Science Advisory Board Review of Annis Water Resources Institute

Grand Valley State University

March 8-9, 2011

FINAL REPORT

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Introduction and General Observations

As in Bernard Blade's play, "Same Time, Next Year," the Annis Water Resources Institute Science Advisory Board (AWRI SAB) has seen biennial snapshots of lives in progress. This infrequent yet regular perspective has been very gratifying because as outsiders we see the substantial progress that AWRI has made over the past decade. AWRI is synergistic, collegial, and intellectually stimulating, an atmosphere that promotes nationally-competitive research. AWRI is an integral part of Grand Valley State University, and we thank the GVSU administration for facilitating and encouraging this review. We appreciate being selected for this opportunity, and that our past advice has been valued and acted upon.

The SAB conducted its biennial review of the Annis Water Resources Institute of Grand Valley State University on March 8-9, 2011. The SAB thanks Dr. Alan Steinman and the entire AWRI staff for their hospitality, stimulating scientific presentations and openness during our review. The SAB has met every other year since 2003. Given AWRI's maturity, we think that every three years would be a sufficient revisit rate in the future.

Dr. Steinman received a $500,000 HUD grant for field station renovation, but he is also seeking a much larger grant that would allow the field station to be completely rebuilt. Given the age and condition of the existing field station building, the SAB supports Dr. Steinman's efforts to replace the field station with a new structure. In addition to serving AWRI's expanding research and equipment storage needs, a new building could include dormitory facilities that would promote collaborations with visiting faculty, students, and other scientists.

The SAB commends AWRI for commissioning and publicizing a report on its economic leveraging. AWRI's external grants and contracts have garnered $1 million/year over the last five years. AWRI and its visitors have averaged direct spending of $3 million per year in Muskegon County, and AWRI's economic activity has provided for an average of ~50 full-time jobs each year since 2006. This job creation also has indirect regional economic benefits as employees spend their salaries within the region. AWRI has clearly had a significant economic impact within Muskegon County.

The purpose of this report is to provide continued advice and counsel on how to continue to make the AWRI a valuable asset to Grand Valley State University, the State of Michigan, and the southwestern Michigan region.

Information Services Center (ISC)

The ISC has steadily declined in funding and personnel since 2007. Staff now consists of John Koches, Rod Denning, one full-time technical call-in (John VanderMolen), and one part-time technical call-in (Betty Gajewski). Only two projects currently have funding, the NOAA Wind Energy Project (Erik Nordman in the Biology Department, PI; ending in April 2011) and the Duck Creek Watershed Management Plan (Muskegon Conservation District 319 Project, ending in March 2012). Although many more projects were described and some are in no-cost extensions, funding for ISC involvement in them has ended. A large number of community

collaboration meetings were attended, but there was no clear benefit to ISC, AWRI, or GVSU from those meetings.

The ISC essentially no longer functions as a center. John Koches formerly served primarily as a manager, but has now had to assume a more active role in completion of projects. The ISC's GIS services were once unique and in demand, but that demand has drastically diminished. The ISC goal of becoming a GIS portal for western Michigan never materialized.

In its 2009 report, the SAB said it was "time for the ISC to reevaluate its niche," and recommended "immediate attention to a long-term strategy to *re-invent* ISC." ISC was not re-invented. John Koches still considers the ISC niche to be "supporting local units of government." That is an inappropriate role, particularly when local governments are no longer supporting the work of ISC. The SAB does not see that trend changing, even when economic conditions improve, because GIS expertise has become too widely distributed (see 2009 SAB report).

Some of the ISC work area is currently being used as office spaces for post-doctorates and Kurt Thompson. This is a suitable use of the space.

In summary:

- Discontinue providing free services to local units of government
- Eliminate the ISC when funding ends for current projects, and redefine John Koches' role

Faculty and Individual Research Programs

Dr. Mark Luttenton

Dr. Mark Luttenton continues to have a full plate of responsibilities on the GVSU campus and at AWRI, where he has a half-time appointment. In 2009-2011, he taught four undergraduate courses (Freshwater Algae, Environmental Science, Limnology, Biology II) and three graduate courses (Scientific Methodology, Wetland Ecology, Advanced Community Ecology), despite taking a sabbatical leave in Fall 2010. Advanced Community Ecology was taught as a sabbatical replacement, but the other courses are part of his normal course load. Dr. Luttenton is still teaching the courses he picked up when Don Uzarski left AWRI. He says he would like to drop the Wetland Ecology graduate course, but he also said that during the 2009 SAB visit.

