To: Donald Chery

NATIONAL RESEARCH COUNCIL
WATER SCIENCE AND TECHNOLOGY BOARD
MINUTES
NINETEENTH MEETING--SEPTEMBER 14-15, 1989
NATIONAL ACADEMY OF SCIENCES STUDY CENTER
WOODS HOLE, MASSACHUSETTS

ATTENDANCE

Board Members

Michael C. Kavanaugh, Chairman
Richard A. Conway
James P. Heaney
G. Richard Marzolf
Robert R. Meglen
Donald J. O'Connor (9/14)
Betty H. Olson
P. Suresh C. Rao
Patricia L. Rosenfield
A. Dan Tarlock
Hugo F. Thomas
James R. Wallis
M. Gordon Wolman

Absent

Norman H. Brooks
Howard C. Kunreuther
Donald D. Runnells

WSTB Staff

Stephen D. Parker
Sheila D. David
Chris Elfring
Wendy L. Melgin

Liaison Representatives

Donald Chery, USNRC
Robert Hirsch, USGS
Richard Porter, BuRec

Thursday, September 14

CALL TO ORDER AND INTRODUCTIONS

Chairman Michael Kavanaugh convened in executive session the nineteenth meeting of the NRC's Water Science and Technology Board at 8:30 a.m. on September 14 at the NAS Study Center, Woods Hole, Massachusetts. He welcomed

new members D. O'Connor, H. Thomas, and G. Wolman to their first meeting as board members. Subsequently, members and staff each introduced themselves. Kavanaugh commented that he had spent the previous three days in Washington, D.C., visiting with several of the boards constituent agencies and observing part of the NRC process through participation in a Governing Board Executive Committee meeting. He concluded that the board enjoys an excellent reputation and relations with the agencies and can look forward to a healthy agenda of future activities.

AGENDA

The meeting agenda was reviewed and adopted.

MINUTES

Following a brief discussion, the minutes of the board's eighteenth meeting, April 20, 1989 in Washington, D.C. were approved with no changes.

FUTURE MEETING SCHEDULE

Up-coming WSTB meetings are scheduled as follows:

(1) 20th Meeting; February 15-16, 1990; Washington, D.C. (also to include inaugural Abel Wolman Distinguished Lecture by Luna Leopold)

(2) 21st Meeting; August 6-7, 1990; Woods Hole, Massachusetts (NAS Study Center)

(3) 22nd Meeting; December 1990; either in Washington, D.C. or NAS Beckman Center (date and location to be confirmed at a later date)

BOARD ROLE AND MODUS OPERANDI

S. Parker reviewed the role and modus operandi of the Board with respect to oversight of studies and other responsibilities. He noted that it had been suggested that the Board might consider dividing into sets of oversight committees, such as is generally done by NRC commissions and the Board on Environmental Studies and Toxicology. There was little enthusiasm for this concept, though, with members commenting that the program was not so large as to justify discussions by all members of all projects. Generally the members prefer the current approach of all members being involved in broad oversight, with ad hoc committees being charged with activities such as proposal development, committee nominations, and report reviews.

DISCUSSION OF POTENTIAL SOURCES OF BIAS

S. Parker explained the policies and concerns of the NRC with respect to conflict of interest and potential sources of bias matters. He noted the procedures of submitting written statements and annual discussions required of all committees. With this background each member introduced him/herself, described their background, research interests and support, and any public positions they had taken relevant to issues on the Board's agenda. Following this discussion it was concluded that the Board had a reasonable balance of views and expertise to be able to carry out its responsibilities.

NEW AND DEVELOPING ACTIVITIES

At 9:30 a.m. the executive session ended and the following agency reps were introduced and joined in the meeting: D. Chery (USNRC), R. Hirsch (USGS), and R. Porter (USBuRec).

Climate Change and Water Resources Management

S. Parker explained that the Board's proposal had received all required NRC approvals and had just been sent to the Bureau of Reclamation for processing. Support should be in hand about December 1. Initially this activity will comprise a workshop on climate change and water management in the West. The effort will be the responsibility of a small steering committee charged with bringing others into the workshop and producing a report to the BuRec upon completion. The report will contain an agenda for research and studies that the Bureau should undertake relevant to water resources project operation with consideration for climate uncertainty. This first phase will last six months and is likely to be followed by an oversight period. A productive discussion followed concerning the approach that should be taken and the makeup of the committee. Later in the Board meeting a working subgroup identified a steering committee of choice and made many other suggestions:

The subgroup stressed that given the short time between now (Sept. 14) and the hoped for meeting date (January), the activity must be a workshop and not something more formal like a colloquia. The workshop would be more spontaneous (no pre-drafted papers) and rely on creativity on-site. It would begin with one or three background talks (from people with the info. already available and presentable) to set the stage, including a series of questions for the workshop to address. These talks would set the boundaries for the small groups.

