the Institute director's job, of course, is to smooth the effects of such variations and discontinuities, but that may not always be possible. However, the core staff would partly alleviate this problem.

3) According to this model, the Institute would do no physical scientific research itself. Rather, in the cases where such basic research was needed as a precondition to an important piece of synthesis or institutional analysis, the center would seek to have that research performed elsewhere (see "Ability to Integrate, Coordinate and Augment" for further discussion of that process). However, this raises some difficult questions of lead-time, sequencing and staffing. If, for example, the Institute existed now, some of its staff might well want to do an analysis of legal, economic and managerial measures for reducing the damage to surface water of acid precipitation. Since the basic science on acidity and its causes is incomplete, they might need to wait several years for the physical sciences to learn enough about the phenomenon so that their own work could begin. In the meantime, because of the planned turnover policy of the Institute, these analysts would be gone. In their place might be individuals with no interest in this particular subject.

4) It is expected that this Institute will need to attract top quality researchers and analysts in order to be successful. However, it is conceivable that, for personal, economic, or career reasons, insufficient numbers of such individuals will decide to participate. If that were to happen, an appropriate quality level and interdisciplinary mix will not be achieved.

5) Those who have studied interdisciplinary research and educational programs or projects, note their tendency "to become, on occasion, more multi-disciplinary than interdisciplinary."[18] Strong professional and career pressures work in that direction. It would be relatively easy for the Institute to fall into a pattern in which specialists from the same discipline were grouped together and interacted and collaborated so closely that ideas and methods from other

fields were effectively excluded from their projects. Organizational designs which reduce the tendency of specialists of one field to interact more closely among themselves than with specialists in other fields can reduce the likelihood of this result (see "Administrative Structure").

Operational Characteristics

Administrative Structure. This model requires two structures, the Institute itself and the entity to which it is responsible and accountable. In the event that a university consortium operated the Institute, that entity could be largely modelled on NCAR's Board, which is composed of 12-15 members drawn from the institutions participating in the consortium and representing a range of the academically relevant disciplines.

Because this Institute is not primarily concerned with basic research but with "problem solving and policy" related issues, it would be desirable to expand its Board's membership to include federal officials representing agencies with water research and water management responsibilities as well as several state and local water managers or planners. Thus, a Department of Interior official with responsibility for implementing PL 98-242, as well as a representative of the Corps of Engineers, should be on the Board. Other possibilities include representatives of EPA, National Oceanic and Atmospheric Administration, Department of Energy, the Bureau of Reclamation and the U.S. Geological Survey (in the event some other agency ends up with the primary responsibility for Sections 104, 105 and 106). This would result in a Board of 20-24, composed primarily of academic water resource professionals but with a significant number of public officials.

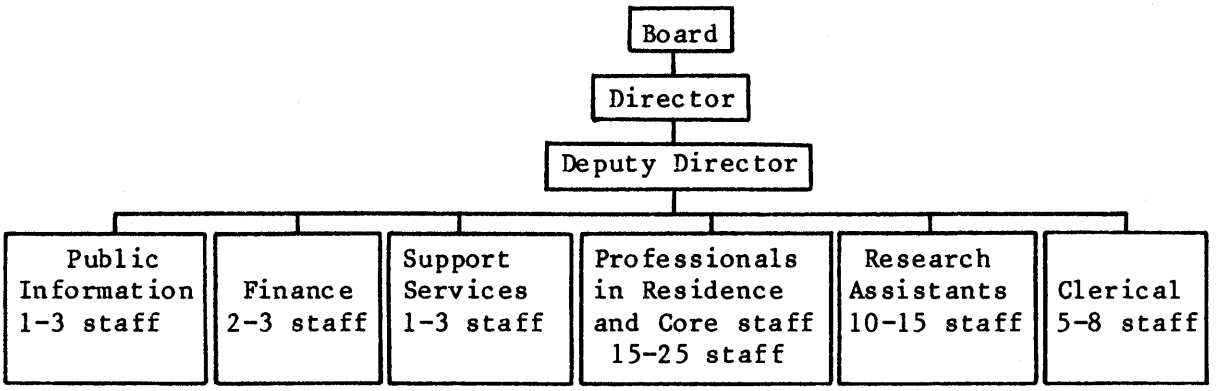
In the event the operator of the Institute was not a university consortium, a governing Board of similar composition should be established. The Board would have responsibility for advice and feedback on substantive issues (research program content, project selection, etc.) to the Institute director. The parent corporation or organization would have the contractual obligation to National Science Foundation for overall performance of the Institute and such functions as financial management, budgeting, and provision of supporting services.

Operational management would be the responsibility of a director, chosen by the Board in the case of a university consortium and by the operating organization in the case of some other type of contractor.

Ideas for projects to undertake could come from a variety of sources--professionals in residency at the Institute, Board members, the director or others. The choice of projects would be a matter for extensive consultation among those professionals, between them and the director, and between him/her and the Board. The final decision would

be the director's. This consultative approach is necessary to balance both the professionals' desire for independence and freedom of inquiry and the need to address issues of general and important concern by the broader community of water specialists who compose the board.

The internal organization of the Institute would consist of several units with specific functions (finance, public information, administrative support) and the other "pools" of individuals including a permanent core staff of 4-5 senior investigators; 10-20 distinguished professionals in residence normally for 2-5 years; 10-15 research assistants, usually permanent staff working under the direction of those professionals; and 5-8 clerical and secretarial personnel). Thus, the general table of organization might look like this:



The OTA report on which this option is partly based spoke of an institute "including a strong program in the natural sciences, engineering and social science...." That language implies an internal structure in which all physical scientists would be grouped together in one unit, all engineers in another, etc. As explained in "Constraints on Operation and Development", if interdisciplinary activities are to be encouraged, that sort of organizational design would be a mistake.

What is proposed instead is a matrix organizational design in which three kinds of human resources (professionals, research assistants and secretaries) are drawn into or assigned to various projects or groupings appropriate to their interests and capacities and the needs of the work. In some cases a professional will work independently, with some research assistance and secretarial assistance. In other cases, groups which cut across disciplinary lines will form or be formed, and one of the group will serve as project leader until its conclusion. Individuals might work on several different projects at once and move from one project to another as one is completed or as their contribution to it comes to an end.

The literature on matrix organizations and project management[19] makes it clear that such designs are not only feasible, they are probably essential in the performance of difficult and varied tasks

which require complex and changing inputs from different kinds of specialists and experts. These are exactly the sort of tasks it is the mission of this Institute to perform.

Matrix organizations, however, impose additional burdens on those who must manage them, in this case the Institute director, his/her deputy, the professionals who serve for a time as project leaders, and support personnel. Conflict and stress are likely to be more frequent and intense than in conventionally structured organizations. However, matrix designs create the sorts of constructive interactions and dynamics necessary to interdisciplinary effort, innovation and creativity. Furthermore, systems and processes can be designed that minimize the conflicts, information gaps, overlaps and resource allocation problems that can arise in matrix organizations.

Among the more traditionally structured units of the Institute will be a public information office staffed by a professional and, perhaps, two clerical assistants. This unit is necessary to carry out information dissemination functions. It is important that results of the synthesizing efforts are widely circulated, not only among specialists, policy makers and water management, but also among interested (and potentially interested) public. This is both a means of carrying out the Institute's intended purpose and a way to develop a broader constituent support base.

Similarly, if the institutional research efforts are successful, they will generate new methods of dealing with existing or emerging problems. These new methods or strategies are, in effect, new technologies which can be transferred to potential users in government, industry and the public. It would be a function of the public information officer, working with the director and the professionals in residence, to think through and help implement strategies to accelerate those technology transfers.

It should be emphasized here that the foregoing information dissemination functions are not an effort to promote the political adoption of <u>any</u> of the Institute's conclusions or recommendations. They are a recognition of the probability that much of the Institute's research would have potential application. The Institute's approach would consist of drawing conclusions, setting out options, analyzing their consequences, and publishing results in technical and popular journals.

<u>Relationships to Other Research and Information Organizations</u>. The sections on site selection and capital expenditure described the linkages that should occur to existing data bases and information systems and to the clearinghouse and referral center if either is established.

The section on administrative structure explains the relationships that would be established through the governing board or an advisory board to PL 98-242 activities and mission agencies which conduct research. The characteristics and uses of those relationships are discussed further in "Ability to Integrate, Coordinate and Augment."

Beyond that, it is important to note that the development of such relationships, where appropriate, would be part of the responsibility of the director and the public information officer and that the professionals in residence would not be kept in isolation but would be encouraged to interact with colleagues elsewhere in various professional fora.

Finally, it can be made clear in the request for qualifications that the operator of the Institute must utilize personnel not only from their own organizations or institutions but also from others. This will have the effect of deepening relationships between the Institute and other organizations that conduct research while simultaneously broadening its political support base.

Staff Structure.

Director (1 permanent)
Deputy Director (1 permanent)
Financial Manager (1 permanent)
Public Information Officer (1 permanent)
Core Staff (4-5 permanent)
Professionals in residence (10-20 temporary)
Research Assistants (10-15 permanent staff, perhaps some temporary student research assistants)
Secretarial/Clerical (8-13 permanent)
Support Services (1-3 permanent)

The professionals in residence would be experts from various disciplines on leave from their universities, agencies or firms. In most cases they would stay at the Institute not less than two years nor more than four. Experience with interdisciplinary research and educational programs suggests that it often takes a year or so for cross-disciplinary collaborative relationships to develop.[20] However, in the case of truly extraordinary individuals who could not commit for at least a two year period, exceptions could be made by arranging for a one year fellows program.

Professionals in residence would receive the same annual pay they would have at their home institution, firm or agency. However, if the Institute were located in a high cost area, a temporary cost-of-living adjustment would be provided.

Some consultants to this project hold the view that only professionals well advanced in their careers should be invited to be

residents on the grounds that two to four years in such an environment might divert younger professionals from developing fully within their own specialized fields and damage their careers. However, provided that the professional career risks associated with lengthy involvement in interdisciplinary activities are fully explained[21] no barriers based on age (or years since terminal degree) should be imposed.

Disciplinary Representation. The professionals in residence should include individuals trained in various physical sciences utilized in water resources research but most would be experts in engineering, law, economics, institutional and organizational analysis and other social sciences. The professionals in residence should include individuals conversant with the most up-to-date techniques for synthesizing results of multiple research studies, such as meta-analysis,[22] and for conducting institutional and social science research.

Perhaps the most crucial thing is that any list of appropriate disciplines for professionals in residence must be continually rethought. As new problems emerge and as new disciplines or specialties develop, the Director and the Board will have to remain alert to them and to the need to alter or expand the human resource mix within the Institute.

The Director and Deputy Director should have broad backgrounds in water resource management and research, familiarity with policy analysis and development, interdisciplinary work experience, and proven ability to handle high level inter-organizational and political relationships effectively.

Operating Costs. The annual operating costs of the institute are estimated to be $5-$8 million. This estimate is based on the assumption of a core staff and interdisciplinary cadre of 15-25 distinguished professionals and a staff of 20-35 research assistants, administrators, clericals and other support personnel. It includes the cost of the governing or advisory Board's activities and expenses, as well as, a public information function.

Funding Source. It should be assumed that a Congressional appropriation will be necessary to cover the full costs of operation. However, it is possible there will be occasions on which the Institute would receive grants and contracts from a variety of other sources, including public agencies, foundations, private sector firms, not-for-profit groups or international organizations.

Fiscal Accountability and Control. Capability and plans for internal financial management and control would be required by the request for qualifications statement. In the case of a university consortium, the existing financial system of one of the participating universities could be used, and budget review as well as financial oversight would be functions of the governing Board. Periodic finance

and compliance audits would be required. These could be performed by the U.S. General Accounting Office, by the designated federal audit agency (in the case of a university consortium or other major government contractor), or by an independent accounting firm.

Scientific Accountability. This would be a continuing oversight function of the Board in the case of a university consortium. In other cases it could be performed by a scientific advisory board including distinguished scholars from a broad base of disciplines related to water resource management.

Periodic in-depth evaluations would be performed every 5 years by an appropriate National Science Foundation review mechanism. It is suggested that the sponsoring organization be required to re-submit a continuation proposal for the Institute every 5 years which would also be reviewed by the National Science Foundation review team. Other potential sponsors could also submit proposals.

