Water Faculty Advisory Committee
Final Report
8 June 2012

Executive Summary

The Water Faculty Advisory Committee was charged with providing recommendations regarding the upcoming cluster hire for the MSU Global Water Initiative, which we here propose to rename as follows: **MSU Sustainable Water Imperative** (MSU SWIm). The Committee reviewed water plans and position descriptions developed across campus to identify five research focal areas for the cluster hire, of which one is cross-cutting and four are topical (Figure 1):

- Cross-cutting area: Integrated Risk Analysis and Critical Decision Making
- Topical areas:
  - Spatial and Social Dimensions of Water
  - Water and Health
  - Ecohydrology and Water Resource Engineering
  - Aquatic Ecosystem Services

MSU SWIm hires should be a mix of junior and senior positions. The cross-cutting integration in particular requires 1-2 senior scientists (i.e., Associate or Full Professor) with established track records of integrative research on projects conducted by large collaborative teams, tackling topics of key importance to society. Their tasks will be to assimilate and synthesize information produced by the topical areas listed here, as well as interacting with the many existing MSU faculty with strengths in these and other water-related topics. The overarching goal is to enable MSU to contribute much more substantially to integrated risk analysis and the scientific support to underpin decision-making in regard to the grand water-related challenges of the present and future. Modeling across multiple scales is likely to be an important tool for such integration.

The committee was also asked to provide advice on resource needs for the new hires and to develop lessons learned from similar programs at other institutions to help guide MSU SWIm. The key messages from these discussions are:

- In order to meet the goals to advance MSU water research quickly, the cluster hires should include senior as well as junior positions (as noted above).
- To attract the best candidates, MSU needs to offer competitive salaries and start-up packages.
- Advertisement of the positions could be conducted jointly for the four topical areas, as well as for the cross-cutting position(s).
- A single oversight committee, including at least one representative from the current Water Faculty Advisory Committee, would assist in establishing and providing guidance to five subcommittees conducting searches for the five areas in Figure 1. This would help ensure that the positions fit the vision outlined in this report.
- High quality infrastructure will improve the chances of attracting the best candidates and will also position MSU to successfully compete for external funds.
- Ideally, at least some of the key faculty working on water should be located in the same building.
- Resources across the university should be leveraged to meet the demands of supporting the new hires and improving conditions for current faculty conducting research on water science, technology and policy.

- A number of other water initiatives/programs benefit from substantial outside financial support (e.g., Cornell - $80 million, Nebraska - $50 million), primarily from a small number of large donors. Relying only on extramural grant support may put the MSU Sustainable Water Imperative at a disadvantage, therefore seeking major donors (e.g., Kellogg Foundation, Wege Foundation) and focusing on water in the MSU Capital Campaign should be seriously considered.
- The need for a coordinated structure for the MSU Sustainable Water Imperative was highlighted by the review of similar initiatives at other institutions. This coordination could be the responsibility of the Office of the Vice President for Research and Graduate Studies (OVPRGS) and would naturally build upon the existing efforts on campus (e.g., CWS, IWR, ESPP).

1. Charge for the Committee

In March 2012, Associate VPRGS Dr. Steve Pueppke convened an Advisory Committee of faculty to provide guidance regarding the upcoming hires for the MSU Global Water Initiative (hereafter proposed to be called the MSU Sustainable Water Imperative – MSU SWIm). The Committee was composed of two or more representatives from each of the four colleges involved with the Initiative (Table 1). The Provost has authorized 16 positions in water science, technology and policy, eight of which MSU intends to fill as a cluster hire in the 2012-13 academic year. The Committee was charged to identify thrust areas for the Initiative that would guide the cluster hiring process, taking full advantage of expertise and facilities already in place on campus in water science, technology and policy. Because others across campus have been discussing potential opportunities and hires related to the Initiative, the Committee was tasked with integrating ideas that were beginning to "bubble up" from colleges, departments, and groups of faculty regarding new investments in water science, technology and policy.

The Advisory Committee was asked to:

- Review "water plans" that have been prepared by academic units as well as groups of faculty, identifying linkages and overlaps that make sense from the standpoint of faculty researchers.
- Identify priority areas for the cluster hire, paying particular attention to how hires will enhance and connect with existing faculty and ongoing research.
- Provide advice on space, configuration, and facility needs of the new hires.
- Assess progress and lessons learned from cluster hires at other institutions with water-related research initiatives (e.g., Michigan Tech, Iowa), and provide advice on the logistics of proceeding with our cluster hire including how to ensure that connectivity is maintained across the positions, individual departments and colleges.

