UMBC

AN HONORS UNIVERSITY IN MARYLAND

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MEMORANDUM

DATE: August 31, 2009

TO: Dr. Tim Topoleski, President, Faculty Senate
Dr. Bruce Walz, Chair, Academic Planning & Budget Committee
Dr. Marjoleine Kars, Chair, Undergraduate Council

FROM: Antonio Moreira, Ph.D.
Vice Provost for Academic Affairs

SUBJECT: Proposal for New Track in Environmental and Water Resources Engineering in the B.S. in Engineering Program

I am forwarding for your review a proposal from the Department of Civil and Environmental Engineering to create a new track focused on Environmental and Water Resources Engineering (EWRE) within the B.S. in Engineering program. Since this is a proposal for a track within an existing approved program, this proposal will not require off-campus approval from either USM or MHEC. It requires review only from our internal campus process for new track approval.

Thank you.

AM:sll
Attachment

Cc: Dr. Warren DeVries
Dr. John Jeffries
Dr. Philip Rous
Dr. Brian Reed
Dr. Chris Steele
Ms. Beth Wells

Department of Civil & Environmental Engineering
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MEMORANDUM

TO: Warren DeVries, Dean
College of Engineering and Information Technology

FR: Brian E. Reed, Chair
Department of Civil and Environmental Engineering

RE: Proposal new track in the B.S. in Engineering program with an emphasis in environmental and water resources engineering (EWRE)

Attached please find the proposal for the development of an ABET accredited degree in environmental and water resources engineering.

CC: Antonio Moreira, Ph.D., Vice Provost for Academic Affairs

Development of an ABET Accredited Degree in Environmental and Water Resources Engineering

Brian E. Reed
Chair, Department of Civil and Environmental Engineering

1. Introduction

We propose a new track in the B.S. in Engineering program with an emphasis in environmental and water resources engineering (EWRE) to address several UMBC/COEIT academic priorities and to respond to the anticipated increasing demand for training in this discipline. First, this degree program responds to growing national and statewide initiatives in climate change and the environment. Environmental engineers, in addition to providing safe water and clean air, address many of the emerging issues associated with climate change, clean sources of energy, and sustainable development. The challenges faced by the EWRE profession today are unique and brought about by a rapidly changing world order with respect to the need for sustainable utilization of energy resources, sustainable use of material resources and production practices, proactive environmental management of emerging technologies (*e.g.* nanomaterials), and sustainable management of shrinking water resources that is increasingly becoming the cause of national and international conflicts. The creation of a new undergraduate engineering degree provides an opportunity to develop a program that embraces new problems and is focused on emerging issues in the field of EWRE. Second, an environmental engineering degree provides an option for UMBC engineering students beyond the available programs (mechanical, chemical/biochemical and computer engineering); this will also likely increase enrollment in COEIT. Third, environmental engineering is the only engineering discipline expected to grow "much faster than the average for all [engineering] occupations" (26% by 2016; http://www.bls.gov/oco/ocos027.htm#outlook, See Figure 1). An undergraduate CEE degree can also play an important role in complementing UMBC degree programs in the environmental sciences, which are also expected to grow at a 20% rate. Fourth, the UG program builds upon a successful implementation of the graduate degree program in CEE that was initiated in 2003. The CEE faculty has been successful in creating a state of the art research infrastructure that has been recognized nationally and internationally, and has been successful in attracting external funding resources. The strong research and graduate degree footprint will catalyze the successful development of the UG degree program by attracting undergraduate students to a department active in cutting edge EWRE research, and continuing to engage undergraduate students in priority research areas through research assistantships. We also anticipate that the UG students will form part of the recruiting pool for the combined BS-MS and Ph.D. degrees.

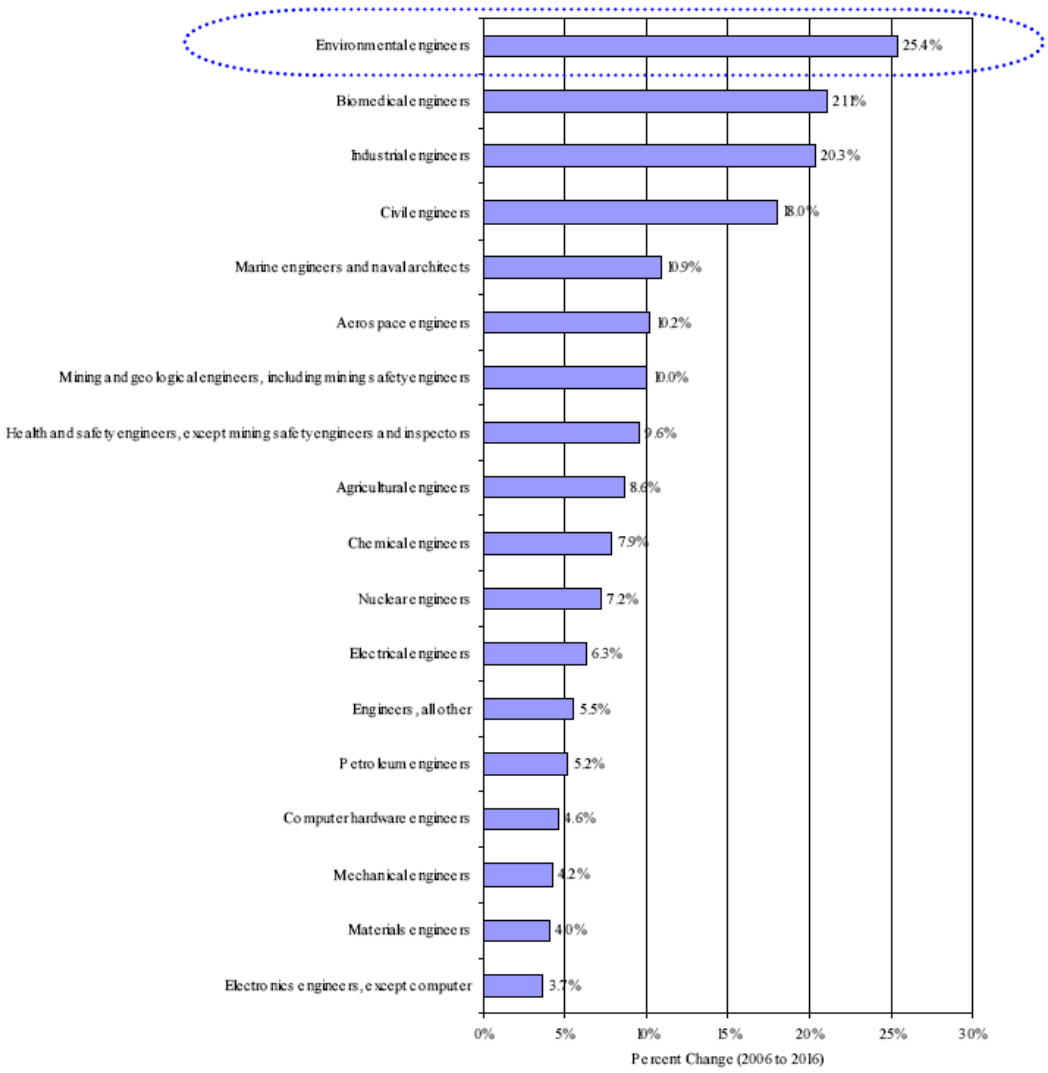

Figure 1. Percent change of engineering occupations from 2006 to 2016

In this document, the following items are addressed:

1. An analysis of potential student enrollments in the program based on market demand, industry needs, and programs at comparably-sized Universities.
2. A description of the additional courses and course sections that would be necessary to offer the program annually.
3. A plan for using a combination of current tenure-track faculty members, the new tenure track faculty member, lecturers and part-time instructors to staff the referenced courses.
4. A description of any specialized laboratories, equipment or any other significant new resources that will be necessary to offer the program.

2. Assessment and Projected Enrollment

To assess the demand for the environmental engineering degree surveys were conducted of current UMBC freshman engineering students and institutions offering a stand alone ABET accredited environmental engineering degree. Results are presented and discussed below.

2.1 UMBC Freshmen Survey

Students from ENES 101 (a freshmen-level required course for the College's engineering programs, these students would be the entering sophomore class if the degree program was online now). The survey explained what environmental/water resource engineers do and then asked the following question:

> "UMBC is considering starting an undergraduate degree program in Environmental Engineering (EnvEng) that may be available in Fall 2009. If this degree was available would you:"

Choose EnvEng as your major?	□
Strongly consider EnvEng as major	□
Consider EnvEng as major	□
No interest in EnvEng	□

The answers to the survey and freshman class enrollment estimates are presented in Table 1. 154 students took the survey with 7.2%, 17.5%, and 37.8% of the students responding that that they would choose environmental engineering as their major, strongly consider Env Eng, or consider Env Eng, respectively. If capture rates of 100%, 25% and 10% are assumed for these three categories then the freshman-senior class enrollment would be approximately 92 students if one assumes that the students leaving the program in later years is offset by transfer students. The student enrollment projections do not take into account new students that would be brought into COEIT from high school recruitment efforts.