Critical Review

Advantages and Disadvantages. Many of the advantages have been described in the preceding presentation. This option addresses the perceived need for increased emphasis and effort on water resource issues of an institutional and interdisciplinary character. It also addresses the frequently stated need for more synthesizing of the existing mass of data and research. The synthesizing function, if successful, could lead to increased public awareness and consensus on water resource issues. It also would provide important supporting assistance to policy makers in both the legislative and executive branches.

The disadvantages include the following:

1) It can be argued that this Institute violates one of its own criteria of need, namely that of a "glaring research need not presently covered..." A good many institutional projects have been funded in the past by the Office of Water Research and Technology (OWRT) and Corps of Engineers. Despite the demise of OWRT, the Corps and the Bureau of Reclamation (which inherited some of OWRT's functions) continue to fund such projects, although perhaps on a reduced scale.

2) In an era of limited public resources, the Institute may be seen by some as a diversion of resources from vital basic research in other aspects of water.

3) It can be argued that interdisciplinary research is a risky and uncertain enterprise (see "Constraints").

4) There are grounds for the view that the services to be provided are, in fact, available to the crucial players in national level water policy. In short, the White House, the mission agencies, Office of Management and Budget, and the Congress (through Committee Staff, Congressional Research Service, Office of Technology Assessment, and U.S. General Accounting Office) have their own capacity for synthesis and other forms of analysis, and they may well prefer to rely on them.

5) It can be argued that, despite promising methodological development, both synthesis[23] and institutional analysis[24] are insufficiently developed procedures to generate unassailably objective results and that they remain qualitative, subjective and judgemental.

Ability to Integrate, Coordinate and Augment. If federal officials with other water research responsibilities are present on the Board of the Institute, it can play an important coordinating and integrating function. It has already been noted that attempts to conduct institutional research on issues of National concern may well reveal areas in which the requisite physical science is lacking. Similarly, the synthesizing function may well bring to light gaps or inadequacies in both mission agency and university-based research. If this information is transmitted to the Board, and the Board includes officials with both mission agency and university research (PL 98-242) responsibilities, the likelihood is increased that the necessary corrective actions in research programming will occur.

Cost Effectiveness. The Institute can be seen as a cost effective approach, since it can be argued that the combination of interdisciplinary variety and extremely high quality personnel is difficult to obtain from normal sources such as mission agency staff, conventional contract research firms or individual university researchers. Thus, five to eight million dollars may be seen as a relatively inexpensive way to seek solutions to complex, multifaceted water resource management problems.

Significant Improvement. The answer to this question is unavoidably value-based and judgmental. It depends on the value put on synthesis, and on interdisciplinary and institutional research. This can be different for different observers. Those who emphasize the advantages described earlier will take one view; those who focus most on the disadvantages will take the other. Similarly, those who sense their organizational interests, personal benefit or political concerns might be advanced will see this as a significant improvement, while those with the opposite reaction will prefer the status quo.

Political, Social and Economic Costs and Benefits. These effects are impossible to estimate precisely. However, depending on the competence and direction of the Institute's research program, the social

benefit of its existence could be substantial if it develops feasible solutions to difficult water related problems or its syntheses become the basis for more knowledge-based and broadly supported policy decisions. It could be shown that one or two solutions to important national problems (like institutional arrangements for managing interstate water transfer or an optimal method for distributing the cost burden for reducing acid precipitation) would have social and economic benefits worth many times the Institute's annual budget.

On the other hand, if no such solutions are ever developed and if the syntheses that are prepared are largely ignored by policy makers and interested publics, then only peripheral benefits (to scholarship and to the participating universities and individuals themselves) will occur. In that case the costs may well be unjustifiable. In short, a substantial trial period, of at least five years of full operation, will be necessary to determine the Institute's overall value.

For political costs and benefits see "Likely Supporting and Opposing Opinions."

Impacts on Current Federal Activities. The potential for improving coordination and integration and for augmenting the institutional research funded by the Bureau of Reclamation and by the Corps of Engineers have been noted. The fact that the projects funded by the Corps generally have a limited geographic focus diminish somewhat the overlap with the anticipated work of the Institute.

It also is possible that the analyses conducted at the Institute could lead to radically different approaches than those currently employed to manage certain water resources or solve certain types of problems. This could result in the alteration or obsolescence of important current functions of federal mission agencies, and, hence, shifts in missions, resource allocations and staffing.

Private Sector Incentives. The request for qualifications described in the "Organization Plan" allows private sector firms (including research contractors, not-for-profit companies and foundations) to respond to and receive a contract to operate the Institute, if their response best meets the criteria.

In addition, the language of the request for qualifications will indicate that the operator of the Institute must show how it will involve not only specialists based in the university community and government, but also experts drawn from private industry.

Likely Support and Opposition. Likely sources of support include:

- water policy makers in the Congress and the executive branch who feel the need for better synthesis or who believe that more attention needs to be spent on institutional issues or on

integrating technological and scientific solutions with institutional considerations;

- members of water user, conservation and environmental organizations who share those views;
- water resources managers at the local, state and federal level who share those views; and
- members of the water resources research community who believe in the value of, or wish to conduct, institutional and interdisciplinary research or synthesis.

Likely sources of opposition include:

- office of Management and Budget, since a new and continuing outlay is involved;
- university-based water resource scientists who want a national laboratory of some kind;
- environmentalists or other interest groups with a single issue or area orientation who see this as a diversion of resources that might otherwise go to their issue or area; and
- perhaps some mission agencies (see "Impact on Current Federal Activities" and "Advantages and Disadvantages").

ANALYSIS OF OPTIONS FOR A NATIONAL WATER RESOURCES INFORMATION CLEARINGHOUSE

Overview

Three options for fulfilling the functions of a national water resources information clearinghouse[25] were selected from the seven mission statements developed in Phase I of this study:[26]

1) specific recommendations for improving current institutional arrangements;

2) a referral center to serve as an initial point of access where persons could go to begin the search for water resources information (both documents and data) and obtain a limited bibliographic capability;

3) a national and state clearinghouse system with regional centers in those areas with compelling need and a common bond among states to obtain information for clients, provide information synopses and analyses of water resource issues, and develop a statement of research needs based upon a function of requests to the clearinghouses.

The distinction between a referral center and a clearinghouse is:

- A referral center points or guides seekers of information to appropriate sources to meet their information needs. It does not provide the actual data or documents needed.

- A clearinghouse, whenever possible, actually obtains the specific information required by information seekers and provides it to them. Most clearinghouses perform this function by collecting and archiving information in their area of specialization on a continuing basis so that it is available for client needs. In the water information area, however, there are so many established information bases, that attempting to develop a single all-encompassing water information data base is not practical. Fortunately, advances in computer communication technology obviate the need for a clearinghouse to actually collect and archive data itself in order to be effective.

Our analysis of these three options was conducted within the framework of the Phase I findings. The most relevant of the Phase I findings to this analysis are listed below.

a. There are 28 federal agencies with water related missions included in the federal plan for water data acquisition.[27] Several

agencies with major data collection efforts important to water resources such as the National Marine Fisheries Service and the National Environmental Satellite, Data, and Information Service (NESDIS) are not, however, included in this plan.

b. Water resource information needs include ground water, surface water, estuarine water, atmospheric water (e.g. rain and snowfall), characteristics (e.g. amount, location, flow, quality, movement, pathways), usage (e.g. costs, consumption, discharge, type, amount) and institutional factors (e.g. rights, laws, regulatory controls, policies, allocation bases, and practices).

c. No single information source meets the needs of all individuals or organizations dealing with water resources.

d. Information needs include both data (raw facts or observations often characterized by numerics or quantification) and documents (writings, maps, charts, books, journals, etc., which summarize, evaluate, explain or interpret knowledge).

e. Water resources information users can be broadly categorized into two groups.

1) Sophisticated users are usually professionals that have the technical capability to synthesize information obtained from a variety of sources in the context of a specific issue. Scientists, engineers and water resource planners working in their field usually fall within this group.

2) Unsophisticated and peripheral users are those who lack either general or specific skills to analyze technical information in a specific context or who lack the knowledge about availability of appropriate information. Legislators and their staffs, local officials, general planners, public interest groups, concerned citizens and scientists and engineers working outside of their area of expertise (or possibly under extreme time constraints) may be included in this category.

The distinction between these categories of users is not precise and is primarily based on their familiarity with the sources for specific information. A routine user of U.S. Geological Survey's (USGS) data systems (National Water Data Storage and Retrieval System [WATSTORE] and the National Water Data Exchange [NAWDEX]) may have a peripheral need for coastal, estuarine or climatological data and be completely unfamiliar with the appropriate National Oceanic and Atmospheric Administration (NOAA) systems that have this information.

f. Sophisticated users (working in their area of expertise) are usually able to meet their information needs (principally data) within the present systems. The major complaint is that they occasionally need

to go to a number of data bases or systems for relevant data and these may not be readily compatible with each other.

g. Unsophisticated users are usually not as concerned with data as they are with documents that synthesize or evaluate information. Many potential users are unfamiliar with specific information sources and are frequently frustrated in their attempts to obtain information.

h. With the possible exception of institutional information, no major information gaps were identified during the Phase I study. In fact, the National Referral Center (NRC) listed over 1100 water related information sources, (many of which were multiple information bases).

i. Water resource information needs are being addressed by government and private sector resources at international, national, regional, state and local levels[28].

In addressing the three options selected for the Phase II analysis, we have also considered that existing water resource information systems have evolved to meet the needs of their clientele. The clientele are frequently the mission oriented personnel within the agency that maintains the information system.

A typical scenario for the establishment of an information system begins with the assignment of a specific mission or task to an agency. In order to accomplish this mission or task, certain information is required. The agency then develops a system to provide information services in support of its mission. Other organizations may have use for some of the agency's information but find that the information system does not meet their needs. The information system is then subject to criticism for being non-responsive.

A variation of this scenario can occur when an agency provides funding to another agency to make incremental modifications to the information system to meet the needs of the first agency. This arrangement is satisfactory for all concerned until fiscal retrenchment forces the first agency to reduce its support. The question then becomes, "to what extent should the second agency bear the cost of meeting the first agency's needs when it has no task or mission to do so?" Often the answer is "none" which results in termination or reduction of data sets, data gaps, or breaks in time series.

Office of Management and Budget (OMB) Circular A-67 "Coordination of Federal Activities in the Acquisition of Certain Water Data"[29] attempts to resolve some of the issues described above by assigning the responsibility for coordinating the water data acquisition activities of Federal agencies to the U.S. Department of the Interior. Several programs have been established for those water data included in the circular.[30]

At the present time, there does not appear to be a need to create or establish new water resource data or document oriented information files at the national level. It is apparent, however, that there are a number of ways to facilitate access to or awareness of present information resources, and that by doing so a number of identified needs may be met.

Each of the three options selected for Phase II analysis can be perceived as ways to address the problem of access or awareness to a different degree. Specific recommendations for improving the current institutional arrangements (Option 1) primarily address problems of coordination, comparability, and lack of resources (personnel and/or funds) within components of the present system. Although the primary effect of these recommendations will be to assist the present system users (sophisticated) by upgrading present capabilities, they will also provide increased opportunity for unsophisticated or peripheral users to become aware of information resources.

Establishment of a National Water Information Referral Center (NWIRC) (Option 2) will enable unsophisticated and peripheral users to gain awareness of water resources information sources (both document and data oriented) and to obtain information on how to access these systems. A limited bibliographic capability will provide some additional services for those users desiring or requiring more focused information on an issue. It does not, however, provide either group of users with syntheses or analyses of information.

The third option, a National/State Clearinghouse System, supplemented by appropriate regional clearinghouses, facilitates information dissemination and use by providing the capability to extract appropriate information from numerous information sources for the potential user. The research needs assessment function also provides guidance to policy and budget personnel on research needs as a function of questions that cannot be answered with extant information. A variation of Option 3 in which the National Water Information Clearinghouse is supported by a number of disciplinary or subject focused Centers of Competence is viable. Water problems, however, usually require an interdisciplinary approach and are site specific. In view of this, geographic focus for a water information clearinghouse is considered more appropriate.

The capability (and responsibility) under this option of providing periodic summaries of water resources information and the status of water resource problems at various levels, and the capability of providing reports on specific issues upon request respond directly to the expressed needs of the many unsophisticated users.

Most important, the third option provides water resources information at the level most appropriate for its application i.e., information relevant for local or state issues will be provided by the

state clearinghouses, information for national issues will be provided by the national clearinghouse, and in regions where there is a compelling need and a common bond among states, regionally focused information will be provided by a regional clearinghouse.

