

Water Resources Planning and Management On-Line

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At the beginning of the 21st century, it is widely accepted that there is a global water crisis of varying dimensions. Concurrently, in the United States, many federal and state agencies are facing the prospects of retirement of seasoned water resources planners and managers. The problem is exacerbated by the shortage of qualified replacements. The U.S. Army Corps of Engineers (USACE) and other agencies have recognized this problem and are exploring a menu of education and training programs that will help in developing qualified replacements for their departing water management staff. As one option for dealing with this problem, the USACE's Institute for Water Resources (IWR) proposed establishing a cooperative master's degree program in water resources planning and management with several regionally located universities (Southern Illinois University, the University of Arizona, Johns Hopkins University, Harvard University, and the University of Florida). The Corps' plan was to send employees to one of these institutions for a full semester, and then have the student return to their duty station to complete their degree locally or on-line.

Getting the Program Started

In 2002, the University of Florida's (UF) Department of Environmental Engineering Sciences (EES) was invited to submit a proposal to IWR to become a partner in their proposed cooperative Water Resources Planning master's degree program. At that time, UF did not have such a program, but it was found that many courses to support it were available. Considering the widespread state, national, and global interest in water, it was determined that a new degree program

in water resources planning and management would be worth considering. But several issues had to be faced before making a final decision on the proposal: availability of qualified faculty who would be willing to be players, program content, new course development, program sustainability, and student potential.

On the faculty issue, it was determined that qualified faculty to support an on-line program were available. An array of required and elective courses was identified that met IWR/UCOWR criteria, but several new courses had to be developed, notably a course on Water Resources Planning and Management and a synthesizing Project Capstone course. It is important to note, however, that UF offers many courses not included in the program that could be selected as electives if their professors were willing to teach on-line. The issue of program sustainability was an especially important one. Consideration had to be given to the longevity of state, national and global interest in water, and to having a continuing stream of incoming students sufficient in size to make investment in the program worthwhile. Based on evidence of global concern with water availability and climate change, it appeared evident that the need for such a program would be sustainable. Regarding the supply of students, the answer was not so simple. It had dimensions of student interest, tuition costs, availability of support, and admission requirements. For UF, it was determined that the major source of students would be employees of agencies and firms engaged in water resources planning and management. Regarding its partner the USACE, it was clear that the number of civil works people employed in water resources planning and management nationwide was large, but that turf and cost considerations could minimize access

to this pool outside of the southeast. Reasoning that USACE alone could not be depended upon to provide the continuing stream of incoming students needed to sustain the program, attention was given to the enormous pool of potential students employed by state, federal, and local government agencies, consulting firms, water management districts, river basin commissions, water utilities, and other relevant organizations.

Once it had been determined that sustainability could be achieved, EES implemented an on-line master's degree program with specialization in Water Resources Planning and Management (WRPM). The program was designed to be course work only, consisting of ten courses totaling 30 credit hours. The on-line format was selected because it was believed to be the best fit for practitioners since it was not geographically or temporally bound. It was also believed that USACE's model of having their students in residence for one semester, while a worthy approach, would not be affordable for them (this has now proven to be true). Students may, however, enroll in all, or a portion, of the program on-campus if they so desire. Engineering students receive the Master of Engineering degree while those with other backgrounds receive the Master of Science degree. The content of both programs is identical.

Program Objectives

Today's world is unlike that of even a few years ago. The pace of technologic change, the shifting in social values and preferences, and rapid changes in computer speed and problem dimensional capability provide us with the ability to analyze futures that until recently were only vague embryos in the minds of dreamers. And in recognition of these changes, there is the need for a collaborative interface among engineers, planners, scientists, citizens, and policy makers. The engineers and scientists of tomorrow will require ethics of practice that permit them to range beyond the technicalities of design and into the realm of policy that ultimately specifies what those designs should be. Imaginative and creative individuals are needed who can perceive and respect technical and non-technical solutions to society's problems; put forth and assess viable alternatives; and understand

and deal with environmental needs in the context of all other needs. Engineers and scientists should be prepared to take leadership roles in guiding those in decision making capacities to create the best possible policies and regulations for the development and management of water, land, and other resources.