The group would then break into smaller working groups (perhaps to work on different tasks or perhaps to work on parallel tasks). The steering committee would need to carefully define the questions and tasks so the meeting is productive, not simply an opportunity for people to talk. The design/structure should be very focused on the goals and purpose of this particular workshop:

Goal as interpreted from current proposal: determine what is known and unknown about climate change that is relevant to BuRec management/operations.

Product as interpreted: general guidance for a research plan with objective of improving BuRec management capability under uncertainties of possible climate change.

The steering committee would stay a day after the (2-day) workshop session to actually prepare the "deliverable," to write up the conclusions and recommendations generated during the small group sessions.

The following possible background paper topics were identified:

- Comparing global climate changes to other changes occurring (relative importance).
- Adaptive model management. This is an approach that explicitly accounts for uncertainty. Process to incorporate new information. Mostly used for ecological decisionmaking, but could be applied here.
- Agronomic shifts.
- Current management options.
- Current institutional responses to drought (e.g., prior appropriations).

Wastewater Management for Urban Coastal Areas

M. Kavanaugh provided a brief review of this developing project since its inception at the August 1988 Board meeting. With an interest in the broader policy issues suggested by wastewater management situations in places like Boston, MA and San Diego, CA the Board had brought together a planning group in April to develop a proposal. The proposal is for a study to help assure the scientific basis, innovation, environmental effectiveness, flexibility, and cost effectiveness of policies and practices pertinent to wastewater management for urban coastal areas. The proposal had recently been approved by the Board, its parent Commission on Engineering and Technical Systems, and the NRC Governing Board.

The U.S. House of Representatives Appropriations Committee had taken an interest in this study and in fact was proposing to add money ($300,000) to the USEPA budget in its support. Largely as a result of this expectation; EPA had recently shown much interest as well. S. Parker had had two meetings to discuss the study. He and Kavanaugh had visited EPA personnel just prior to the meeting. An unsigned, undated letter from EPA, expressing a position on the study, had been obtained. The letter took issue at the underlying framework of the study (need for full secondary treatment) and suggested the study scope be expanded to include estuaries. The letter made numerous other suggestions to modify the Board's draft proposal. The Board discussed this thoughtful detailed letter and concluded that it did not concur with many of EPA's points. A review group of Conway, Heaney, Olson, and Wolman was given the assignment of reviewing and responding to EPA's letter and making appropriate changes in the proposal. (This group met later in the meeting and responded to the agency by letter, dated October 2).

Emerging Technologies in Water Treatment

M. Kavanaugh and C. Elfring reviewed this developing project which would evaluate the status of water treatment technologies, assess the adequacy of technological development, and consider whether this section will be able to achieve the environmental requirements that will be set in the future. A proposal had been developed and was being reviewed by the attendees of the Board's April planning session. Members commended the project as a worthy one and then identified several prospective sponsors such as EPA (with its new initiative focused on advancing environmental control technologies), the NAE (its program relative to technology and the environment), USGS (to help define activities under Section 106 of the Water Resources Research Act), and others. C. Elfring was asked to attend a meeting at EPA on its new initiative in October. R. Conway, D. O'Connor, P. Rosenfield, H. Thomas, and Elfring were identified as a group to help develop this effort further, including making committee nominations at the appropriate time.

International Soil and Water Research and Development

S. Parker provided an update on this project designed to help the U.S. Agency for International Development with its activities in soil and water management in developing countries. The proposed joint activity with the NRC's Board on Science and Technology for International Development was about to be funded. Parker had taken the lead on a membership nominating committee, comprising B. Olson, S. Rao, P. Rosenfield, himself, and BOSTID reps. He had made a membership proposal that was discussed and adjusted. Action on this slate would be held for concurrence with BOSTID and project discussions with AID personnel in October.

