October 26, 2016

MEMORANDUM

TO: University Senate Members

FROM: Jordan A. Goodman
Chair of the University Senate

SUBJECT: University Senate Meeting on Wednesday, November 2, 2016

The next meeting of the University Senate will be held on **Wednesday, November 2, 2016**. The meeting will convene at 3:15 p.m. in the **Colony Ballroom of the Stamp Student Union (2nd Floor)**. If you are unable to attend, please contact the Senate Office[1] by calling 301-405-5805 or sending an email to senate-admin@umd.edu for an excused absence. Your response will assure an accurate quorum count for the meeting.

The meeting materials can be accessed on the Senate Web site. Please go to http://www.senate.umd.edu/meetings/materials/ and click on the date of the meeting.

Meeting Agenda

1. Call to Order

2. Approval of the October 6, 2016 Senate Minutes (Action)

3. Report of the Chair

4. Special Order of the Day
   David Allen
   DOTS Executive Director
   Parking Outlook

5. Special Order of the Day
   Catherine Carroll
   Director & Title IX Officer, Office of Civil Rights & Sexual Misconduct
   Title IX Update

6. PCC Proposal to Establish a Master of Science in Environmental Health Sciences (Senate Doc. No. 16-17-18) (Action)

7. PCC Proposal to Establish a Ph.D. in Environmental Health Sciences (Senate Doc. No. 16-17-17) (Action)

8. PCC Proposal to Establish a Post-Baccalaureate Certificate in Computer Networking (Senate Doc. No. 16-17-16) (Action)

9. PCC Proposal to Establish a Master of Quantitative Finance (Senate Doc. No. 16-17-19) (Action)

10. New Business

11. Adjournment

[1] Any request for excused absence made after 1:00 p.m. will not be recorded as an excused absence.

University Senate

October 6, 2016

Members Present

Members present at the meeting: 130

Call to Order

Senate Chair Goodman called the meeting to order at 3:20 p.m.

Special Order: Presidential Briefing

Goodman announced that there would not be a presidential briefing at this meeting because President Loh had to attend a special meeting of the Board of Regents.

Approval of the Minutes

Chair Goodman asked for additions or corrections to the minutes of the September 7, 2016, Senate meeting; hearing none, he declared the minutes approved as distributed.

Report of the Chair

Nominations Committee

Goodman stated that outgoing senators, with a term ending in April 2017, should have received a message from the Senate Office requesting volunteers to serve on the Nominations Committee. This important committee is charged with soliciting nominations from the membership of the Senate for the Executive Committee, Chair-Elect, the Committee on Committees, and other University-wide committees and councils whose members will be elected at the annual transition of the Senate in May. The committee serves a very important purpose, yet meets only a few times during the period of late-January through March. The Senate relies on the good judgment of the members of the Nominations Committee to present candidates that reflect the quality and diversity of our campus community. Goodman encouraged any outgoing senators to consider serving on this important committee. Those interested can send an email to senate-admin@umd.edu. The Senate will vote on the Nominations Committee slate at its December meeting.

Board of Regents Staff Awards

The Staff Affairs Committee is currently accepting nominations for the prestigious Board of Regents' Staff Awards. These annual awards are the highest System-wide recognition of the exceptional work done by staff members across the University System of Maryland. Awardees receive a $2,000 stipend and formal recognition by the Board of Regents and the University Senate. Exempt and non-exempt staff who have been with the University for at least 5 years are eligible to be nominated in one of the following four categories: Exceptional Contribution to the Institution and/or Unit to Which the Person Belongs; Outstanding Service to Students in an Academic or Residential Environment; Extraordinary Public Service to the University or Greater Community; Effectiveness and Efficiency. There

are coaches available to help nominators gather the necessary materials, and any member of the university community, including students, can nominate an eligible staff member. Nomination packages must be submitted to the Senate Office by **Friday, November 18th**. Detailed instructions can be found on the Senate website.