Since the early 1960s, a host of federal and state laws and rules have emerged to protect the environment, ensure clean air and water, protect endangered species, and encourage the restoration of ecosystems. Accordingly, contemporary water resources planners and managers must be conversant with the broad dimensions of the planning arena with which they must deal. They must be comfortable in working on planning teams involving a variety of concerned stakeholders, engineers, scientists, sociologists, economists, geologists, ecologists, and others. The challenge to educators is to produce technically qualified individuals who can relate their knowledge to the realities of the prevailing political, economic, and social settings in which all water problems must be solved.

Unfortunately, skills for managing human relationships are uncommon in academic engineering and science programs. The result of this deficiency is that many new (and old) planning and management professionals are unprepared to deal with the complete dimensions of their jobs. Recognizing this, the UF curriculum was designed to: (1) provide a comprehensive base in the theoretical aspects of water resources planning and management; (2) translate these theories into practical applications; (3) support objectivity and promote the ability to communicate across disciplinary boundaries and with decision makers in terms that they can understand; and (4) to foster an understanding that water resources planning and management must be conducted in the reality of the world at the moment, but mindful of the need for change as the future unfolds.

Courses included in the WRPM program are:

- Water Resources Planning & Management
- Environmental Policy
- Advanced Environmental Planning and Design
- Principles of Industrial Ecology

- Natural Resources and Environmental Policy
- Advanced Energy and Environment
- Water Resources Planning Practicum
- Water Resource Sustainability
- Global Environmental Policy
- Ecological Engineering
- Public Works Management
- Environmental Soil, Water and Land Use
- GIS in Land Resources Management
- Public Works Planning

Topics covered in these courses include: water resources planning and management, water-related institutions, decision support systems, water and environmental policy, ecology, water resources infrastructure, economics, hydrology, hydraulics, and quantitative methods.

An advanced planning practicum synthesizes the subjects covered in the program. Students analyze a comprehensive water resources plan in a region of interest to them and relate their findings to the subjects addressed in the WRPM program. The objective is to provide an opportunity for students to understand the relevance of the subject matter of the WRPM program to the actual practice of water resources planning, and to judge their selected plan's strengths and weaknesses based on their learning experience.

Admission Requirements

Students having a bachelor's degree in science or engineering (and some other specialties, upon approval) are eligible for enrollment providing they meet requirements for admission to the Graduate School (see www.ufl.edu/pstudnts.html for details). Admission requirements generally include a minimum GPA of 3.0 for all upper division undergraduate coursework and a minimum verbal-quantitative score of 1100 on the General Test of the Graduate Record Examination (GRE). Applicants not meeting the usual threshold values for GRE and GPA may, however, be admitted conditionally based on their professional status and letters of recommendation.

Because most of the students considering enrolling in the WRPM program have graduated

from college a number of years ago (sometimes as much as twenty years) the GRE requirement is daunting. To provide some relief in that regard, the UF Graduate School has waived the GRE requirement for all USACE applicants. Furthermore, for all students who have received their degree in engineering, a passing score on the Fundamentals of Engineering (FE) exam may be substituted for the GRE requirement. Another difficulty is sometimes the upper division GPA requirement. It is not uncommon for a student who graduated, say ten years ago, to have a GPA below the usual threshold for admission. In such cases, strong reference letters from employers and evidence of increasing professional responsibility are used in making a final decision on admission. It is interesting to note that of the first fourteen students to graduate, eleven were exempt from the GRE and the upper division GPAs of all fourteen ranged from 2.87 to 3.46. The average GPA of all fourteen students, upon graduation, was 3.8. Clearly, all of these individuals were well qualified to do graduate work. It should also be pointed out that all of the graduates had been fully supported by their employers to pursue the master's degree. This, in itself, indicates that these students were qualified to pursue a graduate degree. Employers pay tuition costs only for employees that they believe are well-qualified and whose completion of the program will add value to their organization. For further information on admissions, contact the EES academic office at 352-392-0842 or at studentservices@ees.ufl.edu for details on enrollment.