Table 1. Members of the Faculty Advisory Committee

Name	**Academic Unit**	**College**
Steve Hamilton	Zoology, Kellogg Biological Station	Natural Science
Jiaguo Qi	Geography	Social Science
Dawn Reinhold	Biosystems and Agricultural Engineering	Agriculture and Natural Resources
Joan Rose	Fisheries and Wildlife, Crop and Soil Sciences	Agriculture and Natural Resources
Vlad Tarabara	Civil and Environmental Engineering, Environmental Science and Policy Program	Engineering
Ned Walker	Microbiology and Molecular Genetics	Natural Science
Julie Winkler	Geography	Social Science

Irene Xagoraraki	Civil and Environmental Engineering	Engineering
Jinhua Zhao	Economics, Environmental Science and Policy Program	Social Science

2. Review of Water Plans

The committee began discussions by focusing on recommendations from last year's MSU Blue Ribbon Panel report, college planning documents (Table 2), and position descriptions written by chairs and faculty members (Table 3). The committee also considered feedback from faculty collected via a survey by the Center for Water Sciences. The committee used these positions as a starting point to identify common focal areas for research. In addition, the committee considered whether focal areas had a national or global priority, a strong likelihood of future funding, and whether obtaining such funding would be more likely if existing capacity at MSU were to be bolstered by strategic faculty hires (see Appendix 2 for information on funding).

Table 2. Positions identified in planning documents. Colleges and departments used a variety of approaches, with varying degrees of faculty engagement, to identify these positions.

CNS

- Water & human health
- Water & environmental systems:
  - Hydrology
  - Ecology
  - Evolutionary biology
  - Microbiology

CANR

- Irrigation
- Water quality & risk
- Water, climate, energy
- Wetland ecology and hydrology
- Landscape systems analysis- ecohydrology, quantity, quality
- Socio-economic modeling of water use

CEE

- Public health engineering
- Risk & reliability engineering
- Urban hydrology engineering
- Water infra-structure engineering

CSS

- Modeling of policies and regulations (regional and transboundary)
- Water justice- access
- Distribution- spatial disparities between supply and demand
- Adaptive risk management- dealing with uncertainty

Table 3. Positions identified by faculty members.

Department	Position
CARRS	Water law and policy with domestic and international applications (e.g., US-Canada, developing country/world park)
CARRS	Watershed management planning and policy with domestic and international applications
BAE	Ecological and Health Risk analysis
FW-AFRE	Aquaculture
FW	Wetlands
Forestry	Broad-scale forest-water cycle interactions

3. Potential Themes and Focal Areas of MSU Sustainable Water Imperative

We recommend that MSU SWIm be envisioned as encompassing four primary topical thrust areas that support an overarching, cross-cutting goal (Figure 1). The four topical thrust areas are 1) water and

human health, 2) spatial and social dimensions of water resources, 3) aquatic ecosystem services, and 4) ecohydrology and water resource engineering. These thrust areas are relatively broad in scope in order to capture the wide-ranging expertise of current and future MSU faculty and to provide flexibility for responding to evolving challenges and needs in water-related research and opportunities for extramural funding.

The cross-cutting integration requires 1-2 senior scientists (i.e., Associate or Full Professor) with established track records of integrative research on projects conducted by large collaborative teams, tackling topics of key importance to society. Their tasks will be to assimilate and synthesize information produced by the topical areas listed here, as well as interacting with the many existing MSU faculty with strengths in these and other water-related topics. The overarching goal is to enable MSU to contribute much more substantially to risk analysis and scientific support to underpin decision-making in regard to the grand water-related challenges of the present and future. Advanced technologies and modeling across multiple scales are likely to be important for such integration. Some hires for the four topical thrust areas are expected to be at the Assistant Professor level, but Associate or Full Professor hires are also encouraged as hiring at a senior level will provide greater early momentum to MSU Sustainable Water Imperative.