By May 2011, Dr. Luttenton will have five graduate student advisees, substantially more than the two he supervised as of the last SAB visit. Former graduate student Melissa Conte has completed her degree and is working on a journal manuscript about her brown trout research. Dr. Luttenton also supervises two undergraduate research projects and serves on 12 M.S. Biology graduate committees.

Dr. Luttenton's service commitments to the University are numerous and important. His efforts on the Graduate Directors Discussion Panel, the Graduate Council, and as the Biology Graduate Program Coordinator have advanced graduate education at GVSU, which also benefits AWRI. He also chaired the Rediske and Biddanda tenure committees.

In terms of contact hours, Dr. Luttenton has essentially a 100% time commitment to the Biology Department, but he is able to maintain a strong presence at AWRI. As in the past, Dr. Luttenton has been a strong link between AWRI and the GVSU Biology Department. He will serve as AWRI Acting Director during Al Steinman's sabbatical leave, for which he will be released from teaching one course by the Biology Department.

Dr. Luttenton achieved his goal of increasing research funding for 2009-2011 by securing two grants:

- Muskegon River Steelhead Reproduction and Juvenile Survival (MDNRE, $170,000)
- Distribution and Hybridization of Invasive Cattails in Michigan (MI Botanical Foundation, $1,700)

The steelhead reproduction research, which resulted from a MDNRE collaboration, is related to dam operation that could improve salmonid habitat downstream. This research could lead to future grants, because it is an issue that is applicable to other dams in Michigan.

Dr. Luttenton also achieved his goal of 2 presentations/year, including graduate student presentations. He published one article in a peer-reviewed journal. Increased publishing is a goal for 2011-2013.

In summary:

- Dr. Luttenton is an outstanding professor and advisor who plays a vital role in the Biology Department and AWRI.
- Dr. Luttenton has achieved most of the 2009-2011 SAB goals, especially the increased grant funding; try to maintain this funding level
- Publication of 1-2 papers annually in peer-reviewed journals would be a reasonable scholarly goal for Dr. Luttenton's laboratory.
- Work with Dr. Steinman to develop a smooth transition for assuming Acting Director duties during his sabbatical leave (e.g., time scheduling at AWRI and GVSU, job expectations, emergency contact protocols)

Dr. Rick Rediske

Dr. Rediske and his lab continue to pursue interdisciplinary collaborative projects covering a diversity of topics, ranging from beach forecasting to harmful algal blooms to benthic ecology. These projects have been supported by a solid base of new grant funding over the past two years, totaling about $180,000, with additional support from a large, multi-investigator Great Lakes Research Initiative grant. The research of Dr. Rediske and his students has led to an increased number of publications and presentations in the last two years.

In the previous review, Dr. Rediske highlighted a goal of getting more of his graduate students to publish. Although the publication rate of his graduate students remained low over the past two years, there are signs of movement in the direction of increased publication, with his postdoctoral associate publishing a paper in the Journal of Great Lakes Research. In addition, two of his MS students have given presentations at professional conferences. These conference presentations are excellent learning experiences for the students, and will hopefully prime them for putting

their research results into publishable format. Dr. Rediske himself has co-authored seven peer-reviewed publications since 2009, and is the senior author for three technical reports. He has set as a goal for the next two years the publishing of results from his fish contaminant research project (with Notre Dame) and his interdisciplinary water resources research. These should be high-priority objectives. While Dr. Rediske's field of study lends itself to collaborative, interdisciplinary research which naturally leads to multi-authored papers, he should continue to pursue the goal of being senior author on one to two peer-reviewed publications per year. It was noted that Dr. Rediske is the lead PI on most of his new grants, and this lead role should facilitate senior authorship of several papers.

Dr. Rediske's work load achieves a good balance of research, teaching and public/professional service. Because much of his work is oriented toward applied problems in aquatic systems, he has close ties with the management community and with the public in general. Therefore his service on various advisory committees and his presentations to public agencies are very appropriate and should continue.