Big Ten Academic Alliance (BTAA) Governance Leaders Conference

Goodman reported that he, Reka Montfort, Executive Secretary & Director, and Willie Brown, Past Senate Chair, attended the Big Ten Academic Alliance Governance Leaders Conference at Michigan State University September 28-30. Representatives from all 14 conference schools were in attendance. They met with campus leaders at Michigan State, including their President, members of their Board of Trustees, and their Associate Provost/Associate Vice-President for Academic Human Resources, who is the equivalent to our Associate Provost for Faculty Affairs. They discussed topics such as communication premises & pitfalls, the role of academic governance in developing an institutional response, background and future of the Big Ten Academic Alliance, the Coalition on Intercollegiate Athletics, and Current NCAA Discussion Regarding Student-Athletes and Academic Integrity. They also had an opportunity to hold breakout sessions regarding engagement in governance including topics such as governance structures/systems, the role of governance in campus planning, types of reward/recognition to ensure involvement and engagement, and best practices in governance at all of the Big 10 institutions. It was a productive meeting, and they hope to continue to engage that group throughout the year using a Slack group. Goodman noted that the University Senate is unique because of its representation of all members of campus and noted that senates at other institutions have the university president chair the senate or represent multiple campuses. He reminded Senators that they have specific responsibilities under the Plan of Organization for Shared Governance including advising the President, receiving and considering recommendations from the President, and consulting with the campus community on all matters of concern, submitting proposals to improve the quality of campus life, and formulating and recommending to the President policies relating to education, research, and administration. He encouraged Senators to engage in these matters and noted that they should feel empowered to raise concerns for the betterment of the University.

Next Meeting

President Loh was originally scheduled to give his State of the Campus Address at the November 2nd Senate meeting. Goodman stated that the President has to travel out of the country that week so his address has been rescheduled to the December 6th Senate meeting. We will have a regular Senate meeting on November 2nd,including a presentation by David Allen, Director of Transportation Services to address the parking concerns that senators raised on the presidential briefing Slack channel. Both of the next two meetings will be in the Colony Ballroom on the second floor of the Stamp Student Union.

Underrepresented and Diverse Faculty Hiring Initiatives (Senate Doc. No. 16-17-07) (Action)

Stephen Thomas, Chair of the Joint Provost-Senate Underrepresented and Diverse Faculty Hiring Task Force, presented the Task Force's recommendations on both the President's Postdoctoral Fellowship Program and the Senior Strategic Faculty Hires initiatives.

Goodman thanked Thomas for his presentation and stated that the Senate would discuss and vote on each initiative separately, so that one does not adversely affect the other, starting with the President's Postdoctoral Fellowship Program.

Goodman opened the floor to discussion of the President's Postdoctoral Fellowship Program.

Senator Kahn, faculty, College of Computer, Mathematical, and Natural Sciences, noted that this was a great idea, but was concerned that the issue that needs to be addressed is not at the postdoctoral level. He noted that barriers existed beyond the postdoctoral level among minorities seeking to become junior faculty members. He added that bringing people into the postdoctoral program does not necessarily mean that they will be faculty members following the program.

Thomas noted that the task force had discussed these issues, including the promotion and tenure of junior faculty.

Dean Pines, A. James Clark School of Engineering, noted that he was a member of the task force and stated that there were some cases in Engineering in which some applicants for faculty positions had potential but not enough experience. They were given postdoctoral appointments for a year and then we hired them as faculty members. He noted that there is a large backlog of people in postdoctoral roles that are waiting for a faculty position due to the hiring freezes over the past few years. He concluded that the postdoctoral program is a worthwhile program as it does produce new faculty members.

Dean Ball, College of Behavioral and Social Sciences, noted that there are a number of fields on campus that do not regularly have postdoctoral appointments. He added that there have been a number of applicants for tenure-track positions that were not quite ready and that the postdoctoral program would help to bring these people into the community to prepare them for the tenure-track position.

Thomas noted that one of the interviewees the task force contacted lamented that their postdoctoral fellowship program saw people leaving to go to other institutions and that the point of this program was to bring people into the University and train them for future faculty positions. He added that the other institutions that are part of the common application have restricted the postdoctoral fellowship program to science, technology, engineering, and math (STEM) fields only, while UMD has opened it up to all fields.

Senator Kahn raised concerns about bringing people in with an implicit promise of a tenure-track position.

Thomas noted that some other institutions did allow for that option, but that this was not recommended for our University.

John Bertot, Associate Provost for Faculty Affairs, noted that the report identified this option as a best practice from other institutions but that units should follow normal search procedures and guidelines.

Senator Payne, faculty, College of Computer, Mathematical, and Natural Sciences, noted that the postdoctoral fellows would need very strong mentors to succeed in obtaining faculty positions at the conclusion of the fellowship.