Table 1. UMBC Freshman Engineering Survey Results and Enrollment

Decision	# of Students	% of Total	Assumed % of students captured	Students Declaring Env Eng as Major
Choose EnvEng as your major?	11	7.20%	100%	11
Strongly consider EnvEng as major	27	17.50%	25%	6.75
Consider EnvEng as major	52	37.80%	10%	5.2
No interest in EnvEng	64	41.50%	0%	0
TOTAL	154			**23**

2.2 Recruiting New Students to COEIT

While it is not possible to precisely predict the number of new students entering UMBC's COEIT as a result of the proposed CEE UG degree, several trends support the assumption that College enrollment would increase. As mentioned previously, the US Department of Labor has predicted that Environmental Engineering is the only engineering discipline that is expected to grow "much faster than the average" (http://www.bls.gov/oco/ocos027.htm#outlook), and hence we believe that there will be increased market demand for the degree which should lead to an increase in students seeking the EWRE degree. Second, there has been a dramatic increase in the number of high school students taking the advanced placement exam in Environmental Science (10-fold increase since 1998, See Figure 2). While not all students taking this exam may necessarily be interested in an environmental engineering major, the results in Figure 2 indicate that CEE would have a strong recruiting pool for the CEE-UG degree.

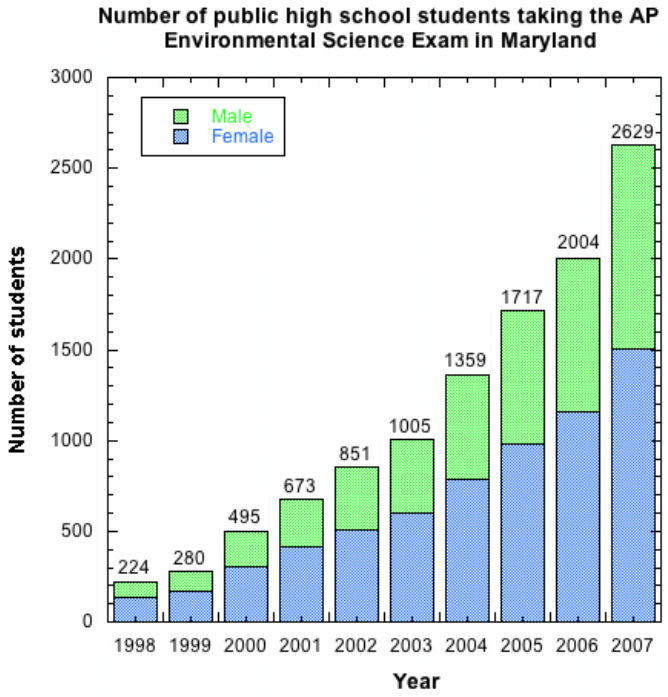

Figure 2. Number of public high school students taking AP Env. Sci. Exam

An outreach effort to Maryland high schools would be a part of the CEE program so that the enrollment in COEIT would increase rather than just redistributing students from existing departments. CEE will work will Anne Spence to incorporate environmental and water resources engineering in her successful "Project Lead the Way" (PLTW) effort. PLTW is

partially responsible for the dramatic increase in Mechanical Engineering (ME) undergraduate enrollments (nationwide ME enrollments were projected to increase by 5%; UMBC ME's enrollments have doubled). It is believed that additional increases in COEIT enrollments will occur if environmental and water resources engineering is included in PLTW. Existing full-time tenure track faculty (Ghosh and Reed) and the two lecturers (positions to be filled in the second half of Years 1 and 2) would be involved in the high school/community college outreach effort. Finally, note that 57% of the students taking the AP exam were female; successful recruitment in proportion to this profile has the potential to improve the COEIT's diversity profile.

Third, the number of higher education institutions offering an undergraduate degree in environmental engineering has increased significantly in the last 10 years (see Section 2.3) indicating that other institutions have also recognized the need for the EWRE degree, Note that no Maryland institution offers a EWRE undergraduate degree.

2.3 Survey of Institutions Offering Environmental Engineering UG Degree

A survey of the institutions (52 total) offering an ABET accredited UG degree in environmental engineering or related subject was conducted by email in October-November 2008 explicitly to gather information pertinent to this document. Of the 52 institutions, 46 institutions offer an ABET accredited degree in environmental engineering; one offers a degree in earth and environmental engineering; two offer an environmental engineering option in civil engineering, one offers an environmental engineering science degree, one offers an environmental resources engineering degree, and one offers a degree in environmental systems engineering. The number of programs having an ABET accredited UG environmental engineering degree increased from 16 in 1997 to 46 currently (see Figure 3).

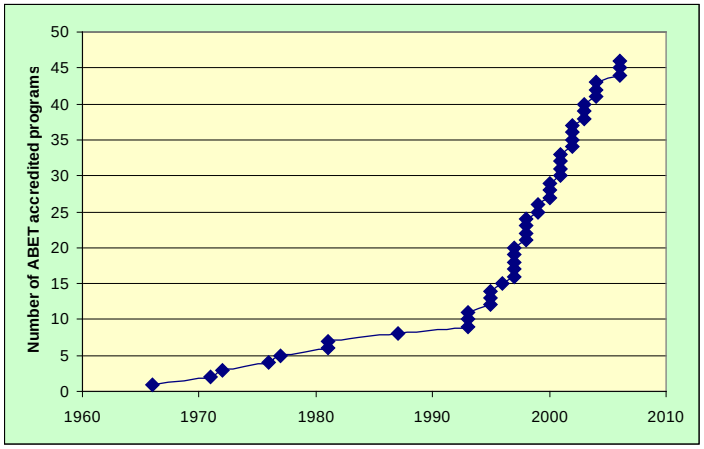

Figure 3. Number of ABET Accredited Env. Engineering UG Degree Programs

Representatives from these programs were identified through a web search, and two surveys asking the following questions were distributed to the representatives by e-mail:

1. What are your current enrollments in the Environmental Engineering program?

Freshman	
Sophomore	
Junior	
Senior	

2. Can you send me past enrollments and any projections that you may have developed?
3. Department the degree resides in: _____
4. Number of tenure track faculty that are responsible for teaching the environmental and water resources engineering (EWRE) courses: _____
5. Total number of tenure track faculty in your department: _____

Forty 40 responses were received on questions 1 and 2, and thirty responses were received on questions 3 though 5. Results of the surveys are presented in Table 2. For all but two institutions, the environmental engineering degree resided in a "larger" department, in most cases Civil and Environmental Engineering (only students working towards the environmental engineering degree were counted). The number of faculty teaching EWRE courses and the total number of faculty in the home department were requested because the effort in running a department is distributed over a larger number of faculty when the environmental degree is offered as part of a larger home department. The average freshman through senior student enrollment was 64 $\pm$ 54 students. The average size of the EWRE faculty was about 8 resulting in a student/EWRE faculty ratio of 9.5$\pm$ 7. Note the EWRE faculty size was used to determine this ratio because non environmental engineering enrollment (*e.g.*, students studying for the more general civil engineering degree) were not included in the enrollment counts. If we assume a class size of 100 students and 3.25 tenure-track faculty, UMBC's CEE student/faculty ratio would be 30.8 (19 if the two lecturers are counted). These numbers are much higher than the national average and the high enrollments could adversely impact CEE's graduate program/research productivity.

Table 2. Results from Institutional Survey

Enrollment (Fresh-Senior)		**# EWRE Faculty**		**Student/EWRE Faculty Ratio**		**# of Faculty in Home Department**	
Mean + Std Dev.	63.8 $\pm$ 53.4	Mean + Std Dev.	7.7 $\pm$ 4	Mean + Std Dev.	9.5$\pm$ 6.8	Mean + Std Dev.	16.4 $\pm$ 6.8
Range	12 - 261	Range	3 - 20	Range	1.2 - 29	Range	3-28

3. Course Description and Scheduling

A description of the additional courses and course sections that are necessary to offer this program annually is presented in this section. The proposed full curriculum and proposed new course descriptions are provided in Appendix A. Attention was spent on structuring courses and enrollment caps to maximize enrollments and minimize the number of separate sections offered. A total of fourteen new courses would be offered in the undergraduate engineering curriculum, as listed in Table 3. One section of each course would be offered, with an enrollment goal of 25 students.

Table 3. Proposed New Courses Required for UG in Environmental Engineering

New Undergraduate Courses	Year First Offered
ENCE 102 Intro to Env Eng and Science	2009-2010
ENCE 301 Env. Chemistry and Biology	2011-2012
ENCE 310 Fluid Mechanics	2011-2012
ENCE 312 Hydraulics	2011-2012
ENCE 302 Physicochemical and Bio Processes	2011-2012
ENCE 304 EWRE Laboratory	2011-2012
ENCE 473 Air Quality/Global Climate Change	2012-2013
ENCE 471 Green Engineering	2012-2013
ENCE 411/GES 416 Physical Hydrology (Welty and Miller alternate years)	2012-2013
ENCE xxx Advanced Engineering elective (fall)	2012-2013
ENCE 402 Solid/Hazardous Waste	2012-2013
ENCE 481 Senior Design in EWRE	2012-2013
ENCE 412 Applied Numerical Methods	2012-2013
ENCE xxx Advanced Eng. elective (spg)	2012-2013

New courses have been given numbers for illustrative purposes only, inclusion of course numbers is not meant to imply that courses have been approved

In Table 4, a six year teaching plan is presented based on hiring two lecturers (one in the second half of year 1, one in second half of year 2) and one tenure-track faculty (hired in year 3). If enrollment goes above 100 into the 125 student range then a fourth tenure track faculty will be required to operate the UG program and maintain CEE's research/graduate program productivity. The lecturers will initially receive a reduced teaching load in exchange for high school and community college recruitment activities; student advisement; and program development efforts. Courses would be added to the program in a staggered fashion: one freshman course beginning in 2009-10; no additional new courses in 2010-2011; five new junior-level courses beginning in 2011-2012; and eight new senior-level courses (including senior design) beginning in 2012-2013. All courses would be repeated annually after they are first offered.