Dr. Rediske has indicated a desire to focus on two primary research objectives in the near future: the ecology and toxicology of harmful algal blooms, and a greater emphasis on water quality research in the international arena, with a current focus on Ghana and Haiti, where one of his graduate students is currently conducting research. The first objective is a natural continuation of research his lab has been conducting for several years. The second objective is a new one, which is being pursued through collaboration with an anthropologist. Dr. Rediske indicated that NSF is one of the potential funding sources for this work. In this regard, it will be important to determine whether the emphasis will be on basic vs. applied science, which will determine potential funding mechanisms that can be pursued. If NSF funding is a primary goal, then it will be necessary to develop focused, basic science questions that have relevance beyond local water quality issues. However, if the research focuses on more applied issues, there may be other funding sources that can be pursued. However, despite the obvious need for applied science in developing countries, funding for this work can be difficult to acquire, and requires the development of strong relationships with national government agencies, universities, and donor agencies. These can take time to cultivate, and so it would be wise to continue to follow the research trajectory that Dr. Rediske's lab has established in the U.S., which will continue to provide a funding base for his lab, while pursuing international opportunities.

In summary:

- Dr. Rediske continues to play a valuable role in AWRI's research, teaching, and service programs.
- Publication of the research conducted in Dr. Rediske's laboratory has shown improvement. A continuing goal should be to publish first-authored papers.
- Transition to new, international research projects is a commendable objective, but it will need to be done through collaborative partnerships and it will take time.

Dr. Ryan Thum

In the previous SAB review (2009), which occurred shortly after Dr. Thum had taken his position with AWRI, it was noted that he was taking the necessary steps to establish an active research program, and several recommendations were made, including: 1) Collaborate with other colleagues both within and outside of AWRI; 2) Maintain a commitment to committee work that is balanced with teaching and research demands; 3) Develop mentoring and graduate student advisory relationships. During the current review the SAB was pleased to observe that Dr. Thum has followed all of these recommendations, and that in two years he has established a well-funded, high profile research program. His major accomplishments include the acquisition of a number of major grants, including a NSF MRI grant for $289,866 and a NSF research grant for $149,500, the population of his research laboratory with two technicians, three graduate students, and several undergraduate students, the publication of 8 papers (corresponding author on 5), and a large number of presentations at professional meetings, workshops, and management agency meetings. In addition, Dr. Thum continues to teach an undergraduate course and serve as mentor for a large number of independent study courses. The SAB was pleased to note that Dr. Thum has been proactive about involving students in proposal writing, publications, and presentations.

Dr. Thum's current research program effectively combines applied and basic research. His research on Eurasian water milfoil genetics and its implications for management has captured the attention of industry and management agencies, while at the same time addressing basic questions related to evolution and species invasions. Because of the broad interest in the practical applications of his lab's research, in the last two years Dr. Thum's lab has transitioned from a challenging start-up phase to a state of almost being over-committed. Dr. Thum appears to have a well-defined set of objectives for his research program, and it will be important to prioritize these objectives for the next two to three years. Dr. Thum's field of research is amenable to a variety of funding sources and collaborative relationships, and so it will be important to ensure that collaborative commitments are in line with his lab's long-term research goals in order to avoid dilution of his efforts.

Based on Dr. Thum's current performance, the SAB sees no major issues that need to be addressed. A goal that was discussed during the 2009 review was the submission of a NSF CAREER grant proposal. Dr. Thum is in an excellent position to apply for this funding, and he has defined it as one of his immediate goals. Two challenges that Dr. Thum identified are the long-term maintenance of the sequencing/genotyping facility and the hiring of a full-time research associate. The hiring of a research associate will obviously rely on a continuous stream of grant funding, and if Dr. Thum's research program continues to evolve and be funded at its recent level then it is expected that this challenge will be met. There are several potential mechanisms for facility maintenance, which include cost recovery from external users (which is already being applied to some extent), and the inclusion of maintenance costs in grant budgets (e.g., as a percentage of operating costs). However, maintenance costs for sequencers are typically high, and it may be difficult to meet them using these two mechanisms. The most feasible solution may be to work toward developing a larger group of researchers (within AWRI, GVSU, and external researchers) who can use multiple grants to share the burden of maintenance costs.

In summary:

- Dr. Thum has followed through on recommendations made during the previous review, and he has made excellent progress in developing a well-funded research program and a cadre of graduate and undergraduate students.
- Dr. Thum has well defined goals with regard to grants, research and publication. A challenge in the next few years will be to keep his program focused on those goals while meeting the demands of multiple collaborators and interest groups.

Dr. Bopi Biddanda

Dr. Biddanda joined AWRI in June 2000 and continues his impressive programs in carbon cycling and microbial ecology. In the past two years, he maintained his high level of progress in research and scholarship and should be recognized for his efforts. He has three funded research projects (NSF, NOAA, EPA) and two pending. He continues to submit proposals to highly competitive programs including 2 to NSF and 2 to NOAA, and 1 to EPA. He continues to receive a commendable acceptance rate for his proposals.