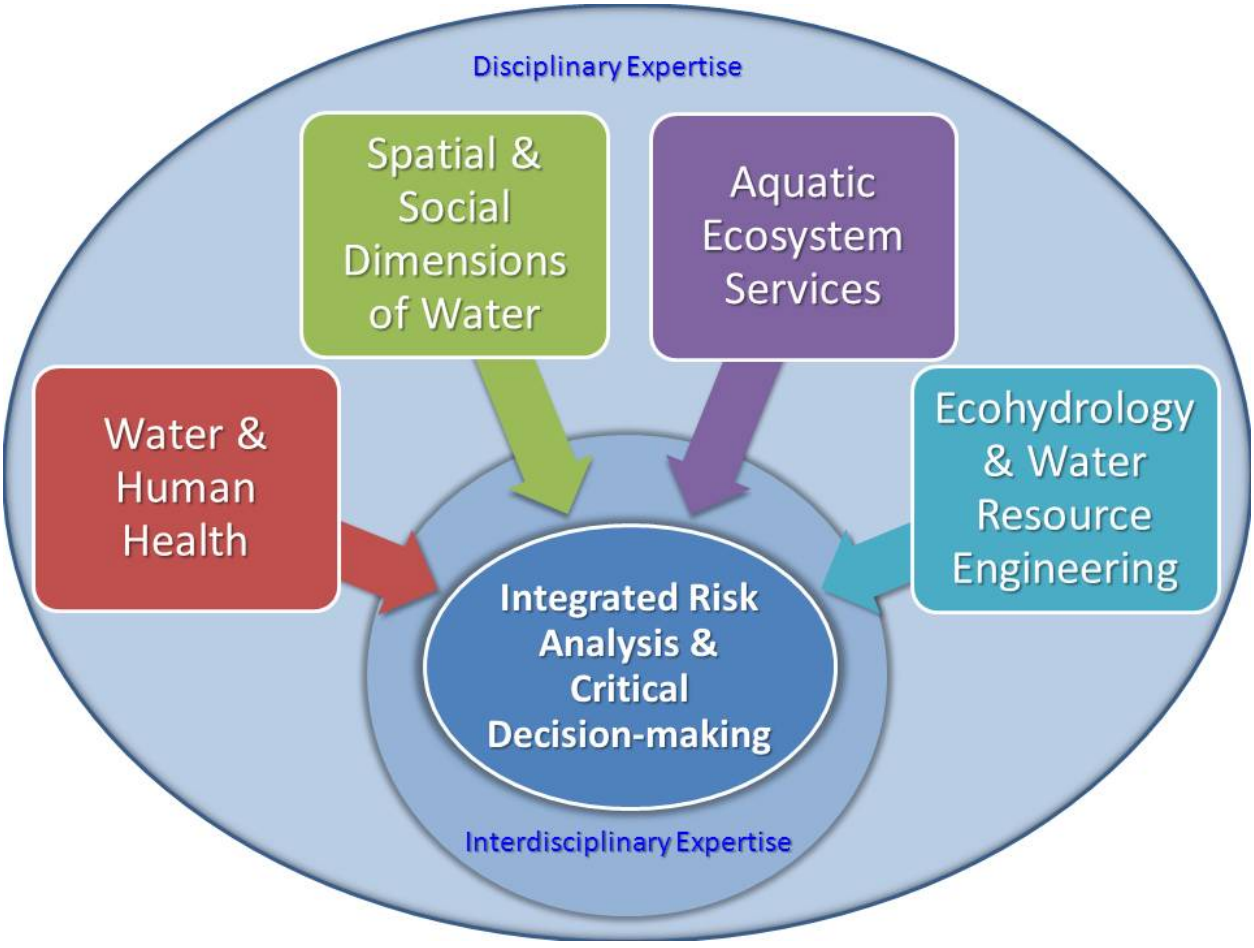

Figure 1. Proposed framework for MSU Sustainable Water Imperative. The outer boxes represent the four topical thrust areas that feed into the cross-cutting goal of integrated risk analysis and scientific support to underpin decision-making.

Below we elaborate on the cross-cutting integration and describe the four topical thrust areas. Additionally, we identify priority research emphases for initial and future faculty hires. Although all hires are expected to contribute to the cross-cutting overarching objectives, some hires will primarily fill gaps on campus in essential disciplinary knowledge whereas others will focus on increasing MSU's capacity for integrative, interdisciplinary/transdisciplinary research. As noted above, we recommend that those positions with explicit integrative expectations be made at the Associate or Full professor levels and be joint across two or more departments or colleges, whereas the more disciplinary positions may be filled at the assistant professor level. We did not limit the number of recommended positions to 16 or the priority hires to 8; the committee identified a larger number of potential positions because additional positions through "regular hiring" could also contribute to bolstering our strength in water science, technology and policy. Our recommendations for specific positions for the MSU Sustainable Water Imperative are summarized in Appendix 1.

Cross-Cutting Goal: Integrated Risk Analysis and Critical Decision Making

Effective interdisciplinary and transdisciplinary research at MSU requires closer and more effective interaction among researchers in different disciplines and academic units. For MSU SWIm to be successful, we must enhance our disciplinary strength while fostering greater linkages among faculty who can contribute to the research portfolio we envision. It is these linkages that will distinguish MSU SWIm from most water programs at other universities.