Thomas noted that the National Master Mentor Network training was conducted recently for the first time and that it was successful in training senior faculty to be excellent mentors. This initiative will be continued in order to create more successful mentors.

Senator Baden, faculty, College of Computer, Mathematical, and Natural Sciences, raised concerns about postdoctoral fellows going elsewhere after the fellowship has concluded and the scale of the program in that there are only three people a year for this opportunity. He questioned whether it would have been better to suggest that the money used for this program be put towards the hiring of underrepresented and diverse candidates at the assistant professor level.

Thomas noted that the task force had discussed this issue as well and noted that other postdoctoral programs and assistant professor initiatives on campus are still operating and encouraged the other programs to look at diversity in their hiring practices.

Bertot noted that UMD joined the postdoctoral fellowship program consortium for two reasons. One was to bring more diverse fellows to our campus and to contribute to the larger academy, while the other was to increase the recruitment pool for faculty hires, as UMD would have the ability to recruit from postdoctoral fellows at other institutions within the consortium. He added that the investment is relatively small for the potential payoff.

Senator Jones, faculty, A. James Clark School of Engineering, asked if search committees for faculty members should be identifying potential candidates that are not ready to be faculty members but would do well in a postdoctoral fellowship, or if this is outside that process.

Dean Pines responded that this initiative is a separate program and noted that his examples only served to show the ability of a postdoctoral fellowship leading to a faculty position even though there is no guarantee that postdoctoral fellows will obtain a faculty position.

Seeing no further discussion, Goodman called for a vote on the President's Postdoctoral Fellowship Program initiative recommendations. The vote was in 105 favor, 13 opposed, and 5 abstentions. **The motion to approve the recommendations passed.**

Goodman opened the floor to discussion of the Strategic Senior Faculty Hire initiative.

Senator Singer, faculty, College of Computer, Mathematical, and Natural Sciences, raised concerns about hiring senior faculty due to the cost and the effectiveness of improving diversity. He noted that hiring people who have already made it does not do more than hire good people.

Thomas noted this issue had been discussed by the task force. He noted that this is one of the most common ways in which institutions advance in increasing diversity.

Dean Pines noted that this does not mean recruiting solely from academia. This initiative also looks at recruiting senior people from industry who will help advance the research being done here but may not have the right resume for academia.

Senator Martinez-Miranda, faculty, A. James Clark School of Engineering, agreed with Senator Singer's concerns about the senior faculty hiring initiative. She noted that hiring senior faculty from outside the University may result in less promotions for junior faculty at UMD. She suggested a network like the previously mentioned mentor network to assist junior faculty in preparing their dossiers for promotion.

Thomas highlighted the advancing faculty diversity initiative noted in the appendix of the report. He stated that the National Research Mentoring Network, which UMD has access to as part of the Big Ten Academic Alliance, also has resources and opportunities for promotion guidance for junior faculty.

Bertot added that the task force was charged with two specific initiatives, so that is why the discussion is tailored to those areas. He added that these recommendations are part of a larger ecosystem of initiatives happening at the University. ADVANCE and the Office of Faculty Affairs (OFA) regularly address the issues Senator Martinez-Miranda spoke about with Appointment, Promotion, and Tenure (APT) workshops. OFA is working to build a more cohesive approach to these issues.

Senator Martinez-Miranda asked whether diversity issues had been addressed in the workshops.

Bertot noted that OFA had been working with the Office of Diversity & Inclusion (ODI) to address diversity issues in the workshops.

Kumea Shorter-Gooden, Chief Diversity Officer, stated that some of the issues may lie in underrepresented and diverse faculty members navigating the APT process. She noted that Thomas is one of the people that works with ADVANCE to assist faculty of color in navigating the APT process. She added that one of the challenges is a lack of underrepresented and diverse full professors to provide mentorship for junior faculty.

Thomas noted that several faculty had gone through a year-long APT workshop program through ADVANCE and were successfully promoted. He agreed that this needed to be highlighted more.

Senator Lathrop, faculty, College of Computer, Mathematical, and Natural Sciences, noted that this is a national problem. He stated that he is in favor of this report because it allows for the opportunity to look beyond our country and to talented scholars from all over the world.

Senator Blanchard, faculty, College of Behavioral and Social Sciences, asked for clarification on the process and when the candidate would be informed of UMD's interest.