During this review cycle, Dr. Biddanda published, or has in press, 5 papers (including one that received the Chandler Misener Award from JGLR), has one in review, 4 in preparation for scientific journals (two of which have been invited), and 4 popular science articles. These make an impressive set in leading journals. He has participated in national scientific meetings, Great Lakes educator workshops, and a number of invited seminars. He has been a prolific, perhaps too generous, reviewer of proposals (6 for NSF) and journal articles (>20), and currently serves on the editorial boards for the Journal of Plankton Research and Aquatic Microbial Ecology and on the NSF Microbial Observatories Program Panel. Collaborations with AWRI and external scientists continue to provide contributions on the Great Lakes and Michigan lakes.

The graduate courses he teaches, Aquatic Microbial Ecology (Fall 2007) and Ecosystem Biogeochemistry (Fall 2008) reflect his broad research interests, and teaching courses on campus provides an opportunity to identify students interested in employment.

He supports four graduate students, a research assistant, and mentors two undergraduates. Dr. Biddanda has given an impressive array of invited and contributed seminars across Michigan and has presented his research in national meetings. He provides significant service to AWRI and GVSU through graduate student committee work and AWRI service committees (e.g., radiation, seminars, scholarship days).

Dr. Biddanda has responded well to the 2009 review (as he did in response to the 2005 and 2007 reviews) and his program has shown a high degree of maturation during that time. He should continue to concentrate on building and maintaining a strong research funding base and enhancing his research program. In addition, he should continue to publish at least two papers per year as a lead or senior (last) author. Dr. Biddanda's research on the ecology of a submerged sinkhole in Lake Huron is very exciting due to its unique features, and he has done a nice job of expanding his microbial ecology and carbon cycling work. He should continue along this path.

In summary:

- Dr. Biddanda is developing a national reputation for his work on carbon cycling and microbial ecology in lakes, and his work on Great Lakes sinkholes has received considerable attention in the scientific and popular press. Overall, his program has shown an impressive degree of maturation over the last two SAB review cycles.
- Dr. Biddanda has published steadily and has papers in the pipeline on a continuous basis. We laud that productivity, and expect that it will be maintained.

Dr. Carl Ruetz

Dr. Carl Ruetz joined AWRI in 2002 and was promoted to Associate Professor in 2009. He will be evaluated for tenure in 2012, which is the appropriate length of service (perhaps overdue) to be considered for tenure now that AWRI has gained independent academic status with tenurable faculty. The major research projects in Dr. Ruetz's laboratory continue to focus on fish populations (e.g., sturgeon, walleye) in western Michigan, with grant support from both state and federal sources. A new USEPA-GLRI project on coastal wetlands, in which Dr. Ruetz is a participant, diversifies his research portfolio. These projects are quite interesting, have attracted graduate students, and have good potential for expansion and longevity. Collectively, they provide a strong nucleus for his program into the future.

Dr. Ruetz has obtained an impressive amount of external funding ($639K) since 2009 for his laboratory as PI or co-PI, which is a major increase over his previous level of funding ($167K in 2007-2009). Efforts to obtain high-profile funding from NSF appear to have put on hold for the time being, which may be appropriate given his current array of projects that demand his time and attention. In our past review, we suggested that Dr. Ruetz visit potential federal funding agencies in Washington, DC, and volunteer to serve on a NSF (or other) review panel, which we hope may still happen in the future.

Dr. Ruetz's laboratory has matured to an impressive 8 individuals including a postdoctorate (funded by AWRI), 3 graduate students, 2 technicians, and 2 undergraduates. Since 2009, his laboratory has published 7 papers and 1 book chapter and presented an impressive 34 papers at professional meetings, including many by his students. While this is a strong rate of publication, journal quality could still be improved by targeting higher impact journals (e.g., *Ecology*, *Ecological Applications*) with more broad-based and integrative papers. His graduate students are actively involved in publication and have received university awards for their scholarship. Dr. Ruetz appears to be a very involved and active mentor.

Dr. Ruetz continues to provide strong teaching to GVSU students in his annual *Fisheries Biology* course and his semi-annual *Fisheries Management* course. He is involved in an appropriate level of external and internal service, most prominently in an editorial capacity.

In summary:

- Dr. Ruetz has built an active and well-funded laboratory than includes all 3 levels of training (postdoctorate, graduate students, undergraduates). He is publishing frequently, and with his students, although he could still target higher impact journals for his papers.
- Dr. Ruetz has diversified his funding to federal agencies (e.g., USFWS, USEPA), which is a positive sign for his program and his professional development.