Information clearinghouses in addition to providing information or referral can also collect, store, archive, catalog, process or otherwise become engaged in activities involving actual possession of information. We did not recommend organizational structures that embodied these functions because of the unnecessary duplication that would result from the development of additional water information files. Water information clearinghouse functions can be adequately performed by accession from or referral to existing water information files.

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OPTION 1: IMPROVING CURRENT INSTITUTIONAL ARRANGEMENTS

This option proposes revision of OMB Circular A-67; interconnection of major water related data bases; establishment of centers of competence; establishment of a water research-in-progress information system; upgrade of the capability of the National Referral Center; and addition of specific water expertise to the Congressional Research Service.

Introduction

The Phase I study identified a large number of existing water resource information sources supported by both the private and public sectors. The U.S. General Accounting Office (GAO) has included 37 federally supported water related information sources in its Congressional Information Sources, Inventories and Directories (CISID) data base. The National Referral Center (NRC) lists over 1100 information sources related to water. Each of these information sources was established to meet the needs of specific agency clientele or as a result of an assigned mission.

Considered as a whole, the aggregation of water resource information sources appears to go a long way toward meeting the needs of the water resources community. Unfortunately, this appearance is deceptive. Because of lack of awareness of the resources available and the lack of knowledge of how to access specific bases, the present system, in fact, is not meeting all the information needs.

At the national level, OMB Circular A-67 provides for coordination of a substantial portion of the water data acquisition and dissemination activities of the federal government. Through a series of voluntary agreements, this coordination is extended to certain categories of data at state and regional levels. No comparable coordinating directive, however, exists for document based information systems. In addition, several areas of water resource related data fall outside the scope of Circular A-67. Data related to water resource issues not adequately covered, or specifically excluded, by Circular A-67 include atmospheric, soil moisture, estuarine and pollution related water data.

Reorganization and fiscal retrenchments have also created problems in the water resources information area, particularly for those most in need of improved services, the unsophisticated and peripheral users. Since this category of user is not normally directly associated with an agency's mission, they are not considered as legitimate clientele by the agency. Information programs serving them are frequently the first to bear the brunt of fiscal cutbacks as agency administrators strive to protect core functions. Some information oriented agencies have not suffered fiscal retrenchment, but have not had infusion of new resources to meet increasing demands.

Recommendations

1. Revise OMB Circular A-67 to include coordination of excluded or neglected water resource related data.

Comment: Water issues are often complex, and resolution requires expertise from a number of disciplines and information from a number of different sources. Coordination of traditional hydrologic water data acquisition and dissemination, particularly quantity and quality (excluding pollution), are adequately addressed by OMB Circular A-67. Atmospheric water data acquisition and dissemination are well addressed by OMB Circular A-62, "Policies and Procedures for the Coordination of Federal Meteorological Services",[31] which reaffirms the central role of the Department of Commerce with respect to basic meteorological services. Other water related data such as soil moisture (primarily acquired by the Soil Conservation Service) and pollution (primarily acquired by the Environmental Protection Agency [EPA]) are not covered by coordinating directives.

Circular A-67 places responsibility for coordination of water data acquisition with the Department of Interior. The U.S. Geological Survey, through the Office of Water Data Coordination (OWDC), has been given the responsibility for implementing this directive. This arrangement does not recognize the preeminence of the National Oceanic and Atmospheric Administration (NOAA), Department of Commerce, in the area of climatological, marine and coastal environmental data, much of which is directly relevant to water resource issues. Circular A-67 also does not recognize the role of EPA in water quality issues and NOAA in marine pollution issues.

The term "coordination" can mean demanding conformity to a single policy (regulation) or bringing together into a common movement or condition (cooperation). In dealing with water related information management, cooperation is the appropriate meaning for coordination. The large number of sources of water information have been developed to meet the different needs of the water community. There is no preeminent or all-encompassing water issue or problem for which the coordination of all water information systems can be regulated. Neither is there a single federal agency with an appropriate mission to serve as the central focus for water issues. In such a climate, coordination in the cooperative sense is the only way in which an effective national water information system can be developed without impairing the specific missions of respective agencies.

A "cooperative" coordination model would imply that the more knowledge water information system managers have of other systems, the more they would try to structure their own systems to avoid unnecessarily duplicating information holdings adequately addressed by others. The present environment is favorable for this model due to

rapid advances in computer technology, particularly with regard to communications between systems.

The evidence collected during this project suggests that a "cooperative" coordination model is functioning to some degree among water information system managers. Interchange of ideas, goals, strategies, plans, etc. is occurring on an informal basis. No clear incentives exist, however, to pursue this interchange to a fully coordinated system. This cooperation will continue to occur with or without any additional formal initiatives, but formal initiatives may remove institutional barriers that prevent development of coordinated systems.

> Action: Circular A-67 should be revised to reflect the shared responsibility of NOAA (Department of Commerce), USGS (Department of the Interior) and EPA in the area of water resource information acquisition, storage and dissemination.

The present areas of preeminence, USGS-water quantity, water quality, hydrology[32]; NOAA - atmosphere, climate, oceans, estuaries and coasts[33]; and EPA - pollution[34], do not greatly overlap. Any revision of Circular A-67, however, must be carefully coordinated with the federal activities presently governed by Circular A-62 to ensure that no diminution of the real time reporting requirememts covered under A-62 occur. Perhaps a reasonable approach would be to have those agencies concerned with activities covered under Circular A-62 and A-67 develop a memorandum of understanding to cover the areas of possible overlap. This could be done prior to considering a revision of Circular A-67.

Despite lack of specific mention of this shared responsibility there is some cooperation and coordination at the working level. EPA's Storage and Retrieval of Water Quality Data System (STORET)[35] is accessible through USGS's NAWDEX. NOAA's National Environmental Satellite, Data and Information Service (NESDIS) is encouraging NAWDEX subscribers to become subscribers to the National Environmental Data Referral System (NEDRES) and is working with USGS to develop a memorandum of understanding to formalize their informal working relations.

2. Develop automatic switching between major water resource related data systems of USGS, NOAA and EPA.

Comment: Our analysis of the present institutional arrangements for water resources information indicates that the aggregate of water resource information resources provides fairly comprehensive coverage of the water resource field. However, individuals desiring to access this information gain an impression of fragmentation and unnecessary duplication because, with few exceptions, each system must be accessed independently.

At the Federal level, three agencies, USGS, EPA and NOAA, maintain extensive water related information systems that complement each other and together cover a wide range of data needs. EPA's STORET maintains data files primarily on water pollution and water quality. NOAA's NEDRES provides referral to extensive environmental data files, while USGS's NAWDEX provides referral to many water related data bases and actual access to USGS's WATSTORE[36] and EPA's STORET. No direct linkages exist, however, between STORET and NEDRES or NEDRES and NAWDEX, and STORET users cannot access NAWDEX directly. A direct linkage between NAWDEX and NEDRES is being explored at the system level.

> Action: Provide automatic switching capability between STORET, NAWDEX and NEDRES so that users with access to one system can access the information in the others. (NAWDEX users can now access STORET information).

Implementation of this action would meet two of the major complaints from water data users that surfaced during Phase I, i.e. "there is not enough estuarine or coastal data" and "there is not enough information on water quality." When justification or support for these statements was sought, it was discovered that the individuals were just not aware of the information because it resided in unfamiliar data bases. The individuals making the comments usually were familiar with at least one of the three major systems (STORET, NAWDEX, NEDRES). If this recommendation were to be successfully implemented, consideration could be given to providing the same type of switching for other less extensive federal water data bases.

An alternative to developing switching between systems is to develop a separate system which provides access to a number of data bases. Many on-line information vendors provide direct access to a number of different bibliographic data bases.[37] The Chemical Substances Information Network (CSIN) managed by the Council on Environmental Quality (CEQ)[38] is a sophisticated system that provides access to a number of independent data bases in a way that a CSIN user requires no prior knowledge of, or training on, the independent systems. A system similar to CSIN for water, however, was considered too costly to be included under this option.

3. Establish selected Centers of Competence under the direction of the Water Resources Scientific Information Center (WRSIC).

Comments: In 1967 WRSIC initiated its Center of Competence program to provide the principal source of abstracts for its information base. At its fullest development, 20 Centers of Competence were providing about 80-90% of WRSIC's abstracts.[39] [40]

This system provided very high quality abstracts with comprehensive coverage of the water resources literature. There was some duplication

in the articles abstracted, but this was acceptable since different centers highlighted different points. In the late 1970's, WRSIC, because of change in management and funding cuts, ceased supporting the Centers of Competence and funded preparation of abstracts through competitive contracts. The present arrangement has the advantage of a lower cost per abstract and the abstracts have a more generalist orientation. These advantages have been gained, however, at the cost of quality and selectivity, i.e. an abstract prepared by a Center of Competence focusing on water resource economics would probably be much more valuable to a water resource economist trying to determine if the material in the article were relevant to his/her needs than an abstract prepared by a generalist.

Several of the Centers of Competence had developed into Information Analysis Centers with the capability of answering questions, suggesting solutions to problems and producing "state-of-the-art" papers in their areas of competence. This capability was also lost to WRSIC with the cessation of support.

The Center of Competence program supported by WRSIC should not be confused with EPA's Centers of Excellence program which funds eight cooperative research programs at U.S. universities. Each of the centers focuses on some aspect of pollution or pollution effects. These programs have research as a primary focus but include some elements of technology transfer. Several of the centers deal with some aspects of water research while two, The National Center for Ground Water Research, at The University of Oklahoma and The Marine Science Research Center at The University of Rhode Island, have a major water orientation.

The potential for WRSIC Centers of Competence in the area of information dissemination and transfer are great.[41] The cost of reestablishing the entire Center of Competence program may be prohibitive, and it is not certain that reestablishment of all the centers can be justified by need. However, a program in which a carefully chosen set of Centers of Competence focused on high priority water resource issues would provide specialized information resources for a reasonable cost. Incorporation of a "sunset" provision, i.e. periodic review with the requirement to make a positive decision on continuation of support, would ensure that this program only addressed those areas most in need of increased information resources.

This study has not attempted to develop a priority ranking of all water resource areas which could benefit from designation of a Center of Competence. However, areas which appear to be of immediate or emerging concern at this time include interbasin transfer, ground water contamination, and institutional water issues.

Action: Provide additional funds to WRSIC to support up to 5 Centers of Competence.

These Centers of Competence shall deal with issues of present or emerging priorities. The centers should have the responsibilities of abstracting reports and preparing annual state-of-the-art and issue papers in their areas of competence.

Funding could be cost-shared with a host organization with specific interests in the water resources area. Initial agreements should be for a fixed number of years, with a periodic review to determine if continuation is warranted. A reasonable federal funding level for each Center of Competence should be $100-150 thousand/year.

4. Establish a water research information system dealing with current research in progress within the Water Resources Scientific Information Center.

Comment: A good research-in-progress information system serves several important functions such as bridging the gap between completion of research and publication of results by providing a pointer to the information source (investigator); promoting efficient research planning by providing pointers to potentially unnecessary projects; and enabling investigators to discard inappropriate approaches by providing early input into project planning.

Attempts to develop a catalog of federal research projects have been underway for almost three decades[42]. This activity did not have a "high" standing in overall federal agency priorities, however, and compliance in early years was spotty for all areas of research, including water. Dissemination of information on research-in-progress was primarily by hard copy. However, the time involved in producing hard copy resulted in out-dated information. From 1967 to 1978 WRSIC published an annual Water Resources Research Catalog using research descriptions obtained from the Smithsonian Science Information Exchange (SSIE), the major national source for information on research-in-progress at that time. From 1978 to 1981 the Water Resources Catalog was maintained on-line as part of the Department of Energy's Remote Console On-Line Bibliographic Data System (RECON)[43].

Since the abolishment of SSIE in 1981, a research-in-progress file has been maintained by the National Technical Information Service (NTIS). Reporting, however, is voluntary, and only nine agencies regularly submit information. In addition, there is no indexing specific to water resource subjects. Many users have stated that their needs for research-in-progress information on water resource issues are not being met.

Other agencies concerned with tracking research-in-progress in their areas of concern have established independent systems for this purpose. The U.S. Department of Agriculture (USDA), for example, supports the Current Research Information System (CRIS) for agriculture

research[44]. This system is accessible through the DIALOG Information Services, an on-line information vendor.

Action: Provide additional funding to WRSIC to develop an effective water research information system to provide current information on water related research-in-progress.