The Student Body

As of October 2007, thirty-seven students were enrolled in the UF Graduate School to pursue the WRPM master's degree program: nine USACE Civil Works employees, two USACE Commissioned Officers, two U.S. Navy Commissioned Officers, one U.S. Air Force Commissioned Officer, three South Florida Water Management District employees, one St. Johns River Water Management District employee, one Southwest Florida Water Management District employee, three local government employees, ten Consulting Firm employees, and five employees

of State Agencies, Industry, Utilities, and other categories for a total of 37. These students were located in seven states, the United Kingdom, Italy, and Mexico. Some USACE students completed part of their work while on temporary assignment in Iraq. By December of 2007, sixteen master's degrees with specialization in Water Resources Planning and Management had been awarded.

The WRPM online master's program attracts a broad range of students. The specializations of Bachelor's Degrees of students enrolled in the program mirrors the diversity of backgrounds of practitioners on water resources planning and management teams. At this writing, bachelor's degree majors of students enrolled include: biology, chemistry, engineering, environmental science, forestry, geography, geology, marketing, mathematics, meteorology, planning, zoology, public health, psychology, and soil and water science – clearly an interdisciplinary mix.

Student Attributes

The WRPM was designed for professionals engaged in, or planning to be engaged in, water resources planning and management. The students enrolled generally received their bachelor's degrees more than five years ago, and as many as twenty years ago. They have considerable professional experience and many of them have leadership positions in their organizations. It is noteworthy that as they benefit from the master's program they also bring considerable value to the program by sharing their knowledge and experience with other members of the class, and with the professor as well.

Because of the requirements of their positions, many of these individuals must travel frequently for brief periods, and sometimes for longer periods. This must be understood and provided for by the instructor. Since the program is on-line, students are not fixed to watch the lectures at a particular time. And even when they are on travel they can often watch lectures as long as the location affords internet access to them. As long as there is flexibility in their pursuit of the program, students can catch up when needed and this should be recognized. Each student has to be considered individually in terms of his/her special circumstances. It is

important that the instructor communicate with on-line students in a timely matter and work with them to handle special circumstances once they have been identified.

For students in the military, the need for flexibility in course management by the instructor may be more complicated. Currently (2007), there are five military officers in the WRPM program. Two of them are based in Italy and one is based in the UK. All of these individuals are subject to long or short-term deployment to other areas. The U.S. Air force Officer is particularly subject to frequent short-term moves. In some cases the relocations afford internet access, but not always. Under such circumstances, the instructor will have to work out a catch-up solution that is feasible. These students are important to our nation and to our program and every effort should be made to accommodate them. Experience has shown that the military are excellent performers in the program and that they are committed to the pursuit of their degrees.

At this writing, experience with a foreign national taking the program in her home country is very promising. It appears that if the individual is well qualified and has good internet connections, difficulties will be minimal.

Program Delivery

The WRPM master's program is offered by streaming video through the UF College of Engineering's UFEDGE Program. The facilities available include five production studios. The program is accessible to students anywhere in the world as long as they have appropriate internet connections. Once a lecture has been recorded it goes on the server and is available to students 24/7 for the entire semester. Thus a student in week 5 of the course desiring to review the lecture of week 3, for example, can do so. This is a luxury that students taking courses live on-campus do not have.

The WRPM on-line program affords easily accessible life-long learning opportunities for students. As the half-life of engineering, science, and other educational programs decreases, the need for such programs becomes acute. For further details, see: <http://www.ees.ufl.edu>, or contact the author at wvies@eng.ufl.edu.