- At this juncture, it is important that Dr. Ruetz expand his reputation beyond the fisheries community with a concerted effort to publish in general ecological journals and participate in national and international scholarly activities as appropriate.
- Overall, Dr. Ruetz's trajectory is clearly positive, and he has positioned himself well for his tenure review in 2012. He has made major strides in his scholarship since 2009 and the SAB compliments him on his accomplishments.

Dr. Jim McNair

During the last cycle, Dr. McNair published 2 peer reviewed articles and 2 technical reports, submitted 3 others, and he has 5 in preparation. It appears that only the 5 in preparation and one of the technical reports are based on new work at AWRI. We had expected more. He made 7 presentations and currently is on 4 grants, two as PI. Four other submitted proposals were unsuccessful.

Dr. McNair joined AWRI in 2009 with hopes that he would make a significant difference, both in his individual contributions and as an integrator across the other scientific staff. AWRI has long needed a scientist that has a personal research agenda that naturally connects to and integrates the interests and skills of the other scientists. McNair's research interest could eventually provide that glue.

In the last review cycle, Dr. McNair was encouraged to both pursue his own interests in modeling and analysis and provide leadership for the AWRI scientific staff in developing multidisciplinary, multi-investigator proposals that can take advantage of the skills, interests, and regional competitive advantage of their location in Muskegon. While there is clear evidence of his discussions and evolving collaboration with other PIs, new AWRI-wide collaboration on major new efforts have not emerged. We have suggestions on a new approach to encourage that below under "Overall Scientific Direction of AWRI".

In summary:
- The SAB continues to urge Dr. McNair to serve as the intellectual nexus for collaborative, or program, grants that would emanate from AWRI, such as to special programs of the NSF.
- Dr. McNair should continue to focus significant energy on publication in peer-reviewed journals, with the goal of 2-3 published papers per year based on new work at AWRI.

Dr. Alan Steinman

Dr. Steinman's scientific record and leadership continues to excel. He has received 11 new grants and contracts (10 as P.I.) for $1.25 million, including HUD support for the field station renovation. He has also secured donations to support 3 postdoctoral scholars that have added quite significantly to AWRI scholarship and integration. He published 8 journal articles (4 senior author) as well as 2 book chapters, 4 technical reports, and has 4 manuscripts in review. He made an impressive (and exhausting) 23 scientific presentations and 25 community presentations. He does all of this while having full administrative responsibilities as Director – many of the grants and contracts are for lab-wide activities in addition to his personal research.

Dr. Steinman teaches BIO 680a (Emerging Issues in Water Resources) every other year and provides guest lectures in many other courses. He advises one postdoctoral scholar, advised 2 graduate students between 2009-2011, is on the committee for 4 others, including students at MSU and Notre Dame. He is also very active in professional and community service activities, including serving on several national, regional, and state advisory boards and committees. These are time-consuming activities but very important for the AWRI Director to do – they well serve AWRI, GVSU, the community, and the environment.

Most of his research is focused on local and regional issues, which is appropriate given the logistics and overall mission of the AWRI. His research is of high quality and provides a good example for his more junior scientific staff. It is clear he plays an important mentorship role. Presently, the balance he has between administrative demands and scientific productivity seems good and highly successful in both areas. It is difficult to juggle scientific, academic, and administrative roles but it is important for Dr. Steinman to maintain an active research program. To this end, as suggested during the last review cycle, GVSU should give consideration to creating and funding as Assistant/Associate Director position for AWRI. Such a position would reduce the administrative load on Dr. Steinman, and allow him to focus more of his time and energy on programmatic development, collaborative proposals, and personal research that would enhance the overall research and educational enterprise at AWRI.

In summary:

- Dr. Steinman continues to serve as a role model for other faculty at AWRI, given his ability to maintain a very active and externally-funded research program along with excelling in his duties as AWRI Director.
- Although the SAB realizes that current economic climate in Michigan is not ideal for this, GVSU should again consider funding an Assistant/Associate Director position for AWRI to ensure that Dr. Steinman can maintain his strong research program, which benefits the entire AWRI mission.