The overarching goal of MSU SWIm is to facilitate research drawing on the knowledge being generated by the four topical focus areas, integrating and synthesizing the information through modeling across spatial and temporal scales and bridging natural sciences, engineering, and social science. Such integration will enable MSU to assess environmental, economic and social dimensions of critical water resource issues, and hence to be able to offer leadership for science-based decision-making. Local to global integrative research to support science-based decisions may be in the form of projections, scenarios, risk analysis, and decision science, and is not just a unidirectional flow of information from topical areas into models, but rather involves the interactive collaboration of faculty working across diverse disciplines. For example, through better understanding of how decisions are made, social science models can study the impacts of changes in technology, regulations, social norms and economic policies. Biophysical process models, on the other hand, can evaluate the impacts of such decision changes on water, ecosystems and the environment. Combining these modeling efforts can shed light on the reciprocal interactions between socioeconomic and environmental dimensions of water issues; consideration of either dimension in isolation provides an incomplete and insufficient understanding of the causes, consequences, and solutions of the water-related challenges we face.

The need to evaluate water issues as complex systems of drivers and feedbacks is increasingly expressed by major government agencies (including funding agencies) and poses one of the greatest challenges for sustainability research. Furthermore, new approaches for the involvement of a broad array of stakeholders at all stages of the research process are needed, as well as improved strategies for the dissemination and application of findings. Although MSU is endowed with strong modeling capacity in many areas, we need critical capacity in integrated assessment models that can effectively link biophysical process models with social and economic models, potentially across regional, national and international scales.

Spatial & Social Dimensions of Water

An increasingly large proportion of the global population is expected to have limited or no access to high quality water resources by the mid to late 21st century, with wide-ranging implications for quality of life, resource management, and geopolitical stability. Both physical drivers, such as climate variability and change, and human factors, such as population growth and demographic changes, influence water availability at scales from the local to the global. This thrust area of MSU SWIm focuses on projected future changes in the availability, accessibility, and management options of high quality water resources and draws on MSU's strengths in regional and global change research. Potential hires under this cluster will contribute to a greater understanding of the spatial and social dimensions of water issues. Priority research areas for initial hires include 1) how increasing degradation of water quality and quantity affects food security and what can be done to ameliorate its impacts; and 2) water governance and policy in the face of growing water demands, diminishing supplies, and a changing climate. Priority research areas for future hires include climate change impacts on water availability, environmental justice with respect to water, water demands for energy production (including biofuels), and risk management strategies for coping with altered water availability and other environmental impacts.

Water & Human Health

Water-based and waterborne diseases are the largest contributors to the increasing global burden of disease. Contamination of drinking water and recreational waters is an issue in both developed and developing regions of the world. Global threats from ancient diseases and emerging new pathogens are immense and increasing. Failing water infrastructure, flooding and disasters, non-point source pollution and emerging contaminants all impact human health and well-being, either directly or by compromising ecosystem health and services. Additionally, water serves as habitat for intermediate hosts and vectors of human pathogens. Major research arenas include application of new metagenomic technology to understand the nature and role of microbial life in aquatic systems and pathogen risk; a better understanding of how relationships among pathogens, humans and the environment emerge in a biological, social, and landscape context; risk analysis in settings such as large-scale water development projects; and the mitigation of human health risk. This thrust area of the MSU Sustainable Water Imperative focuses on water-based and waterborne diseases including an understanding of the factors that determine their prevalence, the risks they pose, and measures that can be taken to prevent or minimize risk. Priority areas for initial hires include 1) disease ecology using new genomic technology in relation to current and projected future configurations of water resources and supply systems; and 2) new technologies for water treatment and sanitation that are cost-effective and practical for the settings in which they are most needed. Priority research areas for future hires include understanding of the water microbiome and the design of reliable and resilient water supply infrastructure in the face of disease risks.

Ecohydrology & Water Resource Engineering

Quantitative analysis of hydrologic systems is crucial to addressing the sustainability of water resources in the context of a rapidly growing population, particularly in the face of climate change. This thrust area of the MSU Sustainable Water Imperative focuses on hydrologic and hydraulic analysis to address urgent water quantity problems, with a secondary emphasis on water quality. Particular emphasis will be placed on understanding hydrological processes to address environmental problems, i.e., ecohydrology. Priority areas for initial hires include 1) consequences of, and adaptation to, increasing frequency and severity of extreme hydrological events, as projected by climate models; and 2) management of urban and peri-urban hydrological systems, which are particularly prone to problems related to altered hydrology and degraded water quality. Risk and reliability engineering, water infrastructure engineering

and technologies for improved water resources management are other areas of interest for future hiring.