Marketing and Student Recruiting

Marketing and student recruiting go hand-in-hand. Sustainability of the program depends largely on the ability to bring new students into the program as others graduate. The marketing avenues exploited in the WRPM program include: the WRPM web page (<http://www.ees.ufl.edu>), printed brochures delivered to target audiences, presentations at professional meetings, letters to appropriate agency heads and others, personal visits to agencies and organizations, telephone calls to target persons and organizations, asking students already enrolled or graduated to spread the word to their colleagues, and advertising in appropriate journals.

Experience has shown that the program coordinator must personally play a major role in the marketing process. (S)he is best suited to identify high-potential markets and to identify and make appropriate personal contacts. Others can help in preparing ads, disseminating literature on the program, and developing brochures and other marketing documents. But without a knowledgeable program coordinator who can ferret out the right targets and identify the focal points for them, the marketing venture will not be very effective. Who you know, and who you identify is very important here.

The market place for the WRPM program is a three legged stool. Leg one is the state of Florida (the most easily accessible), leg two is the United States, and leg three is the rest of the world. At this writing, the Florida market is being blanketed fairly well. The next priority is reaching out to the other 49 states (the market there is huge). The lowest priority at present is the international one (sizable but subject to some cultural, cost, internet accessibility, and language barriers). As of October 2007, UF student enrollment in the WRPM master's degree program was: Florida 75%, other states 14%, and international 11%. In 2008, the principal focus of recruiting will be on potential students in other states.

Virtually all of the students in the WRPM program are supported by their employers. As a result, the tuition cost for out-of-state students becomes a major factor. Up until the fall of 2007, the UF out-of-state tuition cost was about \$1,000

per credit hour (\$3,000 per course). It was found that this eliminated a number of interested students from enrolling. A review of out-of-state on-line tuition costs per hour of a number of major U.S. universities revealed that cost generally exceeded \$600 per hour (2006 data). Based on this survey, and other efforts, UF implemented a new \$600 per hour cost for on-line courses being delivered outside of Florida (effective fall of 2007). As a result of this action, the UF program is now highly competitive with major U.S. universities who have an established record of delivering on-line programs nation-wide. The universities reviewed included Georgia Tech, Arizona State, Maryland, North Carolina State, Penn State, Purdue, RPI, and Virginia Tech. The new UF tuition rate is expected to be an important factor in recruiting out-of state students (particularly U.S.).

Qualifications of WRPM Graduates and Employment Opportunities

Graduates of the Specialization in Water Resources Planning and Management program are generally employed. They are pursuing the program to enhance their technical capabilities and obtain additional credentials for advancement. The positions they occupy represent the types of employers that would be interested in hiring graduates of the program. They include: Planning, Engineering, and Project Management Divisions of the U. S. Army Corps of Engineers Civil Works Program; U. S. Bureau of Reclamation; USEPA; Florida (and other) Water Management Districts; Water Utilities: Engineering and other Consulting Firms; City, County, and State agencies; Army, Navy and Air Force Military; USDA Natural Resources Conservation Service; and River Basin Commissions.

On-line and on-campus graduate students completing the WRPM program are prepared to become members of a broadly-based planning and management team. They are qualified to work in fields such as water resource or environmental planning and management, project management, permitting, regulation, decision support, and staff support for decision making bodies.

Attributes of the On-Line Program

The on-line WRPM master's program:

- provides a base to support life-long learning needs of water resources planners and managers;
- provides educational access in localities remote from in-place educational institutions;
- keeps practitioners current on new technological and other developments;
- enhances student on-the-job performance and marketability;
- allows students to take courses in their homes at times consistent with work, family, and other commitments; and
- permits students who relocate their residence to be able to continue their graduate program without interruption.