To support this activity, submission of descriptions of water research projects conducted or funded by federal agencies should be required (possibly through an OMB Directive or legislation) and voluntary submission from other sources should be encouraged.

The system developed should be made widely available to the water community by inclusion in on-line systems such as RECON and DIALOG.

5. Improve the capability of the National Referral Center in the Library of Congress to perform the functions of a water resources information referral center.

Comments: The National Referral Center (NRC), an independent division of the Library of Congress, is a free referral service which directs those who have questions concerning any subject to organizations that can provide the answer. It is a direct descendant of the National Referral Center for Science and Technology developed by the National Science Foundation in 1962. At the present time the NRC uses a subject-indexed computerized file of more than 13,000 information sources. Approximately 1100 of these information sources deal with some aspect of water.

The NRC file is accessible at the Library of Congress through computer terminals located in various reading rooms, to Members of Congress and their staff, to the Congressional Research Service and to many Federal agencies through the Department of Energy's RECON system.

A staff of 6 subject specialists is responsible for handling inquiries. At the present time none of the specialists are specifically trained in water resources. These six specialists responded to 3,000 inquiries in 1981. In 1984 they expect to respond to 18,000 inquiries.

Several items have been identified which limit the NRC from fulfilling the function of a National Water Referral Center:

- The present staff is completely saturated with inquiries at the rate of 18,000 per year.

- NRC does not conduct a continuing, active public information program, so many potential users are unaware of its services.

- The present search software is outdated and does not allow for full text searching i.e., searching the description of the information source as well as the title and descriptor fields.

- Registration of information sources is voluntary.

Actions:

A. Add an information specialist with post-baccalaureate training in a water resource related field to the section of the NRC which handles inquiries.

B. Require registration with the NRC of all federal or federally supported water related information resources. (This action might be included in revision of OMB Circular A-67).

C. Provide additional funding to the NRC to modernize the software used for file searching to allow full text searching.

D. Provide an additional staff member to the indexing and cataloging section to assist in updating of information and locating additional water related information resources in the non-federal sector.

E. Make provisions for the NRC file to be offered through a private on-line information services vendor.

6. Improve the capability of the Congressional Research Service to respond to water related questions from Congress.

Comment: The Congressional Research Service (CRS) is mandated by Section 321 of the Legislative Reorganization Act of 1970 (2 USC. 166) to provide Congress with objective analytical research and reference assistance in support of its legislative, oversight and representative functions.

There is no specialist designated for water issues in CRS. Over the years the workload in the field of water resources has been so heavy that the senior specialist in Engineering and Public Works in the Environment and Natural Resources Policy Division has devoted almost full time to water issues. This position has been vacant since May 1983.

In addition to responding to direct inquiries from Members of Congress and their staff, CRS specialists develop Issue Briefs and Mini-Briefs on topics of high interest. The Issue Briefs, which define and present background on an issue, are 8-12 pages in length and include policy analysis, legislative highlights, notes on hearings and committee reports, a chronology related to the issue and a bibliography. These

Issue Briefs are updated as legislative activity warrants. Mini-Briefs are 3-5 page overviews of a topic with limited analysis and are updated as activity warrants. Both of these types of briefs are available to Members of Congress and their staff through video screen receivers in Member and staff offices.

Action: Add a senior and a mid-level specialist to CRS to specifically deal with water issues.

This action will provide Congress with a focus in CRS for inquiries on water issues. More important, it will allow CRS to develop Issue Briefs and Mini-Briefs on topics related to water issues as is done in other areas by designated specialists. These CRS staff additions should provide adequate support to Congress on water issues.

Critical Review

Maintaining current institutional arrangements with additions of improvements has certain advantages:

- The current institutional arrangements have developed to meet certain needs; these needs will still be met.
- The current institutional arrangements are included within present budget levels. Although there have been some reductions in service because of budget reductions, the basic services will still be provided.

The principal disadvantage of maintaining the current institutional arrangements is that those groups desiring information on water needs who are now dissatisfied (unsophisticated and peripheral users: local and regional public interest groups; concerned citizens; etc.) will probably remain dissatisfied. The only recommendations likely to be helpful to unsophisticated and peripheral users are the recommended staff increase for the National Referral Center and the Congressional Research Service.

Several of the recommendations under this option specifically deal with integration and coordination of water resources information activities. If the users of the three major data bases identified in this analysis (STORET, NAWDEX, NEDRES) can access the other data bases through the one which they use regularly (as STORET can be accessed through NAWDEX) a major step towards integration will have been made.

This option is relatively inexpensive. Personnel will be required to augment the National Referral Center (1), the Congressional Research Service (2), WRSIC (1), and increased appropriations will be needed to establish Centers of Competence ($100,000/center) and develop software for the switching between systems ($1.2 - $1.5 million one-time charge).

Cost effectiveness is a relative matter. Fiscal Year 1984 water data acquisition activities were estimated at $109 million[45] and Fiscal Year 1985 activities at $136 million[46] by the Interagency Advisory Committee on Water Data. This figure does not even include data acquisition activities of several agencies not included in the Federal Plan for Water Data Acquisition. What is the value of this information, or probably more important, the cost of missing or unavailable information? No estimate of this was located during the course of this study. The appropriate cost to the federal government to provide easier access to existing information to the general public and those not presently familiar with water information resources is an issue which can appropriately only be determined by Congress.

Maintaining the present institutional arrangements with some modifications would provide some improvements to the present system. The improvements will not, however, be significant to those unfamiliar with the present system who complain of lack of information. Their dissatisfaction will generate some negative political and social costs. On the whole, however, selection of this option will have very little impact in terms of political, social, or economic costs and benefits.

The impacts of this option on current federal activities also will be relatively small. No major changes are proposed, but the recommendations should make the present system more efficient.

This option will not provide any direct incentives for the private sector, although there is the possibility that private sector information clearinghouses will develop in some areas of water information or water issues where a profit is possible or where the level of concern in the public sector will support such an activity through contributions or philanthropy.[47] [48]

This option will probably be supported by the Federal agencies presently active in the water information field. There may be some resistance to modification of OMB Circular A-67 because of concern with upsetting working relationships that have developed over a number of years and the possibility of "turf" battles if present arrangements are changed.

Those constituencies which are dissatisfied with the present institutional arrangements will not support this option as the sole response to their complaints. Few, if any, of the specific recommendations should generate any major negative criticism.

The actions recommended under this option could be implemented even if the option for a National Water Information Referral Center or the National, Regional, State Water Information Clearinghouse System is supported.

OPTION 2: NATIONAL WATER INFORMATION REFERRAL CENTER

This option proposes the establishment of a National Water Information Referral Center (NWIRC). The Center will serve as an initial point of contact for individuals seeking documents or data on water resources. The Center will identify sources of documents and data in both the public and private sector, and direct persons or organizations desiring information on water resources to appropriate sources. In addition, the NWIRC will provide limited bibliographic services such as identification of appropriate documents on water issues.

Description

As noted in the overview, referral centers limit services to suggesting sources of information likely to satisfy clients. By limiting themselves to this, referral centers avoid duplicating the services of primary information sources.

An information source is usually defined as an entity able and willing to supply information in response to requests. As a general principle, a referral center's files are limited, at least in the initial stages, to institutionalized information sources such as data centers, document centers, archives, specialized libraries, etc.[49] As a referral center matures, its files may include appropriate specialists who are in a position to serve as information sources. However, care must be taken not to saturate individual specialists or include incompetents.

A National Water Information Referral Center will provide an initial point of contact for individuals or organizations desiring information (both documents and data) on water issues. The Center itself will not serve as a repository for water documents or data, but will draw upon catalogs and indices of the type, extent and accessibility of information held by other organizations and individuals.

Establishment of a National Water Information Referral Center recognizes the existence of extensive document and data collections held by public and private organizations at international, federal, regional, state, and local levels, which form an unstructured and unorganized national water information system. At the same time, however, establishment of a National Water Information Referral Center recognizes that there is no single source of information that meets the needs of all individuals or organizations dealing with water resources.

Existing information systems have evolved to meet the needs of a selected clientele. The clientele served by these systems are usually familiar with the resources they use. The National Water Information Referral Center will primarily serve individuals or organizations looking for information outside of their usual sources (peripheral users) or non-technical audiences searching for information (unsophisticated users). The primary purpose of the NWIRC is to help clients save time and expense by pointing the way to the appropriate sources of information.

To respond to inquiries, personnel at the Center will query existing referral systems such as the National Referral Center (available through RECON), NAWDEX, NEDRES, and the United Nations' Environmental Information Referral System (INFOTERRA). The NWIRC staff will use on-line access, where available. If on-line access to a system is not currently available, NWIRC will negotiate interagency agreements permiting such access and will undertake or contract for appropriate telecommunications and software support as necessary to provide linkages.

This approach is compatible with the current operating philosophies of the two major referral systems for water related information, NAWDEX, operated by the U.S. Geological Survey, and NEDRES, operated by the National Oceanic and Atmospheric Administration. Operators of both of these systems encourage the establishment of state or regional service centers which serve as access points to the systems. The NWIRC would function as another service center, but on a national level.

The NWIRC will actively seek out sources of information in the private and public sector through surveys and interaction with professional groups, industry associations, etc. Information sources that are located will be described and submitted to an appropriate existing referral system (NAWDEX, NEDRES or NRC) for inclusion in their data bases. This will avoid the establishment of a duplicative information base.

A special study section will analyze requests for information and work with primary producers, managers and users of information to identify information gaps. As pointed out by the United Nations Educational, Scientific, and Cultural Organization (UNESCO), "a referral center can serve at the national level as an instrument for information policy by consolidating operational experience and user comments into useful evaluation and statistics on the operation of the national information system. Governmental and other decision-makers can ultimately make use of this information to help improve the overall system and its components."[50]

The NWIRC as proposed in this option includes an additional element not found in strict referral systems. A capability to provide limited bibliographic services (identification and screening of documents) is

recommended primarily to serve information seekers who are interested in the background or status of a water issue.

This option also includes the establishment of an Advisory Board made up of representatives of federal agencies with major water responsibilities (USGS, EPA, NOAA, NRC, USDA, Corps of Engineers, etc.), the water research community, local and state governments, corporations, consulting engineers, and public interest groups. Non-federal representatives will be appointed by the head of the agency responsible for operating or funding the NWIRC.

The major functions of the Board will be to provide initial guidance on policy and monitor effectiveness of the organization. Additionally, the Board will have the responsibility of reviewing and approving an annual report on the status of the national water information system prepared by the NWIRC staff.

Functions

The functions of the National Water Information Referral Center will be to:

1. Develop an information retrieval system that will enable staff to direct clients efficiently and accurately to appropriate sources of information on water and water issues.

2. Locate water information sources not presently listed with the existing national referral systems such as NAWDEX, NEDRES, and NRC, and provide appropriate descriptions of the unlisted files to the managers of these systems.

3. Evaluate the adequacy of the national water information system and develop recommendations to improve or expand the system as appropriate on an annual basis.

4. Encourage, through workshops, seminars, publications, etc. standardization of terminology, units of measure, sampling technique and analytical methodology where such standardization will make water information more available and useful to a wider number of users.

5. Provide limited bibliographic services in response to user requests for information. These services will consist of locating and screening documents relevant to the issue and providing a list of appropriate documents to the client.

Institutional Arrangements for a National Water Information Referral Center

Implementation Requirements

Organizational Plan. The National Water Information Referral Center should be organized as a self-contained unit, housed by a federal agency or not-for-profit or private contractor. If a federal agency is used there must be some provision to ensure independence from the mission driven orientation of the agency. Possible host agencies include DOI, Library of Congress, CEQ, DOC, universities or private organizations such as the Center for Environmental Information, Inc.

Initial guidance will be set, and continuing performance monitored by a broadly representative Advisory Board. Board membership should include representatives of federal agencies with major water responsibilities (USGS, EPA, NOAA, NRC, USDA, COE, etc.), the water research community, local and state governments, corporations, consulting engineers and public interest groups.

Facilities. No special facilities are required. Adequate office space for staff appropriate for interaction with the public is a minimal requirement. Space for terminals, personal size computers, word processing equipment, duplicating equipment and a small working library will also be needed.

Required Capital Expenditures. None are required. Leasing costs of personal computers, terminals, telecommunications, printer, copying equipment as well as software/development costs (through contracts) will be required.