Dredging and Water Quality

The topic of dredging and water quality had been raised at the April Board meeting as an important issue area, one in which the Board might try to pursue a study if an appropriate scope could be identified and sponsorship obtained. R. Meglen had reviewed the topic and provided a short report. He had done a literature search and had found 30 "hits." He felt there was a large literature but little synthesis or interdisciplinary studies. He suggested that contaminated sediments will be an issue of increasing importance and the study idea should be kept on the Board's agenda. The Board might synthesize and review the literature, assess the current state of art, and point to directions for the future--technology-wise and research. Parker pointed up that the NRC's Marine Board had done work in this area. He would send any relevant reports to Meglen and Kavanaugh.

Integrated Hydrologic Design for Residential Development

K. Potter (U. Wisconsin & Committee on USGS Water Resources Research) had provided the Board a background paper concerning the potential to improve

stormwater management in developing drainage basins. S. Parker summarized the paper and asked whether the issue described is an appropriate one for the WSTB to pursue. There was interest in the item, and D. Tarlock and G. Wolman volunteered to look into it further, perhaps serving as advocates for the project. Wolman will be talking with Potter, and perhaps a revised description will be produced as a result.

LUNCH BREAK
12:15 to 1:15 P.M.

ABEL WOLMAN DISTINGUISHED LECTURE SERIES

D. Tarlock and S. David reported on progress on the first Abel Wolman Distinguished Lecture, to be delivered by Luna Leopold February 15, 1990. The title of Leopold's presentation will be "Ethos, Equity, and the Water Resource." G. Wolman will be making an opening statement re: the series in general, which is in honor of his father, and Leopold's presentation. Following this report there was a discussion on publication plans and the matter of preserving and making available video-taped copies of the program. "Environmental Science and Technology" and "Environment" seem to be the choice magazines for publication. S. David will be pursuing this further, as well as the question of having the program video-taped. It was agreed that the planning committee, chaired by D. Tarlock, should proceed with identification of the second lecturer to be featured in early 1991. A number of good suggestions were also received by the staff regarding publicizing this first event.

REVIEW OF STATUS OF EXISTING ACTIVITIES

Evaluation of USGS National Water Quality Assessment Pilot Program

J. Heaney and S. David updated the Board on the activities of this committee, which was preparing for its next meeting September 25-26 at the NAS Beckman Center. The committee was about to release an interim report encouraging further development of the NAWQA program. The report would be quite positive on the program and the Geological Survey's ability to carry it out. Some reservation would be expressed about biological components of the program. Another key issue is how the USGS plans to synthesize the regional data being gathered into a national trend assessment. At its last meeting, the committee requested that the U.S.G.S. conduct a sample NAWQA case study in order for them to judge how information obtained on a study unit basis, would be relevant on a national basis. The U.S.G.S. agreed and with the committee's input it was decided that the national-scope question would be: "What have been the effects of changes in wastewater-treatment practices on water quality and ecosystem health?" The case study will focus on the Illinois River basin to answer two questions: (1) To what extent can existing data be used to

distinguish the effects of changes in wastewater-treatment practices on water quality and ecosystem health from other changes that have occurred in the basin over time?; and (2) How will information from the different scales of activity in the NAWQA program (e.g., specific river reach, study unit, and regional investigations) be aggregated to help address this national-scope question?

Committee on Irrigation-Induced Water Quality Problems

C. Elfring and R. Meglen highlighted some activities and issues relative to this project. The committee was currently waiting for clearance of an important letter report to Interior Secretary Lujan asking the Department to maintain a broader perspective concerning solutions to drainage problems in the National Irrigation Water Quality Program). The committee's large report was about to be published by the National Academy Press and would be featured at a press conference on October 17 in San Francisco. The committee will also be participating in an important workshop of the Western States Water Council in January where it would be trying to help assure implementation of its results. Finally, the DOI is interested in having a reorganized form of the committee continue in advisory role beyond March 1990, the currently planned date of termination. The committee focus would be on the national program as that program enters a phase of "solution" evaluation. Elfring discussed in general terms a scope of work for this additional phase. After some discussion this proposal for continuation was approved. Continuation is expected to bring reduction of size and reorganization of the committee. A nominating committee of R. Meglen, D. Tarlock, G. Wolman, and Elfring was identified to act on the Board's behalf at the appropriate time.