Technical Staff

AWRI is served by a contingent of highly qualified technical staff. The significant role of these staff is underscored by their role as authors/coauthors of grant proposals and publications. They also serve a vital educational role, providing informal training to undergraduates, graduates, and postdoctorates. In the 2009 review, the primary concern raised by technical staff was the precariousness of funding for their positions, which is dependent on external grants. This was particularly the case for ISC, and it appears that some of these concerns were justified, with two members of the ISC group having been lost since 2009. While funding uncertainty is a reality for soft-money positions, the group as a whole did not raise strong concerns about this issue in the current review. The exception is Rod Denning, who is uncertain about the future of ISC and his position within it.

Although several technical staff have departed, the SAB was pleased to learn that three new postdoctoral positions have been filled at AWRI. These postdoctorates are making a significant contribution to the Institute's research program and, like some of the other technical staff, are assisting in the writing of grant proposals. The inclusion of a postdoctoral program has also been

a benefit to Master's students, who indicated that postdoctoral fellows have been a very useful learning resource for them.

One concern raised by graduate students and postdoctorates was the level of health insurance provided for these positions, which is apparently very basic. While this is set at the university level with little control by AWRI, as AWRI's role as a graduate institution continues to grow there may be need to consider health insurance programs that are comparable to those at other graduate universities, so that AWRI remains an attractive option for postdoctoral applicants.

Despite the above concern, there is a consensus among technical staff and postdoctorates that AWRI is a great place to work, due to positive interactions among research groups, strong technical support, and the Director's transparent and inclusive management style.

Education and Outreach Program

The Education and Outreach (E&O) program at AWRI is directed by Dr. Janet Vail, who is assisted by 9 seasonal instructors (generally retired teachers) and 2 part-time assistants during the remainder of the year. The SAB was pleased to see that Dr. Vail has been able to secure the resources for the part-time employees during the academic year. Activities of the E&O can be broadly classified into (1) local and extended vessel cruises for educational activities, (2) formal classroom teaching to GVSU undergraduates, (3) sponsorship and organization of regional conferences, (4) teacher continuing education programs, and (5) career fairs and state and federally funded demonstration projects. From 2009-2011, the E&O program received external grant, contract, and endowment support from 5 major sources, totaling ~$375,000 (up from $200,000 in 2007-2009), a remarkable achievement in a period of declining funding. Dr. Vail has initiated a new service learning program "GLISTEN" with Case Western University, and another program for Michigan teachers entitled "Groundswell". Most notably, Dr. Vail has attracted a large GLNPO grant ($292K) via the Great Lakes Restoration Initiative for her educational and outreach activities across the Great Lakes. Dr. Vail is also highly engaged in science instruction at GVSU, where she is teaching an Environmental Studies course, and co-teaching Education courses with Drs. Rediske and Biddanda.

The E&O program is very active and well integrated into the overall fabric of AWRI. In our last review, we suggested that Dr. Vail work more with the AWRI faculty to incorporate recent research into her program, and there is ample evidence that this is now occurring (e.g., co-teaching, research presentations during outreach activities, on-board exercises). One possible new effort might be to incorporate the planned Muskegon Lake Observational Buoy into educational activities, perhaps by real-time data presentation on the internet. Overall, the E&O program is well integrated into local, regional, and state environmental activities that focus on water, especially Lake Michigan, and is impressively active in state curriculum development and certification. Dr. Vail is also highly involved in professional service at the community, regional, and state levels, with clear benefits to AWRI and GVSU.

As in the past, a particularly impressive aspect of the E&O program is the K-12 educational program for school children in the tri-city area, which is conducted in the AWRI classrooms and on-board the AWRI vessels. Even in these economically challenging times, when vessel

endowment returns are at all-time lows, AWRI and the E&O program continue to offer high-quality and frequent educational opportunities. Over the 2-year period 2009-2011, about 11,000 people (children and adults) participated in the vessel program (only a slight drop from the 12,000 in 2007-2009). Another 4500 students and 300 teachers were reached by educational and outreach activities, a large increase from totals in 2007-2011. These activities are enormously important for AWRI, GVSU, the local community, and the state of Michigan. This level of outreach should be the clear envy of much larger, and better known, schools in Michigan, and a model for other Great Lakes states.

A novel idea emerged during SAB discussions with Dr. Vail to develop programs specifically for disabled individuals, which the SAB enthusiastically supports if feasible. Rather than the current model of "accommodating" disabled people on the vessels, for example, would it be possible to "target" the disabled with specific programs, or possibly expose the able-bodied to the scientific challenges of the disabled? For example, how would the sightless gather data with their other senses? Clearly, this is an ambitious and long-term consideration, but the SAB feels that the vitality and reach of the E&O program make this a realistic possibility for the future.