ENCE 411 will be cross-listed with GES 416, and the two departments would alternate years in teaching the course, with students from the two departments combined in one section for instruction. The GES course already exists and as such will not be a new course the first time it will be offered as a cross-listing with ENCE. CEE faculty will also teach entry level engineering courses (e.g., ENES 101) on a rotating basis as part the common undergraduate curriculum in COEIT and this will lead to a decrease in enrollment pressures that Mechanical Engineering and Chemical and Biochemical Engineering are experiencing.

ABET application preparation will begin in year 1 with the ABET submission and visitation occurring in year 4. High school recruiting will begin in year 1 with most of the effort occurring in years 1 through 3. Recruitment work in the later years is envisioned to be mostly maintenance in scope.

The total available yearly instructional capacity at program maturity will be Ghosh (3), Reed (2), Welty (1), tenure track 1 (3), lecturer 1 (8), and lecturer 2 (8). The course load for the lecturers will most likely be less than 8 because of student advising, etc. If enrollment goes above 100 students then a second new tenure track faculty will be needed and this person will have a teaching load of 3 courses per academic year.

Table 4. Six Year Teaching Plan

	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6	
Person/# of courses	**F09-10**	**S09-10**	**F10-11**	**S10-11**	**F11-12**	**S11-12**	**F12-13**	**S12-13**	**F13-14**	**S13-14**	**F14-15**	**S14-15**
Lecturer 1		L1(3)	L1 (2)	L1(2)	L1 (2)	L1(2)	L1(5)		L1(5)		L1(5)	
Lecturer 2				L2(2)	L2 (2)	L2(2)	L2(5)		L2(5)		L2(5)	
Tenure Track 1					TT1 (1)	TT1 (1)	TT1 (2)	TT1 (1)	TT1 (1)	TT1 (2)	TT1 (2)	TT1 (1)
Tenure Track 2							TT2 (1)	TT2 (1)	TT2 (2)	TT2 (1)	TT2 (1)	TT2 (2)
Ghosh	G(1)	G(2)	G(1)	G(2)	G(1)	G(2)	G(1)	G(2)	G(1)	G(2)	G(1)	G(2)
Reed	R(1)	R(1)	R(1)	R(1)	R(1)	R(1)	R(1)	R(1)	R(1)	R(1)	R(1)	R(1)
Welty		W(0.5)	W(1)	W(0.5)		W(0.5)	W(1)		W(1)		W(1)	
UG Courses	**F09-10**	**S09-10**	**F10-11**	**S10-11**	**F11-12**	**S11-12**	**F12-13**	**S12-13**	**F13-14**	**S13-14**	**F14-15**	**S14-15**
ENCE 101		L1(2)		L1(2)	L2(2)			L(2)				L(2)
Engineering Ethics			L1		L1					L		
EMME 110 Statics			L1	L2			L		L		L	
ENCE 102 Intro to Env Eng and Science[1]		G,R,L1		G,R,L2		W, L1,L2,		TT1,R, L1;L2		G, TT2, L1;L2		TT1,TT2, L1;L2
ENCE 301 Env. Chem/Bio					TT1		G		TT1		G	
ENCE 310 Fluid Mech					L1		L		L		L	
ENCE 312 Hydraulics						L2		L		L		L
ENCE 302 Phy, Chem, and Biological Processes						R		R		R		R
ENCE 304 EWRE Lab						L1		L		L		L2
ENCE 473 Air Quality/ Climate Change							L		TT2		TT2	
ENCE 471 Green Eng							TT1		L		TT1	
ENCE 411/GES 416 Phy Hydrology (alt)							Miller		W		Miller	
ENCE xxx Adv Eng Elective (fall)							L		L		L	
ENCE 402 Solid/Hazardous								TT2		L		TT2

Waste												
ENCE 481 Sr. Design								R		G		L
ENCE 412 Applied Numerical Methods								L		L		L
ENCE xxx Adv Eng Elective (spring)								L		L		L
Graduate Courses												
ENCE Biological Proc.	G		G		G		TT2		G		TT1	
ENCE Env Chemistry	R		R		R		R		R		R	
ENCE Phys/Chem Proc.		R		R		TT1		TT1		TT1		TT1
ENCE Risk Assessment		G		G		G		G		TT2		G
ENCE Groundwater (alt)			W				W				W	
ENCE Env modeling		W(0.5)		W(0.5)								
Adv Env Analytical Methods		G		G		G		G		G		G
New Grad course 2								TT1		TT1		
New Grad course 3									TT2		TT2	
Other Activities												
Program development	G,R,W	G,R,W,L1	G,R,L1	G,R,L1,L2	G,R,W,L1,L2							
Course development		L1	L1	L2	L2							
ABET	Prepare (All)	Prepare (All)	Prepare (All)	Prepare (All)	Prepare (All)	Prepare (All)	Submit (All)	Visit (all)				
HS/CC recruiting	G,R	G,R, L1	G,R, L1	L1; L2	L1; L2	L1; L2	L1; L2	L1; L2	L1; L2	L1; L2	L1; L2	L1; L2

[1]Ghosh and Reed will teach as overload for Years 1 though 4

4. Resources and Expenditures

The APB budget spreadsheet is provided in Appendix B. CEE has saved approximately $200K (one-time rollover money) in anticipation of offering the EWRE degree in addition to having one open line (approximately $100K in salary/benefits). A freshman to senior class enrollment of 100 students (25 students/year) was assumed based on the enrollment projection data presented earlier. In-state/out-of-state student ratios, retention rates, etc. were based on Office of Institutional Research data. Addition assumptions include: 1) no part-time student enrollment and 2) the increase in graduate student enrollment through the BS-MS program and graduate students associated with new tenure track faculty were not counted. These assumptions produced a conservative estimate of the revenue generated. A "real" tuition rate of 73% of the published rate and a 4% annual rate increase were assumed. Also include in the budgetary analysis is the effect of a 0% reduction in tuition (last spreadsheet).

In AY 2009-10 the first lecturer will be hired in the spring semester using resources from central administration (30k + benefits). In AY 2010-11, the second lecturer will be hired in the spring semester. Two staff, one in year 2, (a full time administrative assistant), and one in year 3 (a half-time technician) are requested. A tenure-track faculty will be hired in year 3. If enrollment is above 100 students then a second new tenure track position will be required to operate the program and maintain CEE's research/graduate productivity. Four GAs (14K/year plus tuition and health insurance) are requested. One time costs ($200k total) that CEE will cover using reserve funds are as follows: (1) $30K for recruitment of students/lecturer/faculty (years 1, 2, 3); (2) $40k for undergraduate lab equipment in year 3, (3) $10k for computers/printers for staff, (4) $20k for startup for the two lecturers; (4) $100K for lab renovations in year 1 (cost estimated from previous lab renovations). CEE will contribute approximately $700K to this effort over years 1 through 5. Start-up resources for the tenure-track position (250k total, 2/3 in year 3, 1/3/ in year 4) will be funded using DRIF money.

The effect of the CEE undergraduate program on other departments is also outlined in the spreadsheets in Appendix B. Departments that will be teaching required classes in the EWRE curriculum were asked to provide estimates of the resources required to teach an additional 25 students (also included is the impact of enrollments of 125% and 75% of the target enrollment of 100 students). Several GEP courses were listed as "others" as there was not sufficient data to pinpoint which classes EWRE students would enroll in. For ease of presentation, a constant 25

students were assumed on courses offered in Years 2, 3, and 4 (*i.e.*, <100% retention not accounted for) and this represents a conservative estimate of the impact the EWRE program will have on other departments. COEIT and CAHSS calculated the cost per section using historical data. NMS calculated their cost by assuming TA support (1/4) per section and new lecturer position in Year 4 to meet enrollment pressures in service courses. For CHEM 102L $1500 for materials is requested in addition to TA support (total cost $9000).

5. Specialized Laboratories, Equipment and Other Resources

For the undergraduate program, $40K is requested for equipment for the required EWRE laboratory course. The course will be taught in CBE's undergraduate teaching laboratory (email from Dr. Julie Ross, Chair of CBE, is available for viewing). The laboratory space, office space and equipment associated with the hiring of the two lecturers and one new tenure track faculty will be accommodated using existing CEE space in the TRC building. COEIT space in the TRC (room B24, email from COEIT confirming this is available for viewing) has been transferred to CEE and will be used for the new faculty lab and to house graduate students. Equipment for the new faculty will be purchased using startup funds that are funded by DRIF resources (listed in the "other resources" row in the New Program Budget Template).

6. Budget Summary

In Table 5 the budget summary for each enrollment scenario is presented for years 1 through 5. For all but the 75% enrollment scenario the cumulative five-year cost of the EWRE degree program is positive.