Criteria for Site Selection. The NWIRC should be established in Washington, DC or its vicinity given the number of federal agency representatives on the Advisory Board.

Other criteria include:

a. adequate telephone service for computer communications

b. good postal service

c. accessibility to good air service

d. proximity to a library strong in the water field (if bibliographic services are a major effort)

e. co-location with the National Water Resources Research Center or the Water Resources Research Institute proposed in the research section of this report. (This would provide some advantages, particularly for the professionals in the Research Center).

Schedule for Implementation. Because of the existence of the National Referral Center, NAWDEX and NEDRES, which contain a number of water or water related information sources in their files, the NWIRC could begin functioning as soon as it could gain access to these systems.

0-6 mos: Hire staff, appoint advisory board, staff initiate negotiations with major federal referral systems. Board develops initial policy guidance. Staff develops plan for initiating services and develops public information plan to complement plan for initiating services.

6-18 mos: Implement plan for initiating services. Implement public information plan. Complete negotiations on all memoranda of understanding and other agreements. Issue first annual report on the status of the national water information system. Revise OMB circular A-67 to reflect existence and responsibilities of the NWIRC. Become fully operational at the end of 18 months.

Constraints on Development and Operation. The main constraints on development will be:

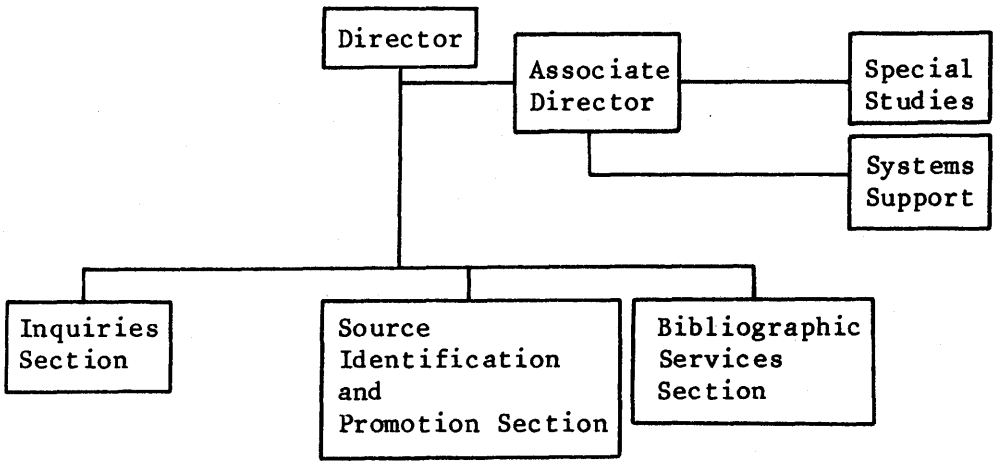
a. Concern about overlapping responsibilities with existing organizations that perform some referral services as part of their overall function. This will be resolved with development of memoranda of understanding which highlight the role of the NWIRC as an initial contact and/or additional assistance center for potential users.

b. Suspicion of a new entity in what is generally considered a mature field. This will be overcome partly through representation of major interest groups on the Advisory Board and signing of memoranda of understanding and operating agreements, but primarily by efficient and effective operation of the referral center.

c. Lack of awareness of the organization and its function. This can only be overcome by an agressive public information and education program oriented primarily to underserved groups (unsophisticated and peripheral users) and the water community in general.

Operational Characteristics

Administrative Structure.



The Director is responsible for overall operations of the organization and for liaison with federal water oriented agencies.

The Associate Director is responsible for directing special studies on usage, needs, gaps and the development of the annual report on the national water information system. In addition, he/she is responsible for activities such as software development which support the three functional sections.

The Inquiries Section will handle all requests for information services.

The Bibliographic Section will handle all requests for bibliographic services.

The Source Identification and Promotion Section is responsible for locating sources of information not presently listed with one of the existing referral systems and developing and implementing a plan to inform the mainline and peripheral water community of the availability and functions of the NWIRC.

Relationship to Other Organizations. Relationships with other organizations will be clarified by memoranda of understanding with federal agencies and appropriate agreements with non-federal entities. Since the Board has representatives of principal federal water agencies, and no new information systems are envisioned, no major conflict is apparent. Although some agencies do provide referral as part of their overall service, this is not seen as a conflict, because those agencies encourage establishment of external service centers.

Operating Costs. $1.2 - $1.8 million

Funding Sources. Funding will be provided by Congressional appropriations and limited recovery of user fees from bibliographic services in accordance with the provisions of OMB Circular A-25 "User Charges."[51]

If user charges are to play a part in funding of the National Water Information Referral Center, care must be taken to ensure that funds collected are available to the Center and not returned to the Treasury. User fees will not, however, probably provide substantial revenues for the NWIRC. Traditional federal practices waive user fees when the cost of collecting would be a substantial portion of the total fee; when it is considered in the best interest of the nation to provide the widest possible diffusion of knowledge; or when the requester is engaged in government or non-profit work for the health, safety or welfare of the nation.[52] It would be expected that the NWIRC would follow these traditional practices since the major rationale for establishment is to meet the needs of underserved users.

Fiscal Accountability and Budget Controls. The agency which hosts or contracts for the operation of the NWIRC will be fiscally accountable. The budget will be developed by the Director with advice from the Advisory Board.

Nature of Scientific Accountability. Principle scientific accountability will be provided by the Advisory Board. In addition, the Board will be expected to arrange for outside expert and peer review of the NWIRC staff activities.

Staffing Structure

Director (1) (permanent)
Associate Director (1) (permanent or exchange)
Assistant Directors (3) (permanent or exchange)
Inquiry Specialists (2-4) (2 permanent, 2 exchange)
Source Identification Specialist (1) (permanent)
Public Information Specialist (1) (permanent)
Bibliographic Specialist (1-3) (1 permanent, 2 exchange)
Clerks (2) (permanent)
Contract personnel (3-6 full time equivalents) (as required for software/linkage development)

Staff Size. 15-22

Disciplines of Staff

- Director - broadly knowledgeable on water and water issues, senior level.

- Associate Director - broadly knowledgeable on water and water issues, mid to upper level. It may be desirable to have this and

other positions filled on an exchange basis to bring NWIRC to full capability with regard to the agency from which the exchange personnel are drawn.

Either the Director or the Associate Director should have familiarity with information management or information systems.

- Assistant Directors - trained in a water related discipline with broad operational experience in water issues and mid-level management.

- Inquiry Specialists - trained in some branch of water resources with familiarity with information resources.

- Source Identification Specialist - trained in some branch of water resources with familiarity with information resources.

- Public Information Specialist (or Educational Specialist) experienced in developing public education or awareness programs, preferably with some experience or training in a natural resource field so that prospective clients will view individual as a peer.

- Bibliographic Specialists - trained or experienced in both water resources and library science.

- Clerks - familiar with computer data entry and computer based word processing systems.

Critical Review

A major advantage of a National Water Information Referral Center is that it provides a marked improvement in the present system for locating water resources information. Since the Center is not bound by a single water mission, it is free to refer to information services over the full spectrum of water issues. The NWIRC will also be in a unique position to identify those information needs that are not being met by the existing system because the subject area may fall on the periphery or outside of an agency's mission.

This option will remedy the lack of a single point of access for water information. This advantage far outweighs the slight disadvantage of duplicating some of the referral functions of the existing water oriented information systems such as NEDRES and NAWDEX. The concentration of the NWIRC in the area of water will provide more focused and appropriate referral than is possible from a general referral center such as The National Referral Center.

The NWIRC provides a natural focus for integrating, coordinating, and augmenting other water information activities. This option draws heavily on established information sources. It specifically supports

the current operating philosophies of both NEDRES and NAWDEX of encouraging development of assistance centers, thereby freeing system personnel to focus on the completeness and accuracy of their systems. The inquiry section of the NWIRC will also seek out new information sources on a continuing basis and provide descriptions of these sources to appropriate existing information systems (thereby enhancing their completeness and accuracy).

Existing water professionals are fairly well served by the present water information systems. The NWIRC will not measurably improve their access to information. The principal constituency of the NWIRC will be the unsophisticated and peripheral users who are not being served. In order for this augmentation of the present system to meet the needs of this underserved group, the NWIRC must become known to the full range of the water community. An effective public information and education campaign must be developed to reach public officials at all levels of government, public interest groups, consulting engineers, part time or peripheral water professionals, the general public and the water community at large.

This option is cost effective in that it draws upon existing data bases through on-line access rather than developing a separate water information referral data base. The presence of the NWIRC should enhance the cost effectiveness of existing water information sources by screening out inappropriate inquiries thereby allowing the information source staff to concentrate on relevant questions.

This study did not attempt to develop a specific estimate of the number of requests that can be expected to be made of the referral system. Such a number would of course be greatly influenced by the success of the public information and education effort. Estimates of usage based on inquiry rates to present information clearinghouses range from 300-1000 inquiries in the first year. We would expect this to increase threefold when the Center becomes known.

The political, social, and economic costs and benefits of providing increased access to existing information sources has not been specifically quantified for the water resources field. However, if one considers that management of water resources was estimated to exceed $50 billion in 1977[53] the costs for not providing access to appropriate information should far exceed the costs of providing the access.

The establishment of an effective, functioning National Water Information Referral Center should postively impact federal water information activities and enhance the quality of management decisions. As more unsophisticated and peripheral users of water information are made aware of information sources, usage of these sources should increase. The screening function of the NWIRC should ensure that this increased usage is appropriate. Information systems that are presently saturated may, however, become overloaded and require additional

resources to function effectively. This possibility must be carefully monitored to ensure that agencies are able to carry out information responsibilities without reduction of primary mission performance.

The NWIRC may provide some incentives for private sector efforts through increased usage of private information resources, and through contracts for system support, bibliographic services and possibly full operation of the Center.

Major opposition is unlikely even from those federal agencies operating water related referral systems, particularly since the NWIRC makes use of these systems. The National Referral Center is presently saturated with requests for information (an estimated 18,000 this year). A special center for water referral should provide them needed relief. Both NAWDEX and NEDRES, the other major federal data bases providing referral services, encourage the establishment of assistance centers to increase access to their files. The NWIRC would be a national assistance center.

The only opposition should be from those who feel a referral center does not go far enough in meeting their information needs. The addition of a limited bibliographic capability to the NWIRC may reduce some of this opposition.

Support for this option should come from a wide range of users, particularly those with the capability of synthesizing and analyzing information but who have difficulty gaining initial access to this information.

OPTION 3: NATIONAL, REGIONAL AND STATE WATER INFORMATION CLEARINGHOUSE SYSTEM

This option proposes the establishment of a national and state clearinghouse system with regional centers in those areas with compelling need and a common bond among states to obtain information for clients, provide information synopses and analyses of water resource issues, and develop a statement of research needs based upon a function of requests to the clearinghouses.

Description

National water resource issues or problems are largely an accumulation of local, state and regional issues on which political attention becomes focused at the national level. Since the need for information on a particular water resource issue is likely to be greatest at the level on which that issue impacts, water information clearinghouses should also be organized as much as possible on that basis. Thus, an effective system of clearinghouses would include not only a national level clearinghouse, but also clearinghouses at the state level that perform similar dissemination, summarization and synthesis functions for state and sub-state information. In addition, there are some areas of the country where several states recognize that they share important region-specific concerns that transcend their state boundaries. These are areas in which regional clearinghouses might be appropriate.

In the course of our study we determined that three regions clearly warrant establishment of regional water information clearinghouses.

a) The Great Lakes Region which confronts interstate, interbasin and international issues of water quality, water supply and water transfer.[54]

b) The states of the West and Southwest which confront similar serious problems of aridity complicated by unresolved issues like Indian water rights and exacerbated by increasing population and industrial growth.[55]

c) The region of Chesapeake Bay and tributaries which has been recognized by the states of Maryland, Virginia and Pennsylvania and the federal government as an area with problems that transcend the boundaries of any single state and which must receive attention because of its national importance.[56]

Other areas may also warrant establishment of regional information clearinghouses. There was no clear consensus, however, among

participants in this study (consultants, interviewees) or in the literature, as was found for the three areas above.

One part of the rationale for this clearinghouse system is that merely referring inquiries to data bases and document collections (as in Option 2) is often insufficient. Although highly specialized professionals working in their own area of expertise may be satisfied with this, many unsophisticated users are overwhelmed by the volume and complexity of the material available. They want (and often need) more service from an information system such as direct provision of selected (screened) data and documents, synopses, summaries and unbiased reports which identify and clarify issues. The peripheral user (the professional requiring information outside his or her field) often needs special assistance in obtaining peripheral information and applying it to particular needs.