In summary:

- The E&O program is a vibrant and active component of AWRI that positively integrates AWRI into the local community, state, and Great Lakes region. Dr. Vail effectively directs an extremely impressive program in challenging economic times, and GVSU should work hard to backfill any financial shortfalls for this vital educational and outreach program.
- The integration of active researchers into the E&O program is a welcomed augmentation to the activities and should continue to be a emphasis. PIs are generally very busy, but the use of graduate students to demonstrate and communicate research findings is a win-win for both the E&O program and for enhancing the communication skills of the student.
- We encourage the E&O program to think about how to incorporate disabled individuals more vitally into their activities, which could be a learning model with far-reaching impacts.

Graduate Program

The SAB was pleased to note that the AWRI Master's program continued to improve during the period 2009-2011, with more enrolled students, more graduates, and a strong sense of solidarity within the group. The SAB met with a group of 6 graduate students and discussed a number of issues, including scholarly output, future employment opportunities, academic environment, facilities, and financial support.

Scholarly Output. Most students felt that they are receiving better encouragement and intellectual support to publish their research results, although they continue to point to the challenges of both completing a thesis and publishing a paper(s) in a 2+ year period. One very positive development since the last SAB is that the M.S. thesis can now be submitted as publishable paper(s) without special formatting as a thesis. The students indicated that this has been a very positive change. The students also indicated that they are encouraged to write grant proposals, which most viewed as a positive exercise (with which the SAB agrees). In this

regard, they specifically pointed to the usefulness of Dr. Luttenton's introductory course, which provides training in grant writing. The students say they make periodic presentations of their research internally, and are enabled with AWRI and PI funding to present their research externally. If anything, the students would like more frequent opportunities to present research internally at AWRI, perhaps in the format of an internal graduate seminar series or brown-bag lunch series. If open to all AWRI personnel, this would also encourage cross-laboratory fertilization of ideas.

Employment Opportunities. In our last SAB visit in 2009, we noted that M.S. graduates should be encouraged to consider Ph.D. programs as their next academic option. We are pleased to note that this idea seems to have taken root with this group of students. Of the 6 students we met, 4 are considering applying to Ph.D. programs upon finishing, and 2 are interested in obtaining jobs in fisheries management, which is also a good career option.

Academic Environment. The students noted that academic course availability continues to be challenging for their progress because a number of relevant courses are only offered once every two years. On the other hand, one particular required course, *Introductory Statistics*, was viewed by the students as having limited utility. The students suggested substitution of a more relevant statistics offering. In general, the SAB sensed a need for additional curriculum development that better prepares students for the Ph.D. track after graduation. Even the institution of a 1-credit seminar for all AWRI students would begin to prepare them for Ph.D. programs. The students appreciate the independent study courses that are offered, which to some degree offset the limited access to formal courses on the main campus. As a relatively small family of scholars at AWRI, the PIs may also want to consider presenting their own research to students on an annual basis. Library access limitations noted in previous reviews are no longer a problem, largely due to enhanced electronic journal access. However, certain common computer software packages (e.g., SAS, Sigmaplot) are available on only a limited number of AWRI computers because of license limitations. The SAB suggests investment in additional licenses to solve this simple problem.

Facilities and Financial Support. The students are largely content with AWRI facilities, including analytical equipment, computing resources (except for some software availability), and desk and bench space. AWRI vehicle sign-out was reported as somewhat cumbersome, and so students often opt to take their own vehicles to field sites. The cost for boat use also appears to be somewhat higher than affordable for student projects. Students may need to work with their advisors to reach a consensus on budget requirements related to boat needs prior to starting a project. Overall, the students are also satisfied with their stipend support ($16,000 per year), which can vary in amount over the course of a year but provides a dependable stipend. The odd system of receiving $8000 in 8 academic months, and then $8000 in 4 summer months makes personal budgeting challenging, but appears to be out of AWRI control. A true negative in the student support packages is the absence of any health coverage, which leaves students with the options of paying out-of-pocket, relying on parental or spousal coverage (if available), or going without coverage. GVSU should rectify this issue with at least partially subsidized student health coverage.