Table 5. Budget Summary

	Year 1	Year 2	Year 3	Year 4	Year 5
Target Enrollment: 100 Students					
Total Revenue	$482,121	$438,311	$867,572	$1,009,339	$1,016,346
Net Revenue	$136,271	($30,982)	($204,746)	$14,154	$112,817
Cumulative Net	$136,271	$105,289	($99,457)	($85,303)	$27,513
125% of projected enrollment					
Total Revenue	$527,713	522,952	$1,012,467	$1,212,014	$1,242,381
Net Revenue	$181,863	$50,534	$(64,538)	$212,141	$334,165
Cumulative Net	$181,863	$232,397	$167,859	$380,000	$714,164
75% of projected enrollment					
Total Revenue	$436,528	$353,671	$722,676	$806,664	$790,311
Net Revenue	$100,053	($103,122)	($335,579)	($174,459)	($99,156)
Cumulative Net	$100,053	($3,069)	($338,648)	($513,107)	($612,263)

Appendix A
Curriculum and New Course Descriptions

UMBC
Department of Civil and Environmental Engineering

Proposed Undergraduate Curriculum
in Environmental and Water Resources Engineering (EWRE)

Freshman Year Fall Semester CHEM 101 Principles of Chemistry I (4) MATH 151 Calculus and Analytic Geometry I (4) ENES 101 Introductory Engineering Science (3) GFR electives (6) 17 Credits	Spring Semester CHEM 102 Principles of Chemistry II (4) CHEM 102L Introductory Chemistry Lab (2) PHYS 121 Introductory Physics I (4) MATH 152 Calculus and Analytic Geometry II (4) **ENCE 102 Intro to Env Eng and Science (3)** 17 Credits
Sophomore Year Fall Semester CHEM 351 Organic Chemistry I (3) ENES 110 Statics (3) PHYS 122 Introductory Physics II (4) MATH 251 Multivariable Calculus (4) GFR electives (3) 17 Credits	Spring Semester BIOL 100 Concepts of Biology (4) MATH 225 Introduction to Differential Equations (3) STAT 355 Intro to Prob/Stats for Scientists/Engs (3) EMME 217 Engineering Thermodynamics (3) GFR electives (3) 16 Credits
Junior Year Fall Semester **ENCE 301 Env. Chemistry and Biology (4)** ENGL 393 Technical Writing (3) **ENCE 310 Fluid Mechanics (3)** GFR elective (6) 16 Credits	Spring Semester **ENCE 312 Hydraulics (3)** **ENCE 302 Physical, Chemical and Biological Processes (4)** **ENCE 304 EWRE Laboratory (4)** CMSC 104 Problem-Solving and Computer Programming [3] GFR elective (3) 17 Credits
Senior Year Fall Semester **ENCE 473 Air Quality and Global Climate Change** **ENCE 471 Green Engineering** **ENCE 411/GES 416 Physical Hydrology (3)** **ENCH xxx Advanced Engineering elective (3)** GFR elective (3) 16 Credits	Spring Semester **ENCE 402 Solid/Hazardous Waste (3)** **ENCE 481 Senior Design (3)** **ENCE 412 Applied Numerical Methods in EWRE (3)** **ENCH xxx Advanced Engineering elective (3)** GFR elective (3) 15 Credits

Bold indicates new courses. Inclusion of course numbers does not imply that these courses have been approved.

CMSC 104
Problem-Solving and Computer Programming [3]
This course is designed to prepare students for CMSC 201 by providing an introduction to computer programming that does not require prior programming experience. Students will be taught the basic use of a programming environment and the basic elements of the C programming language (including loops, control statements and arrays). This course also introduces general computer science concepts such as operating systems, computer organization, computer architecture, data representation and memory usage. Note: This course does not fulfill any of the computer science major requirements. Students who have taken and received transfer credit for, or who are taking concurrently any computer programming course in a high level programming language, will not receive credit for CMSC 104. The list of such computer programming courses includes, but is not limited to: CMSC 103, CMSC 106, CMSC 109, CMSC 201, CMSC 202 and sections of CMSC 291 that cover programming topics.

ENCE 102 Intro to Env Eng and Science (3)
Overview of environmental engineering including water/air quality issues, water supply/ wastewater treatment, hazardous/solid waste management, pollution prevention, global environmental issues, public health considerations/environmental laws, regulations and ethics, and preserving air and water quality. Material balance concepts for tracking substances in the environmental and engineering.

ENCE 301 Env. Chemistry and Biology (4)
Covers basic environmental chemistry and biology with a focus on understanding the principles governing the function of both natural systems and systems perturbed or engineered by humans. Topics include acid/base, complexation, reduction/oxidation, precipitation, hydrolysis and sorption reactions, population growth and limiting factors, microbial community structure, the interactions between microbes and their chemical environment, and biogeochemical processes that govern the fate of nutrients and metals in the environment and in engineered systems.

ENCE 302 Physical, Chemical and Biological Processes (4)
The application of basic physical and chemical concepts to the analysis of environmental engineering problems. Principles of chemical equilibrium and reaction, reaction engineering, interphase mass transfer, and adsorption are presented in the context of process design for unit operations in common use for water and wastewater treatment. Topics addressed include mass balances, hydraulic characteristics of reactors, reaction kinetics and reactor design, gas transfer processes (including both fundamentals of mass transfer and design analysis), and adsorption processes (including both fundamentals of adsorption and design analysis).

ENCE 304 EWRE Laboratory (4)
Laboratory and field techniques in biogeochemistry and environmental engineering and their application to the understanding of natural and engineered ecosystems. Exercises demonstrate data acquisition and modeling suited to identifying and quantifying physical, chemical, and biological processes that govern the effects of human activity on the functioning of natural systems and/or the efficacy of engineered approaches to environmental problems. Applications include chemical and biological remediation, measurement of contaminants, and detection of biogeochemical activity in natural environments. Introduction to use of environmental analytical instrumentation.

ENCE 312 Hydraulics (3)
The movement of water through natural and engineered channels, streams, and rivers. Equations and theory (mass, momentum, and energy equations) for steady and unsteady descriptions of the flow. Design of flood-control and canal systems. Flow controls such as weirs and sluice gates; gradually varied flow; Saint-Venant equations and flood waves; and method of characteristics. Open channel flow laboratory **experiments**: controls such as weirs and gates, gradually

varied flow, and waves. (Stanford)

ENCE 402 Solid/Hazardous Waste (3)
This course covers advanced engineering and scientific concepts and principles applied to the management of hazardous waste and municipal solid waste to protect human health and the environment. Includes biological and physical/chemical treatment technologies for remediation of hazardous waste. The course will also cover beneficial reuse of contaminated media (soil, sediment) and the conservation of limited resources through resource recovery and recycling of waste material. The course will provide an introduction to the regulations concerning hazardous and solid waste management.

ENCE 411/GES 416 Physical Hydrology (3)
Study of the occurrence and movement of water on and beneath the land surface. All phases of the hydrologic cycle are discussed, with particular emphasis on factors that control runoff, flood frequency, measurement and prediction of streamflow, and applications of hydrologic data in environmental planning. Principles of groundwater flow and the influence of geology on both groundwater and surface water also are included. Experience in the use of microcomputers for problem-solving is recommended.

ENCE 412 Applied Numerical Methods in EWRE (3)
Introduction to a suite of numerical methods with examples that illustrate their application to a range of EWRE problems. Use of *MATLAB* as the computational framework. Solution of nonlinear equations, numerical differentiation and integration, numerical solution of ordinary differential equations, iterative solution of systems of linear equations, Fourier analysis of time series, and interpolation of spatial data.

ENCE 471 Green Engineering
Engineering processes and systems to reduce environmental impacts; approaches for evaluating emissions and hazards of chemicals and processes; defining effective performance targets; early-stage design and development techniques that minimize cost and environmental impacts; economics of environmental improvement projects; life-cycle assessments. Example applications include pollution prevention for chemical reactors, green chemistry methodologies, retrofit of water and wastewater infrastructure, and environmental site design for stormwater management.

ENCE 473 Air Quality and Global Climate Change
(1) Quantitative introduction to the engineering methods used to study and seek solutions to current air quality problems. Topics include urban sources of air pollution, indoor air quality problems, design and efficiencies of pollution control devices, and engineering strategies for managing air quality. (2) Introduction to the basic relevant principles and concepts in atmospheric physics, climate dynamics, biogeochemistry, and water and energy balance at the land-atmosphere boundary. Topics include global change (carbon dioxide and global warming; and tropical deforestation and regional climate). Example calculations include carbon footprint, life-cycle analysis of products and processes.

ENCE 481 Senior Design
The project synthesizes prior design education. Students formulate the problem and demonstrate creativity in applying theories and methodologies from their design and analysis subjects to develop the project, with consideration of its technical, environmental, and social feasibility. Parallel to this major design project are smaller projects involving actual building. Lectures on a variety of civil and environmental engineering projects, as well as field trips, are also part of the subject. Instruction and practice in oral and written communication are an integral part, culminating in the completion of the design portfolio.

Advanced Engineering Electives

ENCE 401 Water/Wastewater/Storm Water Facility Design (4)
Covers integration of processes into a complete treatment system. Includes detailed design procedures to control wastes, prevent environmental contamination, and protect drinking water quality. Example applications include drinking water treatment processes, wastewater treatment, and stormwater management.

ENCE 412 Groundwater Hydrology (3)
This course provides students with the fundamentals of sub-surface hydrology and the study of scientific and engineering problems related to groundwater quantity and quality. It introduces the fundamental groundwater fluid and solute mass balance equations. It also relates the parameters of the equations to physical and chemical properties of soils and geological formations. Elementary analytical and computational solution techniques and their applications to the movement of water and solutes in natural environments are discussed.

ENCE 472 Water and Sanitation in Developing Countries
Economic, social, political, and technical aspects of sustainable water supply and sanitation service provision in developing countries. Case studies from Asia, Africa, and Latin America. Service pricing, alternative institutional structures including privatization, and the role of consumer demand and community participation in the planning process. Environmental and public health considerations, and strategies for serving low-income households. (Stanford).