Comments on On-Line vs. Face-to-Face Instruction

There are some educators who comment that on-line programs are inferior to on-campus face-to-face programs. The truth is that there are some differences, but there are also many positive features of on-line programs that are not available in on-campus offerings. Face-to-face instruction offers some features, particularly those related to group discussions and teacher-student interaction that cannot be completely replicated by on-line programs. But on-line instruction offers many attractive features that face-to-face instruction does not. On-line instruction:

- has nationwide and global dimensions and is unbounded by location and time;
- encourages faculty to better organize class materials, and improve the quality of their lectures and visual aids;
- provides access to world-class guest lecturers that would not be possible if they had to come to the campus (the vehicle for this being real time video-conferencing);
- supports paperless courses;
- offers a variety of existing and emerging links for communicating with students;
- helps keep instructors aware of practice as well as theory as many on-line students bring

new information to the attention of their professors;

- offers a learning environment that is dynamic and supported by versatile course management software; and
- gives instructors an opportunity to review their lectures and look for weak spots that deserve attention.

Comments of Graduates

There is an old saying that “the proof of the pudding is in the eating.” The following excerpts from statements of graduates of the WRPM program illustrate the value of the program to them and show the relevance of the course content to those professionally engaged in water resources planning and management.

- “Until I started doing the Capstone project, I don't think I realized how much I had actually learned during this Masters program” (Krista M. Guerrero, South Florida Water Management District, West Palm Beach, FL).
- “Taking the classes in the EES program allowed my thoughts to expand to a more global and sustainable perspective” (Bev Ann Barta, UF doctoral student, formerly Savannah District, USACE).
- “Many of the situations encountered in classroom exercises were realistic and similar to those problems I am faced with day-to-day on the job, and although I am not a “decision maker” at my job, many documents prepared by me are used by decision makers” (Catherine L. Byrd, Jacksonville District, USACE).
- “The set of courses that I completed has expanded my outlook on integrated water resource management to give me a better understanding and broader view of the scope of specialties involved” (Laura M. Beauregard, Seattle District, USACE).
- “Almost every class I took was pertinent and applicable to the work that I am doing on a daily basis. What's more is that my exposure to subjects of global concern and issues regarding our water use and needs was enlightening and fascinating” (Nancy P. Allen, Jacksonville District, USACE).

- “The Master's program has been of unique and irreplaceable value, as it provides knowledge and insights unobtainable elsewhere that are very highly relevant to my chosen career field, and to many of my other similar interests” (Stephen F. Biemiller, Jacksonville District, USACE).
- “The classes I have taken in my study for the Master's degree have given me knowledge of how to examine watershed issues, treat storm water discharges, and even provide me with a better understanding of policy making both at the state and federal levels” (Marcy L. Policastro, Wildwood Consulting).

Conclusions

The 21st century will be an era of increased global concern regarding the availability of water. Consistent with this will be the need for broader educational opportunities for water resources professionals as well as for new students desiring to pursue this career path. For professionals, convenient access to such programs will be critical. And the UF WRPM master's program is designed to be a major player in this important educational venture.

Virtually all students pursuing the WRPM master's degree are practicing professionals. It is important that they be recognized as such and treated with respect. It should also be recognized that they are dealing with water planning and management problems within the prevailing political, social, economic, and environmental context of the moment. Much of their on-the-job learning can be brought into the classroom to benefit other students and program faculty as well. WRPM students are instructed to understand the importance of applying good science and engineering in plan development. They are also taught that these plans must be formulated in the context of what is viable.

After four years of operation, the WRPM program is considered to be sound. The number of students enrolled, their breadth of background, and the positive responses of graduates attest to the vitality of the program. The challenge for the future is to keep the program current, increase the number of courses offered, add to the participating faculty,

and increase enrollment. Program sustainability will depend on success in national and international marketing. An important marketing tool is the quality of the student produced by the program. These students are the faces of the program, and their accomplishments ultimately speak for it.

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