Aquatic Ecosystem Services

An ecosystem approach to understanding, managing and protecting our water resources and the essential ecosystem services they provide to people is an essential component of a broad water research initiative. Interactions between the biota and physical and chemical environment (e.g., biogeochemical cycles) as well as among populations and communities of organisms (e.g., food webs) underpin critical ecosystem services such as replenishment of groundwater, maintenance of clean water, mitigation of flooding, climate regulation, and provision of fish and wildlife. Ecosystem analysis draws on the biological, physical, mathematical, and engineering disciplines to understand the complex interactions and feedbacks that underpin ecosystem processes and services. Integration of ecological knowledge at the population, community, and ecosystem levels is fundamental to the ecosystem approach. MSU is already strong in this area, but two priority research areas have been targeted for initial hires because they are underrepresented at MSU and are key to our broader research agenda: 1) wetland ecology and hydrology, particularly in regard to restoration and management of wetland ecosystem services and/or the role of wetlands in global change; and 2) microbial regulation of water quality, particularly as it relates to greenhouse gas emissions and excessive nutrient loading to the environment. Other areas of interest for future hires include economic valuation of ecosystem services and ecological risk analysis.

4. Support Needed for Success

In order to meet the goals of MSU SWIm quickly, the cluster hires should include senior as well as junior positions. The committee discussed the goal of having at least 50% of the cluster hires be senior positions, either Associate or Full professors. The rationale for this recommendation is that a senior person has the experience and expertise to serve as a catalyst for moving an existing group of MSU faculty forward in a short time frame. In addition, we see these senior hires as focusing on the cross-cutting theme and serving as integrators.

To attract the best candidates, MSU will need to offer competitive salaries and start-up packages. The Chronicle of Higher Education's 2012 Faculty Salary Survey reports that MSU salaries for Assistant Professors rank in the 40th percentile, which is below the national median salary. It is important to provide competitive salaries and startup packages not only to attract the best applicants, but to ensure junior hires have the resources needed to progress through the tenure process. Providing support for students and post-doctoral researchers as part of startup packages can be an additional incentive for applicants.

New faculty members hired as part of the cluster will likely be jointly appointed to encourage interdisciplinary research. The committee recommends that jointly appointed faculty members have at least 60% of their appointment in a home department. In terms of logistics for the hiring process, the search committees will likely be driven by the home department(s) and college(s). We encourage the search committees to identify MSU faculty/units in each focus area that should be consulted regarding the position description, serving on the search committees, and collaborating with new hires. We suggest that if possible the search committees be formed across colleges based on focus area, and not department. For example, MSU hydrology experts include members of Geological Sciences (CNS), Biosystems & Agricultural Engineering (CANR), Geography (CSS), and Civil & Environmental Engineering (COE), and should all be considered for search committee service to guarantee that a new hire will best

fulfill the needs of MSU as a whole. As always, final hiring decisions should be left to the home department(s).

Advertisement of the positions could be conducted jointly for the four topical areas, as well as for the cross-cutting position(s). A single oversight committee, including at least one representative from the current Water Faculty Advisory Committee, would assist in establishing and providing guidance to five subcommittees conducting searches for the five areas in Figure 1. This would help ensure that the positions fit the vision outlined in this report.

Space is an important consideration for the new hires as well as current MSU faculty. The quality of infrastructure will improve the chances of attracting the best candidates and will also position MSU to successfully compete for external funds. Ideally, faculty working on water would be located in the same building; key researchers working together in one space would avoid the fragmentation of water science, technology and policy typical of most universities, and provide critical mass for advancing water research on campus. A new building for water science, technology and policy should therefore be part of a long-term plan for MSU. The recent proposal submitted to the NIST program, which was later defunded by Congress, could serve as a starting point for this concept. Although the NIST proposal was focused on a specific topic, climate and water, it provides an example of the type of space needed in terms of wet laboratories, computational laboratories, microbiological laboratories, office space, and other needs of water researchers.

Regardless of whether a new building is a possibility, space issues will need to be addressed in the short-term. The issue is not just one of quantity, but quality of space as well. New hires will need offices, laboratories and office space for students and post-doctoral researchers. These needs will obviously vary with the position and may be more resource-intensive for some than others. The committee recommends that colleges and departments assist in finding a sufficient quantity of space and that the university invest in improving the quality of space. The current allocation of space should be evaluated by the Colleges to assess what space is available, needs renovation, and/or could be reassigned if departments involved with hiring faculty are space-limited. One approach for providing a physical link without building a new facility is to continue to house faculty in their home departments but provide a space for a central organization.