ENCE 474 Past and Future of Energy Engineering
Fossil and renewable energy resources: oil, natural gas, coal, nuclear, hydropower, solar, geothermal, biomass, wind, ocean energy, and energy efficiency. Topics for each resource: resource abundance, location, recovery, conversion, consumption, end-uses, environmental impacts, economics, policy, and technology. Buildings, transportation, the electricity industry, and energy in the developing world.

ENCE 475 Watershed and Water Quality Modeling
Applications of models used by regulatory agencies such as EPA to simulate mass balance of water and pollutants on a watershed-scale.

Appendix B

Budget and Impact on other Departments Analysis

See Excel Spread Sheet entitled “CEE UG Program-v4”

Appendix C

Analysis of In-state and Out-of-State Programs Offering an Environmental Engineering Degree

1. Are there any similarly designated programs in Maryland?

Yes. Johns Hopkins has a environmental engineering UG degree offered through the Geography and Environmental Engineering Department. It's AY2008 freshman through senior enrollment is 43 students. JHU has 13 tenure track faculty and a student/faculty ratio of 3.3.

2. What are the similarly designated programs in the region

In the following table a list of universities in our region who offer an ABET accredited UG program in environmental engineering is presented. Also listed in the table are the total freshmen to senior enrollment for AY 2008, the number of tenure track faculty associated with the environmental engineering degree, the student/faculty ratio, the department in which the environmental engineering degree resides and the total number of tenure track faculty in the home department. CEE is the home department for the majority of the UG environmental engineering degree programs. The University of New Hampshire offers their environmental engineering degree through the College using both Civil/Environmental and Chemical Engineering Departments.

ABET UG Env Eng Programs	Location	Year Accredited	TOTAL 2008 (Fr→Sr)	# TT in EEWR	Student/WREE Faculty	Home Dept	Total TT in Dept.
Columbia University	*New York, NY*	2001	46	9	5.1	Earth & Env Eng	11
University of Connecticut	*Storrs, CT*	2008	44	10	4.4	CEE	22
University of Delaware	*Newark, DE*	2000	75	7	10.7	CEE	23.5
Drexel University	*Phil, PA*	2002	45	7	6.4	Civ, Arch & Env Eng	20
Gannon University	*Erie, PA*	2006	14	3	4.7	Env Sci & Eng	3
The Johns Hopkins University	*Baltimore, MD*	2006	43	13	3.3	Geo and Env Eng	14
Lehigh University	*Beth., PA*	2008	18	4	4.5	CEE	17
Manhattan College	*Riverdale, NY*	1998				TERMINATED, merged into CEE UG	
Massachusetts Institute of Technology	*Cambridge, MA*	1993 Env Eng Sci	NR	NR	NR	CEE	NR
University of New Hampshire	*Durham, NH*	2001	74	5	14.8	College Level joint between Civil and Chem Eng	21
State University of New York at Buffalo	*Buffalo, NY*	2003	57	7	8.1	CEE	24
North Carolina State University at Raleigh	*Raleigh, NC*	1995	48	NR	NR	CEE	NR
Old Dominion University	*Norfolk, VA*	2004	47	NR	NR	CEE	NR
Pennsylvania State University, Harrisburg	*Middletown, PA*	2001	NR	NR	NR	School of Sci., Eng., and Tech.	NR

Rensselaer Polytechnic Institute	*Troy, NY*	1996	53	NR	NR	CEE	NR
Stevens Institute of Technology	*Hoboken, NJ*	1995	25	5	5	Cvl Env & Ocean Eng	10
Syracuse University	*Syracuse, NY*	1993	30	4	7.5	CEE	9
Tufts University	*Medford, MA*	1997	36	10	3.6	CEE	15
United States Military Academy	*West Point, NY*	1997	43	No Resp	No Resp	Geo & Env Eng	No Resp
University of Vermont	*Burlington, VT*	2006	65	5	13	School of Eng/CEE area	10
Wilkes University	*Wilkes-Barre, PA*	1997	38	3	12.7	Dept of Env Eng and Earth Sciences	7

3. Nationally, where do such programs reside?

National trends follow closely the regional trends. CEE is the home department for the majority of the UG environmental engineering degree programs. Oregon State University offers the environmental degree through its CBE Department.

Worksheet #1: Undergraduate Enrollment, Progression & Retention Profile

Note: This enrollment and retention worksheet is intended to assist academic units in planning for the quantity and kind of students who are likely to enroll in the proposed program. Academic units are strongly encouraged to seek assistance from the Provost's Office in completing this worksheet. A designated group of technical experts are available to assist academic units in establishing enrollment and retention assumptions, providing comparable program data, and considering overall enrollment impacts on the campus. Academic units are encouraged to develop informed estimates of student return ratios. In cases in which little or no data exist to yield an informed estimate, units should use the overall campus rates (section 5 above) which will be updated annually by the Office of Institutional Research.

	Year One	Year Two	Year Three	Year Four	Year Five
1. Net New 1ST TIME Full-time students					
Freshman	25.0	25.0	25.0	25.0	25.0
Sophmore	-	20.3	20.3	20.3	20.3
Junior	-	-	17.2	17.2	17.2
Senior	-	-	-	15.9	22.8
Total Headcount	25.0	45.3	62.6	78.5	85.4
Total Annual Credit Hours	850.0	1495.9	2064.5	2433.1	2646.7
Total FTE	28.3	49.9	68.8	81.1	88.2
2. Net New TRANSFER Full-time students					
Freshman	-	-	-	-	-
Sophmore					
Junior	0.0	0.0	11.0	11.0	11.0
Senior	-	0.0	0.0	8.0	8.0
Total Headcount	0.0	0.0	11.0	19.0	19.0
Total Annual Credit Hours	0.0	0.0	363.0	587.8	587.8
Total FTE	0.0	0.0	12.1	19.6	19.6
3. Total Headcount	25.0	45.3	73.6	97.4	104.3
Total Annual Credit Hours	850.0	1495.9	2427.5	3020.9	3234.5
Total FTE	28.3	49.9	80.9	100.7	107.8

Return Ratios for Undergraduates Entering UMBC as Degree Seeking Undergraduate Students in Fall 2004 (includes both Full-time and Part-time)*					
Student Type	#	2nd	3rd	4th	5th
New Freshman	1419	81%	69%	64%	28%
New Transfer	1093	72%	52%	24%	9%
*Note that nearly all Freshmen enter as Full-time Students.					
2nd year return ratios have increased since fall 2004, though fall 2004 is the last fall term where we have five year of data					
Source: UMBC, Office of Institutional Research, April 3, 2009					

New Program Enrollment, Revenue, and Expenditure Template

	Year 1	Year 2	Year 3	Year 4	Year 5
Program Enrollment & Retention Profile (Net new students)†					
Estimated number of first-time full-time resident students	22	40	56	70	76
Estimated number of annual first-time full-time resident credit hours	765	1346	1858	2190	2382
Estimated number of first-time full-time non-resident students	3	5	6	8	9
Estimated number of annual first-time full-time non-resident credit hours	85	150	206	243	265
Estimated number of transfer full-time resident students	0	0	11	19	19
Estimated number of annual transfer full-time resident credit hours	0	0	363	588	588
Total Credit Hours	850	1496	2428	3021	3234
† Overall ratio of resident to nonresident students is 9:1					
PROGRAM REVENUE					
Note: tuition rises 4% per year unless otherwise noted					
Full-time Tuition & Fee Rate (resident)	$ 8,872	$ 9,227	$ 9,596	$ 9,980	$ 10,379
Undergraduate Tuition discount rate‡	27%	27%	27%	27%	27%
Adjusted tuition & fee rate (resident)	$ 6,477	$ 6,736	$ 7,005	$ 7,285	$ 7,577
Estimated annual revenue from full-time students (resident)	$ 142,484	$ 269,425	$ 392,283	$ 509,967	$ 575,826
Full-time Tuition & Fee Rate (non-resident)	$ 18,213	$ 18,942	$ 19,699	$ 20,487	$ 21,307
Undergraduate Tuition discount rate‡	27%	27%	27%	27%	27%
Adjusted tuition & fee rate (non-resident)	$ 13,295	$ 13,827	$ 14,380	$ 14,956	$ 15,554
Estimated annual revenue from full-time students (non-resident)	$ 39,886	$ 69,137	$ 86,282	$ 119,645	$ 139,985
Tuition & Fee Rate (transfer; resident students)	$ 8,872	$ 9,227	$ 9,596	$ 9,980	$ 10,379
Undergraduate Tuition discount rate‡	4.3%	4.3%	4.3%	4.3%	4.3%
Adjusted tuition & fee rate	$8,491	$8,830	$9,183	$9,551	$9,933
Estimated annual revenue from transfer resident students	0	0	101,017	181,087	188,330
subtotal tuition revenue	$ 182,371	$ 338,561	$ 579,582	$ 810,699	$ 904,141
Higher enrollment scenario: 125% of projected tuition revenue	$ 227,963	$ 423,202	$ 724,477	$ 1,013,374	$ 1,130,176
Lower enrollment scenario: 75% of projected tuition revenue	$ 136,778	$ 253,921	$ 434,686	$ 608,024	$ 678,106
Reallocated funds	299,750	99,750	103,740	107,890	112,205
Other Revenue Sources (Faculty Startup from DRIF)	$ -	$ -	$ 184,250	$ 90,750	$ -
TOTAL PROJECTED REVENUE 100 students	$ 482,121	$ 438,311	$ 867,572	$ 1,009,339	$ 1,016,346
TOTAL PROJECTED REVENUE 125% of projected tuition revenue	$ 527,713	$ 522,952	$ 1,012,467	$ 1,212,014	$ 1,242,381
TOTAL PROJECTED REVENUE 75% of projected tuition revenue	$ 436,528	$ 353,671	$ 722,676	$ 806,664	$ 790,311
‡ Note on tuition discount rate: 1st time full-time freshman: 38.3%; Transfer & continuing students: 4.3%; All undergraduates: 27.0%; These rates apply to undergraduates only.					