Another part of the rationale for the system of clearinghouses is that water experts at both national and state levels suggest that data and information needed for synthesis are available to them, but that they must obtain these materials from a variety of organizations and locations. According to these individuals, adequate materials and competent personnel often exist, but no one entity exists that permits ready access to them all.

Lastly, the clearinghouses would be in an ideal position to identify emerging information needs at their respective level and, hence, to make an important contribution to the identification of water related research needs and to assist in the development of water research goals and plans.

Mission agencies at all levels tend to focus on those issues identified in the past and those for which they have institutionalized approaches, if not solutions. They may well identify new research needs and respond to them, but these tend to be within the domains with which they are already familiar or which are their responsibility by legal mandate. Clearinghouse personnel, by contrast, must respond to information requests from diverse sources. What questions keep recurring for which they find no answers? What issues arise on which the information is insufficient? Such questions and issues would indicate the existence of information gaps. Filling such gaps may either require a new synthesis of existing information or new research.

This national/regional/state system recognizes that many water resource problems have their principal impact at the state and regional levels. It provides a focal point for information, analysis and research planning at the levels at which policy and implementation can be most effective. While doing this it provides a mechanism whereby the accumulation of state and regional issues which generate national issues can be addressed in a rational manner. This was part of the rationale for creation of the state water resource institutes in the mid-1960's.

No formal infrastructure however, was provided for a coordinated regional approach to research or technology transfer within this program. In some parts of the country, however, ad hoc regional approaches to common water resource issues have been developed by state water institutes. Title II River Basin Commissions formed under The Water Resources Planning Act of 1965 did provide a forum for addressing regional issues. A number of institutional weaknesses led to the demise of this program in 1981.[57] New State sponsored regional water organizations are being established which are better equipped to meet multi-state needs.[58]

A national/regional/state water information clearinghouse system would provide an information resource for these emerging organizations and ad-hoc regional state water institute activities.

Federal legislation creating the national/regional/state clearinghouse system should have a sunset provision requiring an in-depth evaluation of the system within four years and at periodic intervals thereafter. Positive action by the Congress based on that evaluation would be necessary for the system to continue. The evaluation should include (but not be limited to) consideration of whether there is sufficient use of the system to justify its cost and whether or not technological advances in telecommunications and computers have made the system obsolete or unnecessary. The legislation should also make provision for periodic peer and expert review of each clearinghouse, utilizing a process similar to that for state water resources institutes established by Section 104(e) of PL 98-242.

This option also includes the establishment of a national Advisory Board made up of representatives of federal agencies with major water responsibilities (USGS, EPA, NOAA, NRC, USDA, Corps of Engineers, etc.), the water research community, local and state government, corporations, consulting engineers, and public interest groups. Non-federal representatives will be appointed by the head of the agency responsible for operating or funding the National Water Information Clearinghouse.

The major functions of The Board will be to: set policy regarding preparation and issuance of issue identification and clarification reports; advise Congress on the creation of additional regional clearinghouses beyond the initial ones established; issue an annual report on water related information gaps and perceived research needs; and monitor the effectiveness of the overall clearinghouse system. Appropriate Advisory Boards will also be established for regional and state clearinghouses.

Functions

The clearinghouses at each level will perform a number of similar functions which focus on the needs and issues at that level. There are

some functions, however, distinctive to particular levels or which crosscut the levels.

National Level Functions

1. Operate a clearinghouse for water resources information focusing on national level issues and problems.

The clearinghouse will serve the needs of federal officials and agencies as well as other organizations and individuals seeking water resource related data, documents and other forms of assistance regarding information on national water resource issues. It will perform all the functions of the National Water Information Referral Center described in Option 2 as well as significant additional functions. Like the NWIRC, the staff which operates the clearinghouse will identify existing and newly developing data bases and document collections as well as other water information referral systems; arrange to update information banks for the referral systems; provide tailored bibliographies; identify information gaps, usage trends, etc.; and seek to encourage standardization of measures, definitions and terminology.

In addition, the National Clearinghouse would be responsible for:

a) developing national standards and policies for identifying, archiving and retrieving water resources data and documents;

b) preparing and disseminating periodic summaries of water resources information and the status of water resource problems at the national level;

c) assembling, screening and packaging data on national water resource issues in response to specific inquiries;

d) collecting, screening and transmitting references to documents (and how to obtain them) which pertain to national water resources issues in response to specific inquiries;

e) preparing synopses, based on existing data and documents, which summarize current knowledge on national water resource issues, as requested;

f) preparing reports as requested that identify and clarify issues and explain the characteristics and limitations of the research relevant to the issue.

Items a and b are presently performed to a limited extent by the U.S. Geological Survey through the development of a National Handbook of Recommended Methods for Water Data Acquisition[59] (Item a) and the preparation of the National Water Summary[60] (Item b).

Items c through f above are likely to require substantially more resources than are required for handling the routine inquiries that only involve providing information from other information systems or sources. Thus, priorities will have to be established among users for these services. A possible priority list would be:

1. Members of Congress
2. Federal agencies
3. State agencies and elected officials
4. Other government officials (sub-state and local)
5. Other U.S. citizens

The preparation of issue identification and clarification reports (Item f) is not only a resource intensive task but may likely be fraught with political implications and organizational risk. Thus, the Advisory Board to the National Clearinghouse should develop guidance for handling such reports.

Items a through f may be performed either by the permanent staff of the National Clearinghouse or by other individuals or organizations under contract to the clearinghouse if the topics are particularly complex and require a wide breadth of expertise.

2. Identify and publicize national water resources information and research needs.

The personnel in the National Water Resources Information Clearinghouse can make an important contribution to the development of federal water research goals and programs. Their experience in responding to requests for data, documents and reports on national water related issues is likely to reveal issues or subjects on which current information is either incomplete or non-existent.

In some cases, inquiries may trigger a search by clearinghouse personnel for sources of information on what are, in fact, new issues or emerging problems. Such searches may end successfully with a satisfactory response to the inquirer. However, in other cases, such searches will be unsuccessful or partly successful. These experiences may be indicators of emerging areas in which new research is needed. Analysis of inquiry response patterns, user feedback surveys and other interactions with clearinghouse users will enable the clearinghouse staff to issue an annual report of water related information gaps and perceived research needs. If this report is reviewed, approved and issued by the Advisory Board as a public report to the President, Congress and heads of federal agencies with significant water related responsibilities, it might stimulate research activities to develop needed information.

3. Provide for linkages to and among regional and state level water resources information clearinghouses.

The National Clearinghouse will conduct at least three different kinds of activities directly pertaining to the regional and state level entities.

a) Serve as a lateral conduit of information about problems, issues and projects across the state and regional entities. This will be accomplished through various methods such as conferences, meetings, discussions and temporary personnel exchanges. This will further national level objectives and concerns as well as foster awareness, cooperation and collaboration across state and regional entities on matters of common interest.

b) Assist in developing and improving access to federal information systems by state and regional organizations. During the Phase 1 study a number of local and state water specialists indicated that computer links and other forms of access to federal water information resources are currently inadequate.

c) Advise Congress on the creation of additional regional clearinghouses beyond the initial number established.

Regionally distinctive problems and issues may emerge which would make the creation of additional regional clearinghouses desirable. These needs are most likely to be recognized by the water resource officials and experts within the affected states. These needs are likely to be demonstrated by increased interstate activity and emergence of regional structures. The National Clearinghouse staff would be responsible for monitoring such developments and keeping the Advisory Board informed about them. While the designation of new regional clearinghouses and the appropriation of necessary funds are Congressional responsibilities, the Advisory Board would be responsible for identifying to Congress those regions which would benefit from establishment of regional clearinghouses. In such cases the existing interstate structures would be strong candidates for such federal designation and funding if they had effectively developed linkages to existing information sources and information user groups within the region.

Regional Level Functions

While the regional level entities will replicate some National Clearinghouse functions with regard to the distinctively regional issues and concerns, there will be some important differences in functions, staffing and relationships. Each of the three regional level clearinghouses initially proposed (Great Lakes-midwest, desert-west, and

Chesapeake Bay-east) and others established subsequently by the Congress will:

1) operate a clearinghouse for water resources information (data and documents) to serve the needs of federal, state, regional or local agencies or other constituencies focusing on the distinctive problems of the region;

2) prepare reports utilizing existing data and documents as requested by various entities interested in regional water resource issues;

3) prepare periodic summaries of water resources information and the status of water resource problems of the region.

4) establish regional standards and policies for identifying, archiving and retrieving water resources data and documents that pertain to the distinctive concerns of the region and are not addressed by national policy;

5) serve as a link between state clearinghouses that require information from, and coordination with, other states in the region and as a link between a state clearinghouse and the National Clearinghouse when appropriate;

6) serve as a regional forum for defining and publicizing regional water resource information gaps and research needs; and

7) make periodic assessments and reports on the progress being made towards meeting regional water research goals.

The substantive focus of each regional clearinghouse would be narrower than the National Clearinghouse. Thus, the staffing needs would be smaller than for the National Clearinghouse. Although staffing would likely vary with region, initial estimates of workload would suggest a permanent staff of 4-6 for each regional clearinghouse. Cost of operation might be shared between the federal government and the participating states.

Regional clearinghouse personnel would perform the periodic functions of analyzing inquiry-response patterns and user feedback for evidence of information gaps and research needs on region-specific issues. On the other hand, the relatively small number of regional level mission agencies developing regionally-oriented research programs, suggests a broader role in research planning for advisory boards at this level than at either the national or state levels.

An Advisory Board for each regional clearinghouse should include representatives of each participating state government, representatives of federal agencies with significant responsibilities within the region,

experts on the distinctive water issues of the region, and public members. Obviously, the size and character of the board will vary considerably from region to region.

Each Regional Advisory Board, like the National Board, will issue an annual assessment of information gaps, research in progress and possible research needs based on the clearinghouse's experience. In addition, the Regional Board will be responsible for developing, perhaps every four years, a set of regional research goals and a regional research agenda or plan for the ensuing period. These assessments, goal statements and plans will be in the form of public reports to the governors and legislatures of the participating states as well as the regional officials of all federal agencies with water related responsibilities within the region. The Board itself could provide a forum for development of agreements for coordinated or joint research projects that cut across state boundaries and involve various mixes of state and federal participation. The Board also could approve regional standards and policies with regard to data and documents specialized to that region, user priorities, and a user fee or cost-sharing structure for clearinghouse services. Finally, it would provide policy guidance to the clearinghouse staff for the preparation of issue-identifying and clarifying reports, and it would have the right of review and comment before such reports are released.

In a number of areas the Board's actions will necessarily be subject to consultation with and statutory or appropriations action by the individual state governments and the federal government.

Since regional clearinghouse interests are specialized and since there will not be uniform and complete coverage nationwide by a system of regional clearinghouses, the regional clearinghouse boards would not be an appropriate source for automatic membership in the Advisory Board of the National Clearinghouse.

State Level Functions

Each state level clearinghouse would:

1) operate a clearinghouse for water resources information (data and documents) to serve the needs of state and local agencies or other constituencies focusing on water resource problems at the state or local level;

2) prepare periodic summaries of water resources information and the status of water resource problems at the state and local level;

3) prepare reports utilizing existing data and documents as requested by various entities interested in state water resource issues;

4) serve as a forum for defining and publicizing state and local water research needs;

5) track research in progress and make periodic reports on the progress being made toward meeting the state water research goals by state and local agencies; and

6) provide representation to the advisory board for any appropriate regional clearinghouse.

It is tempting, for reasons of symmetry, simplicity or standardization, to give the university-based state water resources institutes these functions and additional resources to perform them. The idea of a single integrative state-wide water information source was part of the rationale for their creation in the mid-1960's, and PL 98-242 provides for their continued funding and operation.

However, the diversity among the states as well as sensitivity regarding federal intrusion on areas of state authority conditions the pattern proposed for implementation at the state level. Water resource issues of importance differ greatly from state to state, as does the perceived intensity of water resource related problems. There also are variations in the amount of water resource expertise within state government agencies, in the universities, and in other organizations within the states and in the organizational structures that different states have chosen for water resources management and research.