The committee recommends leveraging resources to meet the demands of supporting the new hires and improving conditions for current faculty. The university should involve industry and potential funders in the development and funding of new laboratories and/or a building.

5. Lessons Learned from other Institutions

A substantial number of water or sustainability programs have recently been established at universities across the United States, including two in Michigan alone. Most initiatives are research driven, although graduate student training is also an important element of the initiatives. Only the water initiative at the University of Nebraska appears to have a strong service component.

Many of the foci and research themes of these programs extensively overlap with those that have been considered for MSU SWIm. This opens the opportunity for substantial collaboration with other institutions, particularly on multi-institution grant proposals, and, since several of these programs have been in place for a number of years, MSU has an opportunity to learn from the successful aspects of these programs. The overlap in focal areas among institutions also reinforces that the topical areas

recommended above are widely recognized as having high potential for intellectual growth and for producing outcomes of significance to stakeholders, and, additionally, have substantial potential for increasing extramural funding.

A challenge, however, will be establishing a unique "brand" for MSU SWIm that distinguishes it from other water initiatives in the minds of potential students, stakeholders, and Michigan citizens and taxpayers. The Land Grant nature of MSU including our widely recognized strengths in agriculture and natural resource management should be strongly linked to the goals of the Sustainable Water Imperative, while simultaneously highlighting the innovative and cross-cutting aspects that represent new and exciting directions. Also, MSU's commitment to—and strength in—research from local to global scales should be highlighted. While at the individual level the expertise sought for the proposed hires will overlap with that of faculty at other institutions, collectively the cluster hires should bring perspectives and capacity to MSU SWIm that distinguish it from water and sustainability initiatives at other universities, particularly when considered together with our existing portfolio of water research. It will be these linkages that make MSU SWIm unique.

Our review of the other programs suggests that the proposed number of new faculty positions is in line with the hiring that has/is occurring with other initiatives. For example, the initiative at the University of Iowa recently has hired eight positions, seven at the assistant professor level and one at the full professor level. Cornell is hiring multiple focus areas, with 2-5 new hires per cluster. The Center for Water as a Complex Environmental System at the University of Illinois at Urbana-Champaign is seeking nine new faculty members, whereas the water systems initiative at Michigan Technological University is hiring seven new positions.

A number of the water initiatives/programs benefit from substantial outside endowment support (Cornell - $80 million, Nebraska - $50 million), primarily from a small number of large donors. Relying only on extramural grant support may put MSU SWIm at a disadvantage, and therefore seeking major donors (e.g., Kellogg Foundation, Wege Foundation) and including water as a focus of the MSU Capital Campaign should be seriously considered. This is where a carefully-selected board of external advisors would be very helpful.

The need for a formal coordination structure for MSU SWIm was evident by the review of similar initiatives at other institutions. All of the initiatives reviewed have an "office" or "director" to spearhead the initiative and to provide a point of contact. The level of support varied greatly by institution, with some programs (e.g., Cornell) having multiple full-time staff and PhD level administrative slots. Almost all programs have some mechanism for faculty association and participation, often through advisory boards or steering committees. Furthermore, a board of external advisors is common, and this should include prominent members of the water research and policy community, drawn from academia as well as industry and non-governmental organizations and ideally including potential donors.

We recommend a formal coordination structure to ensure success of MSU SWIm. The committee noted that it will likely be the linkages—linkages among researchers, disciplines, academics and decision-makers—that will make the MSU initiative unique and therefore fostering and sustaining these connections should be an integral part of the initiative. The Blue Ribbon Panel report also noted the necessity of a "central organization which ties our water science programs together and provides institutional support for interdisciplinary research, particularly for strategic new hires that will be key to linking existing expertise into transdisciplinary programs." We recommend creating the coordinating structure within the Office of the Vice President for Research and Graduate Studies (OVPRGS) that builds

upon existing linkages developed among water scientists and engineers (e.g., through CWS and IWR) and cross-cutting risk and decision making capacity developed by ESPP.

Cornell University has perhaps the most innovative approach for integrating current faculty strengths and interests into their sustainability initiative, whereby current faculty can formally propose new focus areas for cluster hires. The proposals are reviewed by a faculty committee that makes recommendations to university administration. Once new focus areas have been approved, colleges and departments take the lead for the hiring process. This "grass roots" approach has considerable appeal and perhaps can be incorporated, at least to some extent, into MSU SWIm.