	Year 1	Year 2	Year 3	Year 4	Year 5
PROGRAM EXPENDITURES					
PERSONNEL EXPENDITURES (salaries rise 4% per year unless otherwise noted)					
Faculty Positions					
Lecturer 1 (50% in Year 1, 100% thereafter)	$ 30,000.00	$ 62,400.00	$ 64,896.00	$ 67,491.84	$ 70,191.51
Lecturer 2 (50% in Year 2, 100% thereafter)		$ 31,200.00	$ 64,896.00	$ 67,491.84	$ 70,191.51
Tenure Track Faculty 1			$ 80,000.00	$ 83,200.00	$ 86,528.00
FT Faculty fringe (33%)	$ 9,900.00	$ 30,888.00	$ 69,231.36	$ 72,000.61	$ 74,880.64
Part-time faculty (7.5% fringe)	$ -	$ -	$ -	$ -	$ -
Full-time equivalent staff (FTE)					
Administrative Assistant	$ -	$ 40,000	$ 41,600	$ 43,264	$ 44,995
Technician (50% time)	-	-	$ 30,000	$ 31,200	$ 32,448
Staff fringe (33%)	$ -	$ 13,200	$ 23,628	$ 24,573	$ 25,556
Faculty Startup (**$20k in Y1/ Y2 covered by CEE**, DRIF covers Years 3 and 4)	$ 10,000	$ 10,000	$ 184,250	$ 90,750	$ -
Teaching Assistant salary + fringe (16.5%)	$ 32,620	$ 32,620	$ 65,240	$ 65,240	$ 65,240
Graduate Tuition Remission (rises 4% per year)	$ 16,660	$ 17,326	$ 36,040	$ 37,482	$ 38,981
SUBTOTAL PERSONNEL EXPENDITURES	$ 99,180	$ 237,634	$ 659,781	$ 582,693	$ 509,011
OPERATING EXPENDITURES					
Special & Technical (i.e. honorariums, student payments)	-	-	-	-	-
Communication	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Travel (	$ 2,000	$ 4,000	$ 7,000	$ 2,000	$ 2,000
Contractual Services (i.e. marketing, printing, equipment), **30k in recruitment in Y1, 2 &3 -CEE**	$ 10,000	$ 10,000	$ 10,000	$ 1,000	$ 1,000
Supplies (i.e. office, research, items less than $1,000)	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Equipment Capital or Sensitive (5k/yr Library) (**10k in Y1 & 2, 40 k UG lab-Y3, 50k total-CEE)‡**	$ 10,000	$ 10,300	$ 51,573	$ 5,955	$ 6,312
Fixed Charges (i.e. association dues, subscriptions, rental charges)	$ -	$ -	$ -	$ -	$ -
Infrastructure (if any) **CEE covers 100k**	$ 100,000	-		-	-
SUBTOTAL OPERATING EXPENDITURES	$ 124,000	$ 26,300	$ 70,573	$ 10,955	$ 11,312
‡ Note the annual rates of increase in library costs are 3% for book acquisitions and 9% for serial subscriptions					
SUBTOTAL IMPACT ON OTHER PROGRAMS COSTS (from worksheet 1B)	$ 53,500	$ 111,500	$ 127,500	$ 202,500	$ 202,500
Impact of higher enrollment (125% of projected)	$ 53,500	$ 114,000	$ 131,250	$ 206,250	$ 206,250
Impact of lower enrollment (75% of projected)	$ 46,000	$ 101,500	$ 116,250	$ 191,250	$ 191,250
PROJECTED TOTAL DIRECT EXPENSES	$ 276,680	$ 375,434	$ 857,854	$ 796,148	$ 722,824
PROJECTED TOTAL DIRECT EXPENSES (assuming 125% of projected enrollment)	$ 276,680	$ 377,934	$ 861,604	$ 799,898	$ 726,574
PROJECTED TOTAL DIRECT EXPENSES (assuming 75% of projected enrollment)	$ 269,180	$ 365,434	$ 846,604	$ 784,898	$ 711,574
INDIRECT EXPENDITURES					
University overhead rate *(25%)*	25%	25%	25%	25%	25%
Porjected University overhead amount	$ 69,170	$ 93,859	$ 214,464	$ 199,037	$ 180,706
OTHER EXPENSES: TT Faculty Startup Allocated from DRIF (not included in expenses total)	$ -		$ 184,250	$ 90,750	$ -
TOTAL DIRECT & INDIRECT EXPENSES	$345,850	$469,293	$1,072,318	$995,185	$903,529
Higher enrollmemt scenario: 125% of projected enrollment	$ 345,850	$ 472,418	$ 1,077,006	$ 999,873	$ 908,217
Lower enrollmemt scenario: 75% of projected enrollment	$336,475	$456,793	$1,058,256	$981,123	$889,467
TOTAL REVENUE (100 students)	$482,121	$438,311	$867,572	$1,009,339	$1,016,346
NET REVENUE	$136,271	($30,982)	($204,746)	$14,154	$112,817
CUMULATIVE NET	$136,271	$105,289	($99,457)	($85,303)	$27,513

WORKSHEET #1B TO DETERMINE IMPACT OF PROPOSED PROGRAM ON OTHER ACADEMIC DEPARTMENTS

REQUIRED COURSES FOR MAJOR OUTSIDE THE HOME DEPARTMENT

Please list all upper division courses *required* for the major that are offered by other departments and the projected enrollment of new students as a result of the proposed program

Course	College	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5	
ENGL 393 Technical Writing (3)	CAHSS	0	$ -	25	$ 3,500	25	$ 3,500	25	$ 3,500	25	$ 3,500
CHEM 351 Organic Chemistry I (3)	NMS	0	$ -	0	$ -	25	$ 7,500	25	$ 7,500	25	$ 7,500
STAT 355 Intro to Prob/Stats for Sci/Engs (3)	NMS			25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500
Total Outside Required Courses		0	$ -	50	$ 11,000	75	$ 18,500	75	$ 18,500	75	$ 18,500

INTRODUCTORY AND PREREQUISITE COURSES OUTSIDE THE HOME DEPARTMENT

Please list all introductory and prerequisite courses required for the major that are offered by other departments and the projected enrollment of new students as a result of the proposed program.

Course	College	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5	
1st Year		enrl.	cost	enrl.	cost	enrl.	cost	enrl.	cost	enrl.	cost
CHEM 101 Principles of Chemistry I (4)	NMS	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500
MATH 151 Calculus and Analytic Geometry I (4)	NMS	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500
CHEM 102 Principles of Chemistry II (4)	NMS	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500
CHEM 102L Introductory Chemistry Lab (2)	NMS	25	$ 9,000	25	$ 9,000	25	$ 9,000	25	$ 9,000	25	$ 9,000
PHYS 121 Introductory Physics I (4)	NMS	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500
MATH 152 Calculus & Analytic Geometry II (4)	NMS	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500
2nd Year			$ -								
ENES 110 Statics (3)	COE&IT		$ -	25	$ 5,000	25	$ 5,000	25	$ 5,000	25	$ 5,000
PHYS 122 Introductory Physics II (4)	NMS		$ -	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500
MATH 251 Multivariable Calculus (4)	NMS		$ -	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500
BIOL 100 Concepts of Biology (4)	NMS		$ -	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500
EMME 217 Engineering Thermodynamics (3)	COE&IT		$ -	25	$ 5,000	25	$ 5,000	25	$ 5,000	25	$ 5,000
MATH 225 Intro to Differential Equations (3)	NMS		$ -	25	$ 7,500	25	$ 7,500	25	$ 7,500	25	$ 7,500
3rd Year			$ -								
CMSC 104 Problem-Solving and Computer	COE&IT		$ -			25	$ 5,000	25	$ 5,000	25	$ 5,000
Total Intro and Prereq. Courses		150	$ 46,500	300	$ 86,500	325	$ 91,500	325	$ 91,500	325	$ 91,500

GEP COURSES

Please list all service courses required for the major and the projected enrollment of new students as a result of the proposed program.