Across the fifty states there is also great variance in the stage of development and the structure of state and substate water resources data bases, document collections and information systems.[61] In a number of states, water resources institutes carry out the first five functions listed above. However, in other states the institutes are relatively inactive or have not established close working relationships with water resource managers and decision makers. In some states effective information systems and referral networks have been developed that merge water related information with that on other natural resources.[62] Different state agencies often have sole or shared statutory responsibility for periodic reports about water resource information, for assessing the status of water related problems, for establishing water research goals and programs, and for tracking water research in progress.

Since the situations are not uniform, a uniform model for information clearinghouses for all fifty states would be inappropriate. It is appropriate to defer to the legislature or governor of each state the discretion to designate the organization(s) or agency(ies) which will carry out the functions of a state water resources information clearinghouse as well as the membership and duties of an advisory board for that clearinghouse. (If a water resources institute was designated,

its advisory board could also serve as the clearinghouse advisory board.)

Federal funds to support the clearinghouse should be provided on a matching basis. Each year's federal funding will be based on approval of the state's plan for implementing its clearinghouse by the Secretary of the federal department housing the National Clearinghouse. The Secretary's approval will be based on his/her judgment that the plan is a reasonable and cost effective way to perform the first five functions described above, that it will not result in a reduction of current state effort in support of such functions and that it was developed in close consultation with principal water resource officials at the state and sub-state levels as well as interested members of the public.

Institutional Arrangements for a National, Regional, and State Water Information Clearinghouse System

Implementation Requirements

The Implementation Requirements for this option are presented in Table 4.

Operational Characteristics

The Operational Characteristics are presented in Table 5.

Critical Review

Many of the advantages and disadvantages discussed under Option 2 (National Water Information Referral Center) apply to this option, particularly the National level entity.

A major advantage of this option over the referral center option is that it provides true one stop shopping for clients. Under the present system, a user normally seeks information from only one or perhaps a limited number of sources. Clients often wonder whether this information is complete and, therefore, adequate for their needs. The proposed clearinghouse system will assure users that they have all the relevant information pertaining to a given issue. This feature will be an asset to both sophisticated and unsophisticated users, but will probably benefit the peripheral user the most.

The provision for services at the state and regional levels provides information resources at the levels at which most water issues arise and are resolved. Clearinghouse personnel at these levels should quickly develop a knowledge of and sensitivity to issues at their level which would make them very valuable resources for managers. With information resource personnel functioning at each level, information should seldom "fall through the cracks" and information provided should be relevant to the issue driving the inquiry.

Extreme care must be exercised in establishing state level clearinghouses to ensure that they do not conflict with present effective water information activities. The probablility of interfering with existing systems on the regional level is not as great since a criterion for establishing a regional clearinghouse is recognition by the states that regional water issues exist that cannot be resolved by individual state efforts.

The National Clearinghouse will have the same role in integration, coordination and augmentation of water information activities as the National Water Information Referral Center (Option 2). The regional clearinghouses, will have an important integrating and coordinating role for regional issues. State clearinghouses will probably play less of a

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TABLE 4

IMPLEMENTATION REQUIREMENTS FOR A NATIONAL, REGIONAL AND STATE WATER INFORMATION CLEARINGHOUSE SYSTEM

	NATIONAL WATER INFORMATION CLEARINGHOUSE (NWIC)	REGIONAL WATER INFORMATION CLEARINGHOUSE (RWIC)	STATE WATER INFORMATION CLEARINGHOUSE (SWIC)
Organizational Plan	Self-contained unit. Host organization: a federal agency or not-for-profit or private contractor. If federal agency, must ensure independence from mission driven orientation of agency. Guidance and policy set by Advisory Board. Board membership includes representatives of federal agencies with major water responsibilities (USGS, EPA, NOAA, NRC, USDA, Corps of Engineers, etc.), the water research community, local and state government, corporations, consulting engineers, and public interest groups.	Self-contained unit. Host organization: existing regional entity, state water agency, state water institute, university, or private or not-for-profit contractor. Advisory Board made up of state agency representatives, federal agency representatives, regional scientific and technical experts, and public interest representatives.	Self-contained unit. Host organization: the state water resources institute, a university, the state water agency, the office operating an existing state resource information system, or a not-for-profit or private contractor (see text for some criteria for selection of host organization). Advisory Board could be an already established board (i.e. a water institute advisory board); it should reflect the water management and planning infra-structure of the state along with local and public concerns and state technical and scientific expertise.
Facilities	No special facilities required. Need normal office space for personnel, terminals, personal computers, word processing equipment, duplicating equipment and room for small working library.	No special facilities required. Need normal office space for personnel, terminals, personal computers, word processing equipment, duplicating equipment and room for small working library.	No special facilities required. Need normal office space for personnel, terminals, personal computers, word processing equipment, duplicating equipment and room for small working library.
Required Capital Expenditures	None. Leasing costs of personal computers, terminals, telecommunications, printer, copying equipment, as well as software/ linkage development costs (through contracts) will be required.	None. Leasing costs of personal computers, terminals, telecommunications, printer, copying equipment, as well as software/ linkage development costs (through contracts) will be required.	None. Leasing costs of personal computers, terminals, telecommunications, printer, copying equipment, as well as software/ linkage development costs (through contracts) will be required.

TABLE 4 (continued)

	(NWIC)	(RWIC)	(SWIC)
Criteria for Site Selection	Probably Washington, D.C. or vicinity, given priority of service to users and number of federal agency representatives on Advisory Board. Otherwise, adequate telephone service for computer communications, good postal service, accessibility to good air service or ground transportation, and proximity to library strong in water resources are necessary. Co-location with the National Water Resources Research Center or the Water Resources Research Institute proposed in the research section of this report may provide some advantages, particularly for the professionals in the Research Center.	Within region, probably at a major Standard Metropolitan Statistical Area (SMSA) or state capital to facilitate Advisory Board access. Otherwise, adequate telephone service for computer communications, good postal service, accessibility to good air service or ground transportation, and proximity to library strong in water resources are necessary.	Within state. At university (if university hosted) or at state capital or other centrally accessible location. Otherwise, adequate telephone service for computer communications, good postal service, accessibility to good air service or ground transportation, and proximity to library strong in water resources are necessary.
Schedule for Implementation	0-6 mos. hire staff; initiate development of memoranda of understanding with major federal information sources and agreements with non-federal resources. Develop plan for initiating services. Appoint Board (Board establishes initial priorities for staff activities). Develop public information plan to generate awareness of services. Develop criteria and procedures for establishing RWICs and SWICs. Initiate contracts for development of linkages and operating software. Revise Circulars A-67 and A-62 to reflect the establishment of the system.	Dependent upon interstate and federal/state negotiations. Once these develop, a schedule similar to that for the NWIC would be reasonable. Implementation must be strongly linked to the NWICs and SWICs in the region.	Variable depending upon state. In states with developed natural resource information systems or with water institutes active in information, the clearinghouse could be implemented almost immediately. Once initiated, implementation schedule should be similar to that for the NWIC. Implementation must be strongly linked to the NWIC.

TABLE 4 (continued)

	(NWIC)	(RWIC)	(SWIC)
	6-18 mos. Implement plan for initiating services. Implement public information plan. Complete negotiations on and finalize all memoranda of understandings. Initiate establishment of RWICs and SWICs. Publish first issue papers. Begin work on first report on information gaps and research needs. 18-24 mos. Issue first annual report on information gaps and research needs. Become fully operational by 24 mos.		
Constraints on Development and Operation	Concern about overlapping responsibilities - will be resolved with development of memoranda of understanding with major federal water information resources and agreements with non-federal sources. The revision of Circulars A-67 and A-62 will be an important factor in removing this constraint. Suspicion of a new entity - will be overcome partly through negotiation and signing of the memoranda and agreements mentioned above but primarily by efficient and effective operation of the clearinghouse. Lack of awareness - an effective public information campaign is the only remedy to this constraint. Proprietary and copyright restrictions on information.	Ability and willingness of states to reach agreements is principal constraint, but since one criteria for establishing a regional clearinghouse is a shared concern of a number of states for problems that transcend state boundaries, this should be a minimal constraint. Willingness/ability to enter into or carry out federal/state agreements on cost sharing, research goals, research plans and projects as well as to agree on content of issue and clarification reports. Adjudicating redistribution of functions in cases where existing ad hoc or interstate agreements or not-for-profit organizations now carrying out functions. Proprietary and copyright concerns, suspicion and lack of awareness.	Interest and perceived value to states/priorities at state level. Concern over host relationship (university/agency differences). Overlap with existing organizations (university/agency/not-for-profit/public interest) providing same or similar services. Proprietary and copyright concerns. Suspicion and lack of awareness.

TABLE 5

OPERATIONAL CHARACTERISTICS OF A NATIONAL, REGIONAL AND STATE WATER INFORMATION CLEARINGHOUSE SYSTEM

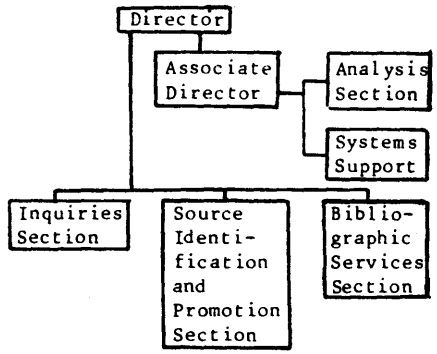
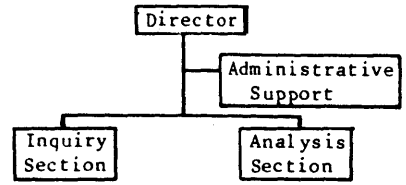
	NATIONAL WATER INFORMATION CLEARINGHOUSE (NWIC)	REGIONAL WATER INFORMATION CLEARINGHOUSE (RWIC)	STATE WATER INFORMATION CLEARINGHOUSE (SWIC)
Administrative Structure			Subject to state plan as approved by the federal agency funding the programs. Would probably resemble structure for RWIC.
Relationship to Other Organizations	NWIC will serve as entry point to existing information systems. This relationship needs to be clarified by memoranda of understanding. Since no new information bases are envisioned, NWIC will not duplicate any agency files. NWIC may replace some of the direct agency-user interactions which will enable the agencies to concentrate on maintaining their systems. As prospective clientele become aware of the responsibilities of NWIC this replacement should increase.	If existing regional entities provide some of the services envisioned for the RWIC, clarification of the role of these entities in light of the RWIC must be established. In the case of state supported entities this should be of minor concern, but there may be resistance from regional not-for-profit/public service groups if not selected as host agency.	Dependent upon selection of host entity. Host entity must demonstrate ability to serve all constituencies within the state.
Operating Costs	$1.8 to 2.5 million per year	$600 thousand - $1 million per year.	$250-$400 thousand / state/ year: $12-20 million nationally/ year.

TABLE 5 (continued)

	(NWIC)	(RWIC)	(SWIC)
Funding Sources	Congressional appropriations and recovery from user fees in accordance with the provisions of OMB Circular A-25 "User Charges."	Federal and state appropriations. Recovery from service fees using criteria similar to guidelines set forth in OMB Circular A-25 and established by the clearinghouse board.	Federal and state appropriations and recovery from user fees in accordance with criteria established by state laws or, in the absence of state laws, criteria established by the state Advisory Board.
Nature of Fiscal Accountability and Control	The agency who hosts or contracts for the operation of the NWIC will be fiscally accountable.	Operate under state or university accounting systems if one of these entities chosen as host entity or a single state can serve as contractor. Board conducts periodic financial review.	State or university fiscal system as appropriate to host agency or contractor. Periodic Board financial review.
Nature of Scientific Accountability	Principle scientific accountability will be provided by the Advisory Board. In addition the Board will be expected to arrange for outside expert and peer review of the NWIC staff activities.	Regional Advisory Board and periodic peer and expert review arranged by the Board.	State Advisory Board plus periodic peer and expert review arranged by the Board.
Staffing Structure	Director (1) (permanent); Associate Director (1) (permanent or exchange); Assistant Directors (3) (permanent or exchange); Research Analysts (4) (2 permanent, 2 exchange); Information Systems Analyst (1) (permanent); Inquiry Specialists (2-4) (2 permanent, 2 exchange); Source Identification Specialist (1) (permanent); Public Information Specialist (1) (permanent); Bibliographic Specialist (1-3) (1 permanent, 2 exchange); Clerks (4) (permanent); Contract personnel (3-6 full time equivalents) (as required for software/ linkage development).	Variable, subject to regional needs, but normally: Director (1) (permanent) Inquiry Specialist (1) (permanent) Research Analysts (1-2) (1 permanent, 1 exchange) Clerk (1) Outside contractors/ consultants as required for information system development and maintenance.	Subject to state plan but probably a Director with other responsibilities, a full time Inquiry Specialist, a full time (or several part time) Analyst(s), a Clerk for administrative support and outside contractors/ consultants as required for information system development and maintenance.