Thomas noted that the letter of intent stage was created to ensure that the proposals are feasible, but added that the process still lies within the unit.

Bertot stated that the purpose of the first stage was to gauge the possibility of moving forward. After the letter of intent would be a good time to engage the candidate in order to develop the full proposal with accurate representation of what it would take to get that person to come to campus.

Senator Baden stated that the postdoctoral fellowship program would look at the pre-tenure level, and the senior hire program would look at it from the top-down. He noted that UMD also needs more underrepresented faculty at the assistant professor level and stated the difficulty of doing this given the hiring climate. He asked about a timetable for review of the initiatives.

Thomas noted that the report calls for an annual evaluation of the programs. He added that critical mass matters, and there is a tipping point in which things begin to take off on their own.

Mary Ann Rankin, Senior Vice President and Provost, noted that the original report had stated a review every three years. She stated that this would be looked at every year. Realistically, it takes a long time to hire people from other institutions. She suggested a commitment to a serious review in five years.

Seeing no further discussion, Goodman called for a vote on the Strategic Senior Faculty Hire initiative. The vote was in 98 favor, 14 opposed, and 4 abstentions. **The motion to approve the initiative passed.**

Goodman thanked Thomas and the members of the Task Force for their work.

Special Order of the Day
Robert Dooling
Chair, IP Policy Subcommittee of the Research Council
Intellectual Policy Review Update

Robert Dooling, Chair of the IP Policy Subcommittee of the Research Council, provided an update on the progress the subcommittee has made since the presentation to the Senate in Fall 2015.

Goodman opened the floor to questions.

Senator Cumings, faculty, A. James Clark School of Engineering, suggested a review of best practices in regards to revenue sharing to ensure that there is proper motivation for all parties involved. He raised a concern that 25% for the University under-motivates the University to pursue patents.

Dooling agreed with that statement and noted that this point was still up for discussion.

Senator Kahn asked whether the graduate students own their lab notebooks, or if he as the faculty member running the lab keeps them.

Dooling noted that this is murky, that people make copies of notebooks, and that there are often informal agreements between the involved parties for these issues.

Ann Bowden, Office of General Counsel, noted that the University is going to own the research the majority of the time because it is federally funded. She explained that the point in the presentation regarding students owning their work is focused on coursework not research. The University has to maintain copies of the data in whatever form it is in.

Senator Locke, exempt staff in Divisions, noted that many donors and corporations are interested in partnering with UMD but are also interested in maintaining some of the IP rights and see an unclear path in the policy, which makes them less likely to donate.

Bowden noted that there is a separate effort that is addressing the issue Senator Locke raised, which is being headed up by the Provost's Office.

Senator Raghavan, faculty, Robert H. Smith School of Business, asked whether videos of him teaching for online courses could still be used if he were to go to another University.

Bowden noted that online courses are treated the same as face-to-face courses, except that the University is putting resources into the technology of online courses, so it gets to use the information if it wants to, but that the faculty member would still own the work.

Senator Raghavan stated that the way the policy is worded right now, it sounds as if even if the faculty member leaves the University, the University has the right to offer that course online with the content generated by the faculty member that is no longer employed at the institution.

Bowden agreed that the subcommittee should relook at that issue and clarify the language.

Senator Hurtt, faculty, School of Architecture, Planning, and Preservation, stated that his school goes through an accreditation process in which the accreditors need to see proof of the School meeting the academic standards specified in their process. This proof is shown through the work of the students, and so the School has a statement in their materials which says that all student work belongs to the School so that it can be used as part of the accreditation. He asked if this statement would be in conflict with the University's policy.

Dooling noted that he had heard of this in another unit and suggested that the School speak with the Office of General Counsel.

Bowden stated that she believes this statement is in conflict with the University's current IP policy, but added that obtaining a waiver through the Office of the Vice President for Research is an option.

Senator Cumings stated that he had created some videos for a course that were used over the summer by a different instructor, which was the intention. He noted that it is unclear whether the University could use those videos for another purpose and asked if he could tell the University that they cannot use his videos because he owns them.

Bowden explained that the policy states the University can only use materials in accordance with copyright law.

Senator Knapp, undergraduate student, College of Behavioral and Social Sciences, stated that the section regarding online courses creates the potential for the University to use materials in online courses from faculty members who have not taught at the University in a long time. He noted that it is not beneficial to students if material is presented in a class online, but students have no way of contacting the professor.