Course	College	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5	
ENGL 100 Composition	CAHSS	25	$ 3,500	25	$ 3,500	25	$ 3,500	25	$ 3,500	25	$ 3,500
Language Course 1	CAHSS	25	$ 3,500	25	$ 3,500	25	$ 3,500	25	$ 3,500	25	$ 3,500
Langauge Course 2	CAHSS			25	$ 3,500	25	$ 3,500	25	$ 3,500	25	$ 3,500
Other GEP Course 1	CAHSS			25	$ 3,500	25	$ 3,500	25	$ 3,500	25	$ 3,500
Other GEP Course 2	CAHSS					25	$ 3,500	25	$ 3,500	25	$ 3,500
Total GEP		50	$ 7,000	100	$ 14,000	125	$ 17,500	125	$ 17,500	125	$ 17,500
CNMS FTE Increase (+1 Starting Year 4, Lectuer)									$75,000		$75,000
TOTAL IMPACT		**200**	**$ 53,500**	**450**	**$ 111,500**	**525**	**$ 127,500**	**$ 525**	**$ 202,500**	**$ 525**	**$ 202,500**

WORKSHEET #1B TO DETERMINE IMPACT OF PROPOSED PROGRAM ON OTHER ACADEMIC DEPARTMENTS: Assuming 125% of Projected Enrollment

Note: course with enrollment but no cost imply that the courses have adequate capacity

REQUIRED COURSES FOR MAJOR OUTSIDE THE HOME DEPARTMENT

Please list all upper division courses *required* for the major that are offered by other departments and the projected enrollment of new students as a result of the proposed program

Course	College	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5	
ENGL 393 Technical Writing (3)	CAHSS	0	$ -	31	$ 3,500	31	$ 3,500	31	$ 3,500	31	$ 3,500
CHEM 351 Organic Chemistry I (3)	NMS	0	$ -	0	$ -	31	$ 7,500	31	$ 7,500	31	$ 7,500
STAT 355 Intro to Prob/Stats for Sci/Engs (3)	NMS			31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500
Total Outside Required Courses		0	$ -	62	$ 11,000	93	$ 18,500	93	$ 18,500	93	$ 18,500

INTRODUCTORY AND PREREQUISITE COURSES OUTSIDE THE HOME DEPARTMENT

Please list all introductory and prerequisite courses required for the major that are offered by other departments and the projected enrollment of new students as a result of the proposed program

Course	College	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5	
1st Year		enrl.	cost	enrl.	cost	enrl.	cost	enrl.	cost	enrl.	cost
CHEM 101 Principles of Chemistry I (4)	NMS	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500
MATH 151 Calculus and Analytic Geometry I (4)	NMS	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500
CHEM 102 Principles of Chemistry II (4)	NMS	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500
CHEM 102L Introductory Chemistry Lab (2)	NMS	31	$ 9,000	31	$ 9,000	31	$ 9,000	31	$ 9,000	31	$ 9,000
PHYS 121 Introductory Physics I (4)	NMS	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500
MATH 152 Calculus & Analytic Geometry II (4)	NMS	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500
2nd Year			$ -								
ENES 110 Statics (3)	COE&IT		$ -	31	$ 6,250	31	$ 6,250	31	$ 6,250	31	$ 6,250
EMME 217 Engineering Thermodynamics (3)	COE&IT		$ -	31	$ 6,250	31	$ 6,250	31	$ 6,250	31	$ 6,250
PHYS 122 Introductory Physics II (4)	NMS		$ -	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500
MATH 251 Multivariable Calculus (4)	NMS		$ -	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500
BIOL 100 Concepts of Biology (4)	NMS		$ -	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500
MATH 225 Intro to Differential Equations (3)	NMS		$ -	31	$ 7,500	31	$ 7,500	31	$ 7,500	31	$ 7,500
3rd Year			$ -								
CMSC 104 Problem-Solving and Computer	COE&IT		$ -			31	$ 6,250	31	$ 6,250	31	$ 6,250
Total Intro and Prereq. Courses		186	$ 46,500	372	$ 89,000	403	$ 95,250	403	$ 95,250	403	$ 95,250

GEP COURSES

Please list all service courses required for the major and the projected enrollment of new students as a result of the proposed program.

Course	College	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5	
ENGL 100 Composition	CAHSS	31	$ 3,500	31	$ 3,500	31	$ 3,500	31	$ 3,500	31	$ 3,500
Language Course 1	CAHSS	31	$ 3,500	31	$ 3,500	31	$ 3,500	31	$ 3,500	31	$ 3,500
Langauge Course 2	CAHSS			31	$ 3,500	31	$ 3,500	31	$ 3,500	31	$ 3,500
Other GEP Course 1	CAHSS			31	$ 3,500	31	$ 3,500	31	$ 3,500	31	$ 3,500
Other GEP Course 2	CAHSS					31	$ 3,500	31	$ 3,500	31	$ 3,500
Total GEP		62	$ 7,000	124	$ 14,000	155	$ 17,500	155	$ 17,500	155	$ 17,500
CNMS FTE Increase (1 Starting Year 3)							$ -		$ 75,000		$ 75,000
TOTAL IMPACT (125% of projected enrollment)		**248**	**$ 53,500**	**558**	**$ 114,000**	**651**	**$ 131,250**	**651**	**$ 206,250**	**651**	**$ 206,250**

WORKSHEET #1B TO DETERMINE IMPACT OF PROPOSED PROGRAM ON OTHER ACADEMIC DEPARTMENTS (ASSUMING 75% of Projected Enrollment)

Note: course with enrollment but no cost imply that the courses have adequate capacity

REQUIRED COURSES FOR MAJOR OUTSIDE THE HOME DEPARTMENT

Please list all upper division courses *required* for the major that are offered by other departments and the projected enrollment of new students as a result of the proposed program

Course	College	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5	
ENGL 393 Technical Writing (3)	CAHSS	0	$ -	19	$ 3,500	19	$ 3,500	19	$ 3,500	19	$ 3,500
CHEM 351 Organic Chemistry I (3)	NMS	0	$ -	0	$ -	19	$ 7,500	19	$ 7,500	19	$ 7,500
STAT 355 Intro to Prob/Stats for Sci/Engs (3)	NMS			19	$ 7,500	19	$ 7,500	19	$ 7,500	19	$ 7,500
Total Outside Required Courses		0	$ -	38	$ 11,000	57	$ 18,500	57	$ 18,500	57	$ 18,500

INTRODUCTORY AND PREREQUISITE COURSES OUTSIDE THE HOME DEPARTMENT

Please list all introductory and prerequisite courses required for the major that are offered by other departments and the projected enrollment of new students as a result of the proposed program

Course	College	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5	
1st Year		enrl.	cost	enrl.	cost	enrl.	cost	enrl.	cost	enrl.	cost
CHEM 101 Principles of Chemistry I (4)	NMS	19	$ 7,500	19	$ 7,500	19	$ 7,500	19	$ 7,500	19	$ 7,500
MATH 151 Calculus and Analytic Geometry I (4)	NMS	19	$ 7,500	19	$ 7,500	19	$ 7,500	19	$ 7,500	19	$ 7,500
CHEM 102 Principles of Chemistry II (4)	NMS	19	$ 7,500	19	$ 7,500	19	$ 7,500	19	$ 7,500	19	$ 7,500
CHEM 102L Introductory Chemistry Lab (2)	NMS	19	$ 9,000	19	$ 9,000	19	$ 9,000	19	$ 9,000	19	$ 9,000
PHYS 121 Introductory Physics I (4)	NMS	19	$ 7,500	19	$ 7,500	19	$ 7,500	19	$ 7,500	19	$ 7,500
MATH 152 Calculus & Analytic Geometry II (4)	NMS	19	$ -	19		19		19		19	
2nd Year			$ -								
ENES 110 Statics (3)	COE&IT		$ -	19	$ 3,750	19	$ 3,750	19	$ 3,750	19	$ 3,750
EMME 217 Engineering Thermodynamics (3)	COE&IT		$ -	19	$ 3,750	19	$ 3,750	19	$ 3,750	19	$ 3,750
PHYS 122 Introductory Physics II (4)	NMS		$ -	19	$ 7,500	19	$ 7,500	19	$ 7,500	19	$ 7,500
MATH 251 Multivariable Calculus (4)	NMS		$ -	19	$ 7,500	19	$ 7,500	19	$ 7,500	19	$ 7,500
BIOL 100 Concepts of Biology (4)	NMS		$ -	19	$ 7,500	19	$ 7,500	19	$ 7,500	19	$ 7,500
MATH 225 Intro to Differential Equations (3)	NMS		$ -	19	$ 7,500	19	$ 7,500	19	$ 7,500	19	$ 7,500
3rd Year			$ -								
CMSC 104 Problem-Solving and Computer	COE&IT		$ -		$ -	19	$ 3,750	19	$ 3,750	19	$ 3,750
Total Intro and Prereq. Courses		113	$ 39,000	228	$ 76,500	247	$ 80,250	247	$ 80,250	247	$ 80,250

GEP COURSES

Please list all service courses required for the major and the projected enrollment of new students as a result of the proposed program.

Course	College	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5	
ENGL 100 Composition	CAHSS	19	$ 3,500	19	$ 3,500	19	$ 3,500	19	$ 3,500	19	$ 3,500
Language Course 1	CAHSS	19	$ 3,500	19	$ 3,500	19	$ 3,500	19	$ 3,500	19	$ 3,500
Langauge Course 2	CAHSS			19	$ 3,500	19	$ 3,500	19	$ 3,500	19	$ 3,500
Other GEP Course 1	CAHSS			19	$ 3,500	19	$ 3,500	19	$ 3,500	19	$ 3,500
Other GEP Course 2	CAHSS					19	$ 3,500	19	$ 3,500	19	$ 3,500
Total GEP		38	$ 7,000	76	$ 14,000	95	$ 17,500	95	$ 17,500	95	$ 17,500
CNMS FTE Increase (+1 Starting Year 3)									$ 75,000		$ 75,000
TOTAL IMPACT (75% of projected enrollment)		**151**	**$ 46,000**	**342**	**$ 101,500**	**399**	**$ 116,250**	**399**	**$ 191,250**	**399**	**$ 191,250**

WORKSHEET #1A: DETERMINING POTENTIAL SOURCES OF STUDENTS

This worksheet is intended as a tool for academic units and governance bodies in the consideration of the likely sources of students, historical enrollment patterns, and the enrollment profiles of comparable programs. To the extent practicable, please include informed estimates on the potential for the internal migration of students from a major program into the newly proposed program. Please provide enrollment data on comparable programs within Maryland and among UMBC's peers and aspirational peer institutions.