Committee on U.S.G.S. Water Resources Research

H. Thomas and S. Parker reported on the activities of this committee which had just met the previous week in Boulder, Colorado. In its history, the committee had considered many aspects of the U.S.G.S. water resources programs. Currently three projects were underway: university/U.S.G.S. research relationships, long-term nature of the district programs, and improvements in the streamgaging/data network programs. At its September 7-8 meeting, the committee had spent considerable time organizing a report outline incorporating these and other issues. Writing assignments were underway and a report would begin to evolve by the time of the committee's next meeting in February. The report should contain many stimulating ideas to those responsible for thinking about the future of the agency's water programs 20 to 30 years hence. S. Parker noted that five members were scheduled to retire from this committee at the end of December. He invited nominations. An ad hoc committee of B. Olson, S. Rao, H. Thomas, and S. Parker will review membership needs and make nominee recommendations to the NRC parent bodies before the end of November.

SEMINAR "TECHNIQUES FOR ASSESSING GROUND WATER VULNERABILITY"

At 4:00 p.m. the meeting took a break from project review for scheduled informal seminar/briefing by S. Rao on the topic of "Techniques for Assessing

Ground Water Vulnerability." The purposes of this presentation were two-fold: (1) as education for members and liaisons and (2) to further development of a new study initiative to begin in 1990.

Two approaches can be used to evaluate the contamination of soil, surface waters, and ground waters. In a reactive mode, various monitoring programs--at various spatial and temporal scales--can form the basis for identifying problem areas that have become "contaminated." Reconnaissance surveys (such as NASQAN, NAWQA, EPA's National Pesticides Survey, etc.) provide a basis for regulatory actions to remedy contamination. This also provides a basis for various land-use management decisions. The second approach, in a proactive mode, is to identify the land areas or activities that lead to contamination. Regulatory and management options can be implemented to prevent soil and ground water contamination. This latter approach is the focus of this suggested WSTB initiative.

A number of techniques have been developed to assess the potential for contamination (i.e., vulnerability) either at a local scale (e.g., specific site and activity) or at a regional scale (e.g., state- and nation-wide pesticide-use policy). Use of simulation models and various empirical numerical rating techniques have been proposed for evaluating ground water vulnerability. For example, the USEPA uses a numerical ranking scheme, DRASTIC, to assess the contamination potential on the basis of physiographic and hydrogeologic setting of land areas. Similar DRASTIC-like Delphi rating schemes are being developed and used by several state environmental agencies for regulation of pesticide use. Simulation models of varying complexity (e.g., PRZM or GLEAMS) are being used to assist the EPA and other agencies in making decisions on pesticide registration. The relative merits of models versus rating schemes have been debated in the literature and by the EPA in deciding registration of Aldicarb pesticide use. The Aldicarb case is seen as a template for all future decisions made by the agency on pesticide registration. In nonagricultural applications, the questions of site-selection for land treatment or land disposal sites for hazardous wastes also require an assessment of relative vulnerability of various candidate sites.

The use of Geographic Information Systems (GIS) is becoming popular for inventorying, archiving, retrieving, and displaying spatial data needed in the above stated approaches for evaluating vulnerability. GIS coupling to numerical rating schemes and to simulation models allows the production of computer-generated thematic maps displaying contamination potentials for vulnerability of land areas (at county-level or higher spatial scales). However, the varying levels of data quality and scales of the spatial data bases supporting GIS introduces great uncertainty in the reliability of these vulnerability maps. Questions as to how to validate the predictions (i.e., the GIS thematic maps) through sampling or monitoring also need to be resolved.

It was concluded that a worthy project might be developed, as outlined below:

Phase I - General Review of Three Elements

A. Review of Ground Water Vulnerability Assessment Methodologies Three Basic Categories

1. Numerical Rating Schemes (e.g., DRASTIC-type Delphi)

2. Process Based Indices (e.g., constituents vs. fate)

3. Assimilation Modeling (e.g., flow/transport)

B. Review National/Regional Needs for Ground Water Vulnerability Assessments

Examples:

EPA - Pesticide Use Regulations
Waste Site Remediation Priority Setting
Wellhead Protection Prioritization
Ground Water Quality Classification

USGS - Use of NAWQA (gw portion)/RASA/Toxic Hydrology Programs

NRC/DOE - High-Level Radioactive Waste Disposal Site Screening
Low-Level Radioactive Waste Disposal Site Screening

? - Radon and Other Radionuclei Potential Elevated Concentration

USDA - User and Supplier of Data (i.e., soils)

C. Review Use of GIS in Assessment Methodology Application

- Databases needed, available, accuracy, and scale

Phase II - Detailed Report/Technology Transfer on Appropriate Match-up Among the Three Elements

It was agreed, however, that more development was needed. A planning session was suggested and Rao and the staff agreed to obtain funds for and organize such a session prior to or in conjunction with the February Board meeting. H. Thomas and J. Wallis will join Rao as the principal advocates and organizers of this project.