Most of the institutions with water/sustainability initiatives provide graduate students with a formal recognition of their expertise in water resources and/or sustainability, usually in the form of a certificate of expertise (e.g., Michigan Tech University, University of Iowa). An interdepartmental graduate program in water science, technology and policy, perhaps following the model of the Ecology, Evolutionary Biology, & Behavior Program at MSU, would be appropriate to consider after the new faculty are assembled.

6. Recommended Actions and Timeline

We recommend the following actions and timeline:

- With the key departments involved, search committees should be formed within the next two months and Fall (2012) and Spring (2013) semesters should be devoted to advertising, interviewing and hiring of the new faculty.
- As part of the advertisements, a key mission for MSU Sustainable Water Imperative should be articulated (e.g., "Enhancing global water science and technology for policy and education in a changing world"). MSU University Relations may be able to assist in developing a catchy program name and mission statement.
- MSU should develop a coordination structure within OVPRGS to oversee MSU Sustainable Water Imperative, utilizing the existing networks on campus such as CWS, IWR and ESPP as an instrument to connect the new hires (all 16) with current faculty doing water research. The structure should leverage existing linkages developed among water scientists and engineers (e.g., through CWS and IWR) and cross-cutting risk and decision making capacity developed by ESPP.
- An executive steering committee representing key departments should be formed to guide the Sustainable Water Imperative. Funding should commence for three years to provide resources to support search committee efforts, potential visits to funders, workshops and assistance with multi-disciplinary grants. This group would also examine how to best enhance infrastructure needs for the new hires.
- An academia-industry-community water advisory committee should be formed by Spring 2013.
- Joint appointments should be strongly considered for all hires. It is expected that senior hires will be joint appointments. The cluster hire should include at least four senior hires at the Associate or Full Professor level. Priority for senior hires should be those positions with explicit integrative expectations.
- A single oversight committee, including at least one representative from the current Water Faculty Advisory Committee, would assist in establishing and providing guidance to five subcommittees conducting searches in the four topical focal areas and the cross-cutting area.
- Longer-term plans for high quality infrastructure and a new building (e.g., expansion of the NIST proposal) should begin.

Appendix 1. Recommendations for Specific Positions

Recommendations for specific positions are summarized below. The positions are organized around the four topical thrust areas with additional positions that directly support the overarching, cross-cutting goal of integrated risk analysis and decision making (Figure 1).

Spatial & Social Dimensions of Water

Interface between water and food: The interface between water and food is an important topic for the MSU Sustainable Water Imperative. This is also an area that could link extensive existing expertise on campus. The position would focus on how increasing degradation of water quality and quantity affects food security and what can be done to ameliorate its impacts.

Water governance and policy: This position would focus on how regulations, standards, policies, norms, and management options influence the efficacy and trajectories of regional and transboundary water resources in the face of growing water demands, diminishing supplies, and environmental change.

Water and Human Health

Waterborne and water-based disease: This position would focus on disease ecology in relation to current and projected future configurations of water resources and supply systems. In particular, the position would involve the application of novel genomic tools and/or models to improve understanding of the ecology of enteric pathogens . Of particular interest is waterborne disease associated with disasters such as floods and the impacts of environmental change, including climate change, on emerging/evolving pathogens.

Water quality technologies: This position focuses on new technologies for water treatment and sanitation that are cost-effective and practical for the settings in which they are most needed. Additionally, improved methods for measurement of water quality are of interest.

Ecohydrology & Water Resource Engineering

Extreme hydrological events: The focus of this position is on the consequences of, and adaptation to, changes in the frequency and severity of extreme hydrological events. This position will be concerned with the development and application of physically-based hydrologic models of groundwater and surface water interactions, and the spatial and temporal scaling issues and controls on hydrologic fluxes..

Management of altered urban and peri-urban hydrology: This position would focus on management of urban and peri-urban hydrological systems, which are particularly prone to problems related to altered hydrology and degraded water quality. With many urban centers around the world growing rapidly, there is an urgent need for studies focusing on water and the sustainability for urban societies and infrastructure networks.

Aquatic Ecosystem Services

Wetland ecology and hydrology: An improved understanding of the complex linkages among wetlands, their hydrogeomorphic and climatic settings, and their interactions with people is needed to better manage these important ecosystems and thereby ensure continued provision of vital ecosystem services. Wetlands provide ecosystem services disproportionate to their area, such as regulating water availability, influencing climate, and affecting human health and well-being through impacts on water-borne and zoonotic diseases, food resources, and access to safe drinking water. Furthermore, wetlands are often biodiversity hotspots and provide important biogeochemical processing as transitional zones between upland terrestrial ecosystems and standing and flowing waters.