Internal Student Migration											
Please complete the chart below showing existing sources of students that may change their major to the proposed program.											
Current Major/Program	Year 1	Year 2	Year 3	Year 4	Year 5						
no data projections available											
Comparable In-State Programs											
Please provide information on enrollment trends for same or similar programs currently offered at in-state public and private institutions.											
Institution	CAY-4	CAY-3	CAY-2	CAY-1	CAY						
See Appendix C											
Comparable Out-of-State Programs											
Please provide information on enrollment trends for same or similar programs currently offered at a representative sample of institutions outside the state.											
Institution	CAY-4	CAY-3	CAY-2	CAY-1	CAY						
See Appendix C											
Feeder/Transfer Programs											
Please provide information on potential feeder programs (Community College, pre-professional, etc.) both in and out of state											
Institution	CAY-4	CAY-3	CAY-2	CAY-1	CAY						
All MD and regeional community colleges, use 11 transfer students per year starting in junior, based on CBE data	11	11	0	0	0						
Captive Sources of Students											
Please provide information on any captive or cohort sources of students. This would include school systems and corporations that plan to fund a set number of students for the program.											
Source	Year 1	Year 2	Year 3	Year 4	Year 5						
NONE	0	0	0	0	0						
Other Sources											
Please comment on any other anticipated sources of students and when possible, provide five-year projections.											
NONE											
CAY=Current Academic Year											

New Program Enrollment, Revenue, and Expenditure Template					
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Program Enrollment & Retention Profile (Net new students)†					
Estimated number of first-time full-time resident students	22	40	56	70	76
Estimated number of annual first-time full-time resident credit hours	765	1346	1858	2190	2382
Estimated number of first-time full-time non-resident students	3	5	6	8	9
Estimated number of annual first-time full-time non-resident credit hours	85	150	206	243	265
Estimated number of transfer full-time resident students	0	0	11	19	19
Estimated number of annual transfer full-time resident credit hours	0	0	363	588	588
Total Credit Hours	850	1496	2428	3021	3234
† Overall ratio of resident to nonresident students is 9:1					
PROGRAM REVENUE					
Note: tuition rises 4% per year unless otherwise noted					
Full-time Tuition & Fee Rate (resident)	$ 8,872	$ 9,227	$ 9,596	$ 9,980	$ 10,379
Undergraduate Tuition discount rate‡	0%	0%	0%	0%	0%
Adjusted tuition & fee rate (resident)	$ 8,872	$ 9,227	$ 9,596	$ 9,980	$ 10,379
Estimated annual revenue from full-time students (resident)	$ 195,184	$ 369,075	$ 537,373	$ 698,586	$ 788,803
Full-time Tuition & Fee Rate (non-resident)	$ 18,213	$ 18,942	$ 19,699	$ 20,487	$ 21,307
Undergraduate Tuition discount rate‡	0%	0%	0%	0%	0%
Adjusted tuition & fee rate (non-resident)	$ 18,213	$ 18,942	$ 19,699	$ 20,487	$ 21,307
Estimated annual revenue from full-time students (non-resident)	$ 54,639	$ 94,708	$ 118,195	$ 163,897	$ 191,760
Tuition & Fee Rate (transfer; resident students)	$ 8,872	$ 9,227	$ 9,596	$ 9,980	$ 10,379
Undergraduate Tuition discount rate‡	0.0%	0.0%	0.0%	0.0%	0.0%
Adjusted tuition & fee rate	$8,491	$8,830	$9,183	$9,551	$9,933
Estimated annual revenue from transfer resident students	0	0	101,017	181,087	188,330
subtotal tuition revenue	$ 249,823	$ 463,783	$ 756,585	$ 1,043,570	$ 1,168,893
Higher enrollment scenario: 125% of projected tuition revenue	$ 312,279	$ 579,729	$ 945,731	$ 1,304,462	$ 1,461,116
Lower enrollment scenario: 75% of projected tuition revenue	$ 187,367	$ 347,837	$ 567,439	$ 782,677	$ 876,670
Reallocated funds	319,750	99,750	103,740	107,890	112,205
Other Revenue Sources (i.e. grants, contracts, gifts)	$ -	$ -	$ -	$ -	$ -
TOTAL PROJECTED REVENUE	$ 569,573	$ 563,533	$ 860,325	$ 1,151,459	$ 1,281,098

	Year 1	Year 2	Year 3	Year 4	Year 5
PROGRAM EXPENDITURES					
PERSONNEL EXPENDITURES (salaries rise 4% per year unless otherwise noted)					
Faculty Positions					
Lecturer 1 (50% in Year 1, 100% thereafter)	$ 30,000.00	$ 62,400.00	$ 64,896.00	$ 67,491.84	$ 70,191.51
Lecturer 2 (50% in Year 2, 100% thereafter)		$ 31,200.00	$ 64,896.00	$ 67,491.84	$ 70,191.51
Tenure Track Faculty 1			$ 80,000.00	$ 83,200.00	$ 86,528.00
FT Faculty fringe (33%)	$ 9,900.00	$ 30,888.00	$ 69,231.36	$ 72,000.61	$ 74,880.64
Part-time faculty (7.5% fringe)	$ -	$ -	$ -	$ -	$ -
Full-time equivalent staff (FTE)					
Administrative Assistant	$ -	$ 40,000	$ 41,600	$ 43,264	$ 44,995
Technician (50% time)	-	-	$ 30,000	$ 31,200	$ 32,448
Staff fringe (33%)	$ -	$ 13,200	$ 23,628	$ 24,573	$ 25,556
Teaching Assistant salary + fringe (16.5%)	$ 32,620	$ 32,620	$ 65,240	$ 65,240	$ 65,240
Graduate Tuition Remission (rises 4% per year)	$ 16,660	$ 17,326	$ 36,040	$ 37,482	$ 38,981
SUBTOTAL PERSONNEL EXPENDITURES	$ 89,180	$ 227,634	$ 475,531	$ 491,943	$ 509,011
OPERATING EXPENDITURES					
Special & Technical (i.e. honorariums, student payments)	-	-	-	-	-
Communication	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Travel	$ 2,000	$ 4,000	$ 7,000	$ 2,000	$ 2,000
Contractual Services (i.e. marketing, printing, equipment)	$ 3,000	$ 3,000	$ 1,000	$ 1,000	$ 1,000
Supplies (i.e. office, research, items less than $1,000)	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Equipment Capital or Sensitive (includes AOK Library)‡	$ 5,000	$ 5,300	$ 5,618	$ 5,955	$ 6,312
Fixed Charges (i.e. association dues, subscriptions, rental charges)	$ -	$ -	$ -	$ -	$ -
Infrastructure (if any)	$ 100,000	-	-	-	-
SUBTOTAL OPERATING EXPENDITURES	$ 112,000	$ 14,300	$ 15,618	$ 10,955	$ 11,312
‡ Note the annual rates of increase in library costs are 3% for book acquisitions and 9% for serial subscriptions					
SUBTOTAL IMPACT ON OTHER PROGRAMS COSTS (from worksheet 1B)	$ 53,500	$ 111,500	$ 127,500	$ 202,500	$ 202,500
Impact of higher enrollment (125% of projected)	$ 53,500	$ 114,000	$ 131,250	$ 206,250	$ 206,250
Impact of lower enrollment (75% of projected)	$ 46,000	$ 101,500	$ 116,250	$ 191,250	$ 191,250
PROJECTED TOTAL DIRECT EXPENSES	$ 254,680	$ 353,434	$ 618,649	$ 705,398	$ 722,824
PROJECTED TOTAL DIRECT EXPENSES (assuming 125% of projected enrollment)	$ 254,680	$ 355,934	$ 622,399	$ 709,148	$ 726,574
PROJECTED TOTAL DIRECT EXPENSES (assuming 75% of projected enrollment)	$ 247,180	$ 343,434	$ 607,399	$ 694,148	$ 711,574
INDIRECT EXPENDITURES					
University overhead rate *(25%)*	25%	25%	25%	25%	25%
Porjected University overhead amount	$ 63,670	$ 88,359	$ 154,662	$ 176,350	$ 180,706
OTHER EXPENSES: Faculty Startup Allocated from DRIF (not included in expenses total)	$ 10,000	$ 10,000	$ 184,250	$ 90,750	$ -
TOTAL DIRECT & INDIRECT EXPENSES	$318,350	$441,793	$773,312	$881,748	$903,529
Higher enrollmemt scenario: 125% of projected enrollment	$ 318,350	$ 444,918	$ 777,999	$ 886,435	$ 908,217
Lower enrollmemt scenario: 75% of projected enrollment	$308,975	$429,293	$759,249	$867,685	$889,467
TOTAL REVENUE	$569,573	$563,533	$860,325	$1,151,459	$1,281,098
NET REVENUE	$251,223	$121,740	$87,013	$269,712	$377,569
CUMULATIVE NET	$251,223	$372,963	$459,976	$729,688	$1,107,257