At 5:15 p.m. the meeting adjourned for the day. Attendees then enjoyed cocktails and a New England Barbecue at the NAS Study Center.

Friday, September 15

REVIEW OF STATUS OF EXISTING ACTIVITIES (CONTINUED)

The meeting reconvened at 9:00 a.m. on September 15, for continued discussions of existing projects (9:00 - 10:15 a.m.).

Opportunities in the Hydrologic Sciences

W. Melgin reported that the report of the committee on Opportunities in the Hydrologic Sciences was reaching an advanced stage. The committee had held its last meeting on July 20-22. All sections of the report had been developed at least through a first draft and the whole report was currently being reviewed and revised for an "editorial subcommittee" of four members which would be meeting for further refinements in early-November. The report should be ready for formal NRC review by late-December. S. Parker noted that discussions of the report with federal agency scientists and managers were quite positive. He felt the project would have a great chance of achieving two of its goals--to enhance the standing of hydrology as a science and to help earmark federal funding for research in the hydrologic sciences.

Western Water Management Change

D. Tarlock, chairman of this study committee, reported that the study had been launched successfully, the first meeting having been held at the Beckman Center of May 25-26. The committee had come quickly to grips with its tasks, heard briefings on water management in both northern and southern California, developed a preliminary report outline, and made background writing assignments. The committee would be taking a case study approach. Its second meeting was scheduled for October 26-27 in Reno, Nevada, where it would learn about water management issues in the Truckee-Carson basin. After several more meetings, a report will be issued designed to help formulate sound water transfer policies, with emphasis on minimizing third-party and environmental impacts.

Ground Water Recharge in Surface-Mined Areas

J. Wallis, a member of this committee, provided a progress report. The committee is charged with reporting to the Office of Surface Mining on feasible approaches to determination of "ground water recharge" in surface-mined area. The committee had met three times, including field trips in mining areas of Montana and Kentucky. The committee was currently engaged in writing its report. A complete, relatively polished draft was expected to be completed prior to its next and final meeting, scheduled November 20-21 in Washington. The project should be completed on schedule in February 1990.

Coastal Erosion Zone Management

S. Parker reported on this study which is nearing completion. A report of recommendations to FEMA concerning options for incorporating coastal erosion zone management into the National Flood Insurance Program was being readied for NRC review and should be transmitted to the sponsor by November 15. The report reflects the committee's view that an erosion element of the NFIP should incorporate the following goals: (1) transfer at least some of the erosion losses from taxpayers to the property owners; (2) discourage new or additional development from occurring in erosion zones as delineated by FEMA; and (3) promote the improvement of development and redevelopment practices in erosion-prone areas.

Glen Canyon Environmental Studies Oversight

R. Marzolf, chairman of this committee, reported on the activities of the committee charge with providing advice to the Bureau of Reclamation and its Glen Canyon Environmental Studies Program. He noted that the "senior scientist" position recommended by the committee had been filled by Duncan Patten, albeit not at the level in DOI recommended by the committee. The committee had met last June 26 and would be meeting again in November to plan further a symposium synthesizing science relevant to the results of the GCES research. Marzolf noted that in July, DOI Secretary Lujan announced that the BuRec is to prepare an EIS to determine the impact of operations of Glen Canyon Dam on downstream ecological and environmental resources.

Restoration of Aquatic Systems: Science, Technology and Public Policy

This new study will assess aquatic restoration attempts and scrutinize how and why certain restoration attempts have succeeded or failed. The two-year study will focus on the understanding of the scientific bases and technology of restoration and roles of local, state, and federal governments. S. Parker reported that study was well-funded, with several sponsors. The first meeting of the committee, chaired by John Cairns, will be held October 5-6 in Washington.

Colloquium V: Remediating Ground Water and Soil Contamination: Are Science, Policy, and Public Perception Compatible?