TABLE 5 (continued)

	(NWIC)	(RWIC)	(SWIC)
Staff Size	19-23 3-6 contract personnel.	4-5/clearinghouse. Contract personnel as needed.	2 1/2 - 4/clearinghouse. Contract personnel as needed.
Staff Disciplines	Director - broadly knowledgeable of water and water issues, senior level. Associate Director - broadly knowledgeable of water and water issues, mid to upper level. It may be desirable to have this position filled on an exchange basis to bring NWIC to full capability with regard to the agency from which the exchange personnel are drawn. Either the Director or the Associate Director should have familiarity with information management or information systems. Assistant Directors - trained in a water related discipline with broad operational experience in water issues and mid-level management. Research Analysts - cross-trained (post baccalaureate) in water resources areas and policy or social science. Competent in qualitative and quantitative (meta-analyses) synthesis with good writing skills. Information Systems Analyst - trained in information systems and distributed data base management preferably with experience in environmental sciences. Inquiry Specialists - trained in some branch of water resources with familiarity with information resources.	Director - broadly knowledgeable of water and water issues, senior level. Inquiry Specialist - cross-trained in some branch of water resources, information source identification and bibliographic techniques. Research Analysts - cross-trained (post-baccalaureate) in water resources areas and policy or social sciences. Competent in qualitative and quantitative (meta-analyses) synthesis with good writing skills. Clerk - familiar with computer data entry and computer based word processing systems.	Director - broadly knowledgeable of water and water issues, senior level. Inquiry Specialist - cross-trained in some branch of water resources, information source identification and bibliograhic techniques. Research Analysts - cross-trained (post-baccalaureate) in water resources areas and policy or social sciences. Competent in qualitative and quantitative (meta-analyses) synthesis with good writing skills. Clerk - familiar with computer data entry and computer based word processing systems.

TABLE 5 (continued)

	(NWIC)	(RWIC)	(SWIC)
	Source Identification Specialist - trained in some branch of water resources with familiarity with information resources. Public Information Specialist (or Educational Specialist) - experienced in developing public education or awareness programs, preferably with some experience or training in a natural resource field so that prospective clients will view individual as a peer. Bibliographic Specialist - trained or experienced in both water resources and library science. Clerk - familiar with computer data entry and computer based word processing systems.		

role in these activities, since their staff will probably be more concerned with specific state and local issues than overall "national issues."

This is the most expensive of the options provided. If a reduction in the cost of water management at the national, regional, state and local levels is significant enough because of improved information access, the system is cost effective. The inclusion of a sunset provision in the proposed option allows for that decision to be made after the system is in operation. The cost of the system, when measured against the cost of water management, is probably a prudent investment.

User fees will probably play a much more important role under this option than under Option 2. Clearinghouse staff will be drawing upon the on-line systems of a number of different organizations both public and private. Many of these organizations charge users for the incremental costs of retrieving information, i.e. computer and telephone costs. Unless these charges are passed onto the users, the costs must be borne by the clearinghouse. Appropriate mechanisms for collecting and disbursing these user charges (such as a revolving account) must be established to ensure that clearinghouse costs are kept under control.

Provisions should be made to provide services to those potential clientele unable to afford access, but whose improved access to water information is deemed to be in the public interest. This category might include public interest groups, educators, researchers and economically disadvantaged citizens involved in water issues.

Formal estimates of usage potential were not developed during this study. If an assumption is made that a fair percentage of users of present information systems will opt to access these same systems through a clearinghouse to ensure adequacy of coverage, the clearinghouses will rapidly develop an extensive clientele. A rough estimate of 500 inquiries/state clearinghouse, 300 inquiries/regional clearinghouse, and 500-1000 inquiries to the national clearinghouse in the first year appears reasonable. A three-fold increase in usage can be predicted as the clearinghouses become known and respected for their services.

The political, social and economic costs and benefits and the impacts on current federal activities should not differ materially from that of Option 2 except that federal water information services at the state and regional level should be provided in a much more efficient manner.

This option may provide positive incentives to private sector efforts through increased usage of private information systems. In addition, the potential for contracts to private organizations exists at all levels of the system for activities up to and including full operation of the clearinghouses.

Opinions opposing this option are likely to arise from organizations at the state and local level who feel that they may not qualify for inclusion in the system under proposed criteria. This opposition should arise in the form "Why don't you increase funding under present initiatives which funnel funds to me and I'll do the job." In addition some agencies may question the need for establishing a new entity to provide access to them when they already have established mechanisms for providing user services.

Much of the opposition will likely rise on the basis of cost, particularly since the mainstream water community is able to satisfy the majority of their water information needs under the present system.

Although this option will make life much easier for the professional because it will allow one stop service, principal support should come from the true beneficiaries i.e., those peripheral users desiring specific information and those outside the water community who want issue identification and analysis in a form they can understand.

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SUMMARY COMMENTS

Research Centers

The water resource research center options proposed in this report are not considered to be mutually exclusive. Each meets a defined need. Sufficient justification, in fact, exists for all three centers to be established and operated separately.

The proposed National Advisory Committee on Water Resources Research (Option 1) is intended to provide a coherent understanding of the nation's many water resources research programs, a function not performed now by any institution nor contemplated in the Research Center or Institute options discussed in this report. Although some have characterized the functions of the committee as benign, we believe it has significant potential for a great improvement of understanding of the scope and nature of national water resources research.

In Option 2, the National Water Resources Research Center, the programs described are intended to address national needs by sponsoring water research that cuts across or transcends existing mission agency programs. The Center would benefit substantially from the information produced by the Committee, particularly in the design of its research agenda, but the Center would not be dependent on such information being available.

The proposed National Water Resources Research Institute, Option 3, addresses the need for a focused, interdisciplinary program of applied water research and synthesis of water resources information. The key element of the Institute is that it seeks to achieve a truly interdisciplinary approach to research and is concerned with problem-solving and policy related issues. Because the program is housed in one facility, it is expected that the research of the investigators at the Institute will be synergistic. In this sense, the Institute's approach differs sharply from the Center proposed in Option 2, which has the more traditional approach of funding research at different institutions. However, it is possible that some overlap could occur in the research activities of the Center and the Institute and for this reason it is recommended that the two organizations develop close working relationships if both are created. Such a relationship could stimulate development of joint programs with the Center funding or otherwise participating in the activities of the Institute.

Information Clearinghouses

There are a number of permutations for information clearinghouses which provide reasonable models or alternate options for meeting the needs for improved access to water information.

One could view each of the proposed clearinghouse options as falling on a gradient of information service activities beginning with the present system of independent, unconnected and relatively uncoordinated information agencies and ending with the full service organization embodied in the one stop National Water Information Clearinghouse. Our first option proposes a number of relatively low cost modifications to the present system to improve coordination and service. A next logical step is to establish an organization which identifies all components of the present information infrastructure and advises users unfamiliar with the full range of this infrastructure as to the appropriate place to go for their information (a referral center-our Option 2). It is not too big a step from telling someone where to go for information to providing the service of getting the information for them (a clearinghouse-our Option 3). This latter service becomes attractive if the information must be obtained from a number of sources. It is easy to envision a National Water Information Clearinghouse system developing by a National Water Information Referral Center gradually taking on more and more full service functions while at the same time providing guidance and assistance to individual state or regional organizations developing water information services.

Combined Functions

Although the specific options for water research centers and water information clearinghouses have been presented as independent, stand alone options, there is merit in considering combining many of the functions of the research centers and the information clearinghouses into a single administrative unit. Clearly there is a logical link between water research and information in terms of the need for information by research personnel and the value of research personnel in the transfer or dissemination of new information or data that has not had time to percolate through the water community.

Information services combined with a National Advisory Committee on on Water Resources Research (Committee)

Of the three research center options, the Committee has the greatest need for support in the area of water information because of its mandate to maintain an on-going understanding of the nation's water resources research programs and to disseminate information about those programs. The information base for the Committee will consist largely of data from individual federal agencies; state water institutes; state, local and regional government research programs; and private sector organizations. These data are not now available in an aggregated form, nor do they exist in a central place. The holders of the data needed by the Committee should be known to the National Water Information Referral Center (NWIRC) proposed as a clearinghouse option. The NWIRC would be a valuable resource for the Committee both to locate information and to provide limited bibliographic services.

A National Water Information Clearinghouse (NWIC) would be of even greater value to the Committee in that the NWIC would actually be able to obtain information required for its operations. Issue clarification and identification studies of the NWIC involving questions of water research would benefit by close ties to the Committee with its research monitoring responsibility.

The responsibility of the NWIC to develop an annual assessment of research needs as a function of information gaps complements the responsibility of the Committee to provide an information base which can be used to periodically review water research activities in the light of national water research goals.

There is technical and programmatic justification for combining or formally linking the Committee with either the NWIRC or the NWIC. The principal difficulty in effecting such a combination or linkage lies in finding an appropriate institutional setting. The recommended setting for the Committee, the National Academy of Sciences/National Research Council, is inappropriate for an organization primarily providing information services. The NWIRC or the NWIC, however, would be an appropriate host for the Committee in the event that the National Academy of Science/National Research Council setting was rejected. Such an option would allow some reductions in the the Committee staff in that NWIRC or NWIC staff could perform support functions. If support of the Committee was made a responsibility of either the NWIRC or NWIC, its independence from agency service missions, or from the host agency for the NWIRC or NWIC would have to be clearly established. In addition specific staff with professional training and experience in water research would have to be dedicated to the Committee.

Information services combined with the National Water Resources Research Center (Research Center)

The Research Center option proposed in this report has the responsibility to conduct a program of extramural research in areas that transcend or cut across existing mission agency programs. Research Center staff will be users of information services provided by either a referral center or an information clearinghouse. As presumably sophisticated users (the staff should be such to develop an effective research program), the Research Center should have more of a need for Clearinghouse support than Referral Center support, particularly as an aid to identifying research needs falling outside of agency missions.

Knowledge of Research Center activities will be useful to both Referral Center and Clearinghouse personnel in their search for information not readily available in major information bases. This particular facet of Research Center/Information System interaction will be particularly relevant for those research efforts generating information not normally developed through present agency programs.

The contribution of the Research Center will, however, be relatively small compared to the nation's total water research or water information generating activities. As such, there is no apparent benefit to be gained by combining the two functions under one administrative or operational entity. A strong case can be made for good working level relationships between the Research Center and either or both the Referral Center or Clearinghouse.

Information services combined with the National Water Resources Research Institute (Research Institute)

Since the Research Institute is proposed to facilitate interdisciplinary studies and synthesis of information about major water issues facing the nation, it could be expected to be a major client of either the NWIC or NWIRC. The interdisciplinary nature of the Research Institute staff would suggest that many of their studies would require information from a number of information services, a situation in which either the NWIRC or NWIC should be particularly effective.

A Research Institute with a strong emphasis on synthesis would not likely become a major source of new data, although new interpretations or synthesis would be of major interest to those potential users interested in interpretation and summary rather than data. The identification of research needs, based on information gaps, developed by the NWIC should be of great value to the Research Institute in its research and study programming.

There is some potential for combining the functions of the NWIC or NWIRC with those of the Research Institute. As was the case with the National Advisory Committee on Water Resources Research, the institutional setting becomes important. It has been proposed that the Research Institute be operated by a university or university consortium with funding passed through the National Science Foundation. It was felt that this arrangement would provide the required degree of insulation from political interference and from "fire fighting" problems to develop a strong research program based upon research needs as opposed to operational needs. Such a philosphy is not wholly compatible with the service oriented philosphy of a successful Referral Center or Clearinghouse. We do not, therefore, recommend a formal organizational tie be developed between the Research Institute and the NWIC or NWIRC.

National water resources research needs and national water resources information needs are not simple, straightforward topics. The wide diversity of the "water" field and the demands of the competing constituencies almost guarantee that universal satisfaction with water research opportunities or provision of all water information needs will not be attained. The various options proposed in this report will, if implemented, satisfy some and leave others dissatisfied.

Implementation of the information oriented options will satisfy a much larger percentage of the water community's information needs than implementation of the research oriented options will satisfy the water community's research needs.

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