Microbial regulation of water quality and climate change: Microbially mediated processes in aquatic ecosystems control water quality (nutrients, contaminants) and climate forcing (greenhouse gas production from aquatic and wetland ecosystems), and thus understanding and managing these processes is key to facing the major environmental challenges of the 21st century. Flowing waters, wetlands, and coastal zones—and particularly the sediments in these environments—are especially important interfaces (also known as critical zones) where microbial processes drive biogeochemical transformations of regional and global importance.

Cross-cutting Goal of Integrated Risk analysis and Critical Decision Making

Two positions are recommended that directly support the central, cross-cutting goal of the MSU Sustainable Water Imperative. As stated in the text, we recommend that these positions be filled at the senior level, and that appointments be joint across colleges.

Integrative modeling and systems analysis: This position would focus on the development, improvement, and application of integrated systems models to better to understand the complex interactions and the impacts of environmental and social change at multiple scales.

Risk analysis and management: The focus of this position is on understanding decisions of individuals, households, communities, governments and businesses in the face of uncertainty, including the development of sound adaptation options and strategies to provide decision makers with information to manage, mitigate, and adapt to environmental changes that affect water resources.

Appendix 2. Funding Trend and Opportunity Information

Although the committee did not spend much time discussing funding trends and opportunities, we acknowledge that garnering large external grants is a main focus of MSU SWIm. Therefore, we provide a brief summary of relevant trends and programs focusing on interdisciplinary/transdisciplinary sustainability programs. This summary is not intended as a comprehensive review, but focuses on a few key items. Please see the Blue Ribbon Panel report for a discussion of additional programs for funding water research, including the Great Lakes Restoration Initiative, NSF Science Technology Centers, NSF Engineering Research Centers and NSF-USAID programs.

Funding Trends

AAAS and NSF report that federal support for many disciplines has remained relatively constant over the past three decades. Although federal support for life sciences research increased dramatically up to 2003, funding is now declining. In addition, most of the life science funding has been allocated to support NIH biomedical science programs, which has resulted in flat or decreased funding for agricultural sciences, non-human biology and other non-medical life sciences. However, there have been significant investments on a program-by-program basis including investment in NSF sustainability programs (see below).

In its latest report on foundation funding trends from 2008-2009, The Foundation Center reports that grantmaking continues to decline as a result of the weak economy. Several relevant findings for the Global Water Initiative are:

- The environment and animals, social sciences and science and technology areas showed the greatest declines in private foundation funding from 2008-2009. Health and education had the highest levels of investment over the same time period.
- The largest share of foundation funding went to educational institutions.
- Among major areas of activity, education, health, human services, and public affairs/society benefit captured the largest shares of grant dollars awarded.
- Foundations in the Midwest favored investments in education.

Sustainability Funding Opportunities: NSF Science, Engineering and Education for Sustainability (SEES)

The NSF Science, Engineering and Education for Sustainability (SEES) program is a cross-cutting, NSF-wide investment to support and advance sustainability science. **The SEES program would be a logical target for MSU water researchers to garner external funding for large, interdisciplinary projects. The focus areas identified in this report align with many of the SEES program goals.** The current portfolio of SEES programs includes:

- Arctic SEES
- Climate Change Education (note: latest budget passed by US House of Representatives prohibits funding of this program, the Senate has not voted on it yet)
- Coupled Natural & Human Systems
- Dimensions of Biodiversity
- Earth Systems Modeling
- Ocean Acidification
- Partnerships for International Research and Education
- Research Coordination Networks
- SEES Fellows

- Sustainability Research Networks
- Sustainable Energy Pathways
- Water Sustainability and Climate

NSF has identified focus areas for future funding programs that include:

- Chemistry, materials, engineering- renewable non-toxic materials, process improvements
- Coastal regions- vulnerability, resilience, cultural impacts
- Hazards and disasters- science engineering risk assessment, decision-making
- Information science and engineering- role in advancing sustainability science and reducing environmental impact of computing

NSF plans to expand the SEES portfolio beginning in FY 2012. NSF has requested an additional $337.45 million (which would result in a total of $998.19 million for the SEES program) to 1) continue the integration, responsiveness, and effectiveness of ongoing programs; 2) emphasize research and education on Sustainable Energy Pathways (SEP); 3) institute a formal program of Postdoctoral Fellowships in Sustainable Solutions; 4) initiate a program of interdisciplinary Sustainability Research Networks (SRNs) linking existing and new nodes; and 5) include international connections through targeted awards in the Partnerships for International Research and Education (PIRE) program.