The topic of remediation on contaminated ground water had been addressed at the Board's fifth colloquium in April. R. Conway, chairman, reported that the various discussion papers had been reviewed and edited and the overview had been prepared. The report was near ready for completion and in need of review by the Board. M. Kavanaugh will provide this service along with several other individuals on the Board's behalf.

INTER-AGENCY REPORT ON GROUND WATER SCIENCE AND TECHNOLOGY

R. Hirsch provided an overview of an important recent activity of the Committee on Earth Sciences, chaired by USGS Director Dallas Peck. A CES subcommittee, chaired by NSF Geoscience Director Robert Corell, had produced a report describing current and planned activities (including budgets) of all the federal agencies in ground water science and technology (but not remediation and enforcement). Hirsch served on the subcommittee; S. Parker is an observer. Information in the report, Federal Ground Water Science and Technology Programs, was expected to be valuable to federal policy makers, given the very high level of interest in the topic in the Congress in particular. This subcommittee would continue with follow on activities. A possible future effort might involve identification of frontiers in ground water, including an assessment of roles of the various agencies. Hirsch noted that it was possible that the Board might be asked to play a role in such an activity, and the members agreed that would be an appropriate and worthy activity. The Board will be kept informed as things develop.

DISCUSSION SESSIONS ON DEVELOPING PROJECTS*

At about 10:15 a.m. and until shortly after 11:00 a.m., attendees divided into three working groups to help bring closure to outstanding questions on three developing activities from September 14. The charges and group participants were:

(1) Waste Water Management for Urban Coastal Areas (Conway, Heaney, Olson, Parker, Wolman)--to consider any appropriate changes to the draft proposal, in light of EPA's expressed views on the activity, and to provide response (with revised proposal) to the agency.

(2) Climate Change and Water Resources Management (Elfring, Hirsch, Marzolf, Meglen, Melgin, Porter, Rosenfield, Tarlock)--to provide a recommended structure for the planned workshop and to recommend candidates for the steering committee.

(3) Techniques for Assessing Ground Water Vulnerability (Chery, Rao, Thomas, Wallis)--to assess S. Rao's presentation, distill from it ingredients for possible study by the Board, and make recommendations for proceeding.

*Note: For the purpose of coherence of presentation, most of the conclusions of these working sessions are reflected in the minutes of the project discussions on September 15.

PRESENTATION ON RISK ASSESSMENT/MANAGEMENT IN WATER RESOURCES

Next, time was taken for a scheduled presentation by J. Heaney on the subject of risk assessment in water resources. The purpose of this session, as Rao's on September 14, was both to educated the members and to serve as

background for consideration of undertaking a study of this topic. In his presentation, Heaney defined several terms, described several applications in civil, water resources and environmental engineering, and discussed several relevant past NRC studies. Heaney expressed concern about the government's interest and ability to use risk assessment as a tool in managing complex systems. After considerable discussion, it was agreed that before making any judgements as to whether a new initiative might be attempted, the social scientist's perspective will be presented by Howard Kunreuther at the Board's February meeting.

LUNCH 12:15 - 1:15 p.m.

SETTING PRIORITIES AND PLANNING FOR FUTURE PROJECTS

Following lunch, the opportunity was taken to summarize the major decisions of the meeting. Emphasis was on reports and discussions of the three workgroups, i.e. coastal urban wastewater management, climate change and water resources, and ground water vulnerability.

Additionally, some new ideas for additional activities surfaced for the first time. P. Rosenfield, for example, suggested taking on a comprehensive assessment of the Board's program, with a goal of producing,in time for the Board's tenth anniversary in 1992, a report of overreaching findings and recommendations to the water resources community. J. Wallis suggested the Board, jointly with BOSTID, take on a study related to water operation and management to reduce the speed of tropical water-born diseases. H. Thomas and others advocated the Board taking increased responsibilities with respect to its mandate in the area of education.

They suggested the making of grants to students occasionally, making it possible for them to observe events such as colloquia, lectures, and Board meetings. There was mixed reaction to this proposal; it would be considered further. It was suggested also that more could be done to disseminate output from the Board's program (e.g. making available videos).

R. Marzolf suggested the idea of a colloquium focused on strengthening biological aspects of water science. It was agreed that would be useful, and he and B. Olson agreed to make a more formal proposal at the February 1990 Board meeting.

ADJOURNMENT

The meeting adjourned at approximately 2:45 p.m.