Possibility of a Ph.D. Program at AWRI

The SAB was asked to consider the possible institution of a Ph.D. program at AWRI in a 5-year horizon. Overall, the current Master's program is active and robust, produces strong graduates, and is critical to the success of AWRI as a research and educational facility. It is natural then to think about the next stage of graduate education, namely the Ph.D. The SAB believes that a near-term effort to erect a Ph.D. program at GVSU/AWRI might detract from the strong upwards trajectory of the Master's program, which is now maturing into a pipeline for students to move into good Ph.D. programs at other institutions. Instead, the SAB recommends a graded approach to this issue. First, individual AWRI PIs could seek to gain adjunct graduate faculty status at other Michigan or tri-state (i.e., Wisconsin, Illinois, Indiana) institutions so that their credentials in Ph.D. education and training can be developed in a co-advising capacity. If this is successful, AWRI as an entity could then seek to develop a joint Ph.D. program with a specific institution(s) at the appropriate juncture. At this point, AWRI PIs could seek to be sole advisors for Ph.D. students. AWRI has outstanding infrastructure (e.g., analytical laboratories, vessels, outreach capacity) that might be very attractive to a partner university in exchange for the research collaborations that might ensue and the "name" that another university with an established Ph.D. program could provide.

Overall Scientific Direction of AWRI

COLLABORATION

The overall scientific direction of AWRI is strong and as of the last review cycle the SAB considers the faculty to have reached a "critical mass" in terms of numbers and expertise to make larger integrative projects feasible. For example, the expertise of the faculty now spans from molecular and cellular to landscape and ecosystem modeling. Opportunities still exist for groups of AWRI faculty to collaborate on interdisciplinary program grants to federal agencies such as the NSF. As pointed out during the last review, periodic NSF calls for special competitions (e.g., CNH) should be heeded by AWRI faculty and submissions made as appropriate. This has not yet happened.

Faculty discussions appear to be bilateral and project specific, as opposed to strategic. We heard from many of the faculty, as well as from students and postdocs, a willingness and interest to be more integrated and strategic, and the SAB suggests the following as ways forward:

Journal Club/Eco-Lunch: Several students expressed appreciation for the postdoctorates' initiative in organizing discussions around relevant papers and research topics. They found them very useful and the broader group suggested that a simple incentive would increase participation. They felt making it a 1-credit requirement for all AWRI students would be welcomed and not considered a burden in their schedules. While the initiative of the postdoctorates was great, these sessions would be even more valuable if they included faculty, and this involvement of permanent staff would ensure continuity.

Strategic Brainstorming: While the current one-on-one engagements around existing projects and suggested periodic internal seminars on faculty research can be useful, a more strategic

approach to integration and collaboration might lead to more effective partnerships and innovative research. We suggest instituting periodic brainstorming sessions of faculty, postdoctorates, and students around higher-level research issues, allowing more discussion of approaches and potential collaboration. Each session could be led by a faculty member, but instead of focusing on their current project or approach, they would identify the ecological or environmental problem they are addressing. If presented at the right level, it should open up discussions and potential collaborations form many perspectives.

For example, a presentation focused on understanding and predicting the initiation, duration, distribution, and dissipation of harmful algal blooms could lead to discussions on the roles of microbial ecology, food-web dynamics, physical processes, eco-toxicology, and genetics, as well as a range of tools for addressing those (GIS, eco-hydrodynamic model, molecular genetics, etc). Such a conversation could lead to a broader, integrative, and strategic research agenda that involves a wide range of faculty, postdoctorates, students, and technicians. This could be done once per month with the lead rotating among PIs and postdoctorates. Involving the MS students would also provide a significant educational/training aspect to the sessions.

FACULTY RETENTION

The SAB is concerned about the ability of GVSU and AWRI to retain the highly performing faculty. While the Director has done an admirable job in recruiting top talent, it may become difficult to retain them in competition with peer institutions. We believe the current 12-month AWRI salaries are commensurate with 9-month salaries at peer institutions and recommend GVSU consider a change of structure. It could be possible to retain the current level of salaries, but make them 9-month appointments paid out over 12 months. This would allow productive faculty to augment their salaries via grants covering summer months, making them more competitive, but at no cost to GVSU or AWRI. In fact, indirect charges associated with the summer-salary grants would actually bring additional income to the University and/or Institute.

POSTDOCTORAL FELLOWSHIPS

The addition of postdoctoral fellowships is new since the SAB's 2009 visit. Dr. Alan Steinman is to be commended for procuring donations (from the Paul C. Johnson/Hines Foundation and an anonymous donor) to support the postdoctoral program, which has clearly benefitted AWRI faculty and graduate students. The new energy that the postdoctorates have brought to AWRI is tangible and exciting, and provides new impetus for M.S. students to consider the Ph.D. track.