Goodman thanked Dooling for his presentation.

Chair-Elect Falvey made a motion to extend the meeting by 15 minutes. The motion was seconded.

Goodman called for a vote on the motion to extend the meeting by fifteen minutes and noted that the motion required a 2/3 vote in favor. The result was 51 in favor and 29 opposed. **The motion to extend the meeting failed.**

Special Order of the Day
Catherine Carroll
Director & Title IX Officer, Office of Civil Rights & Sexual Misconduct
Title IX Update

Catherine Carroll, Director & Title IX Officer, Office of Civil Rights & Sexual Misconduct (OCRSM) provided an update on the University's initiatives surrounding sexual assault and other Title IX concerns.

Goodman thanked Carroll for her presentation and noted there was no time for questions.

New Business

There was no new business.

Adjournment

The meeting ended at 5:05 p.m.

2016-2018 Parking Outlook

J. David Allen
Executive Director
Transportation Services

Unprecedented Growth

New School of Public Policy

The Brendan Iribe Center

A. James Clark Hall

Cole Practice Facility and Academic Research Complex

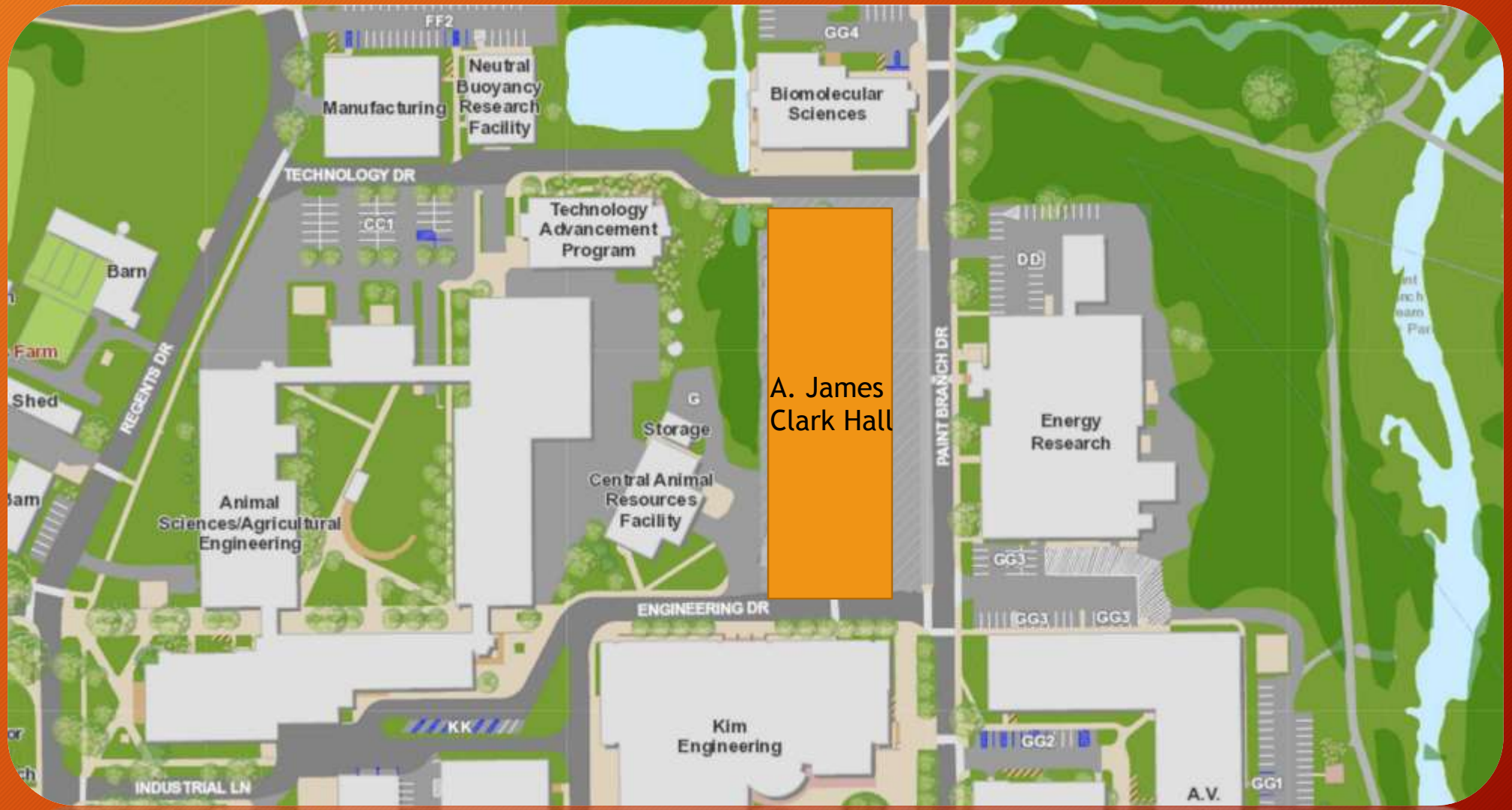
The Purple Line

Central Hall

We Works

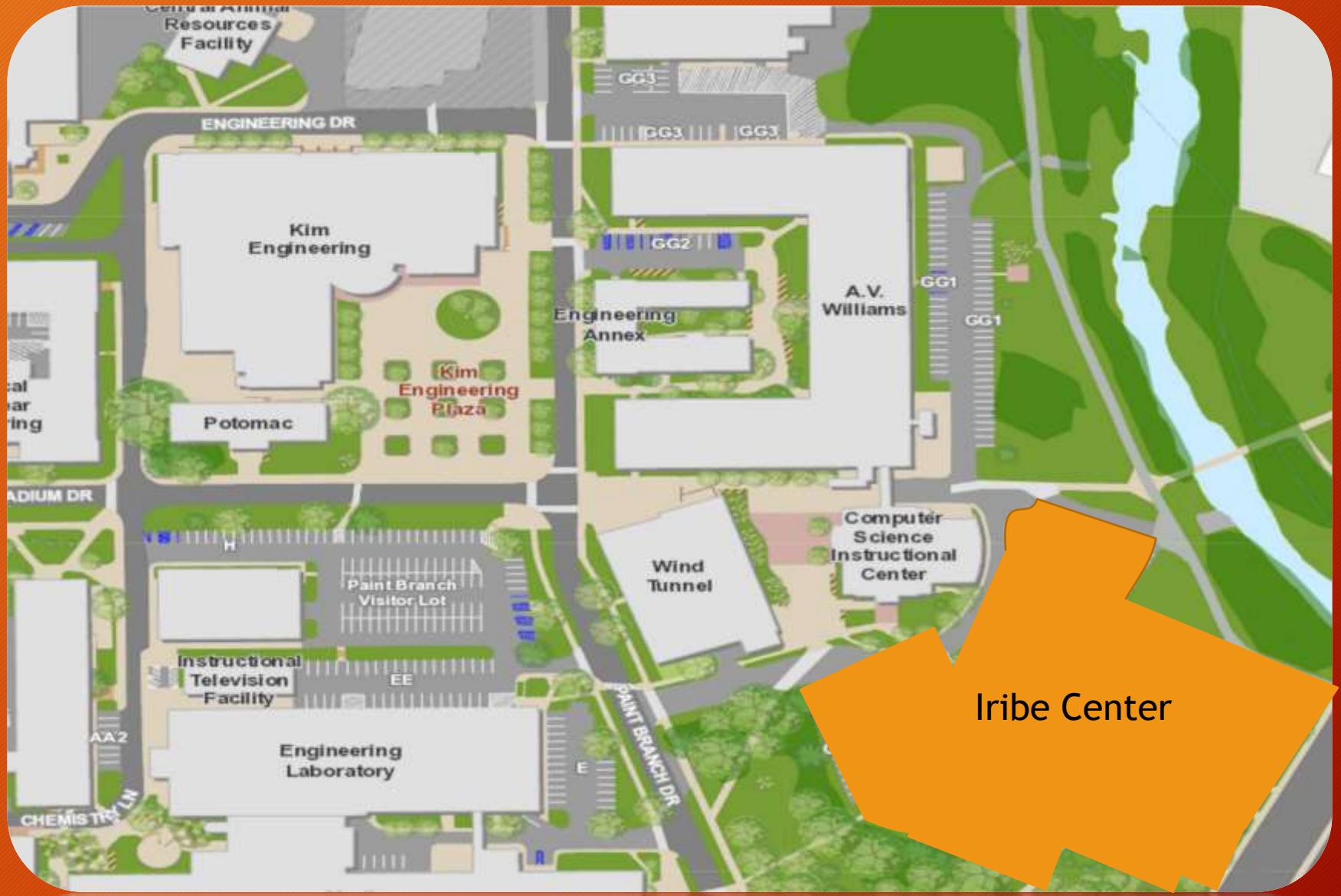
May 2015

192 Lost Parking Spaces



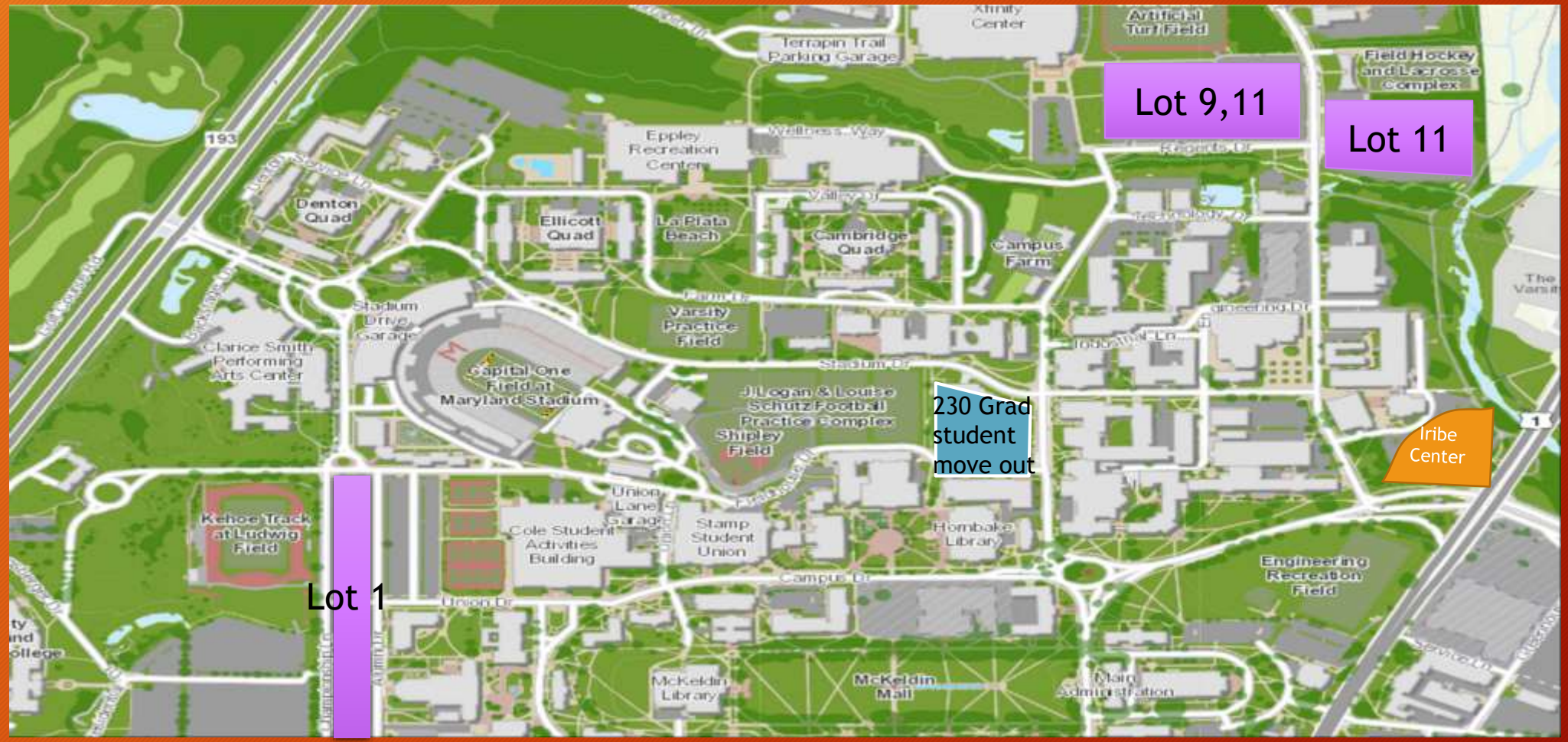
June 2016

352 Lost Parking Spaces

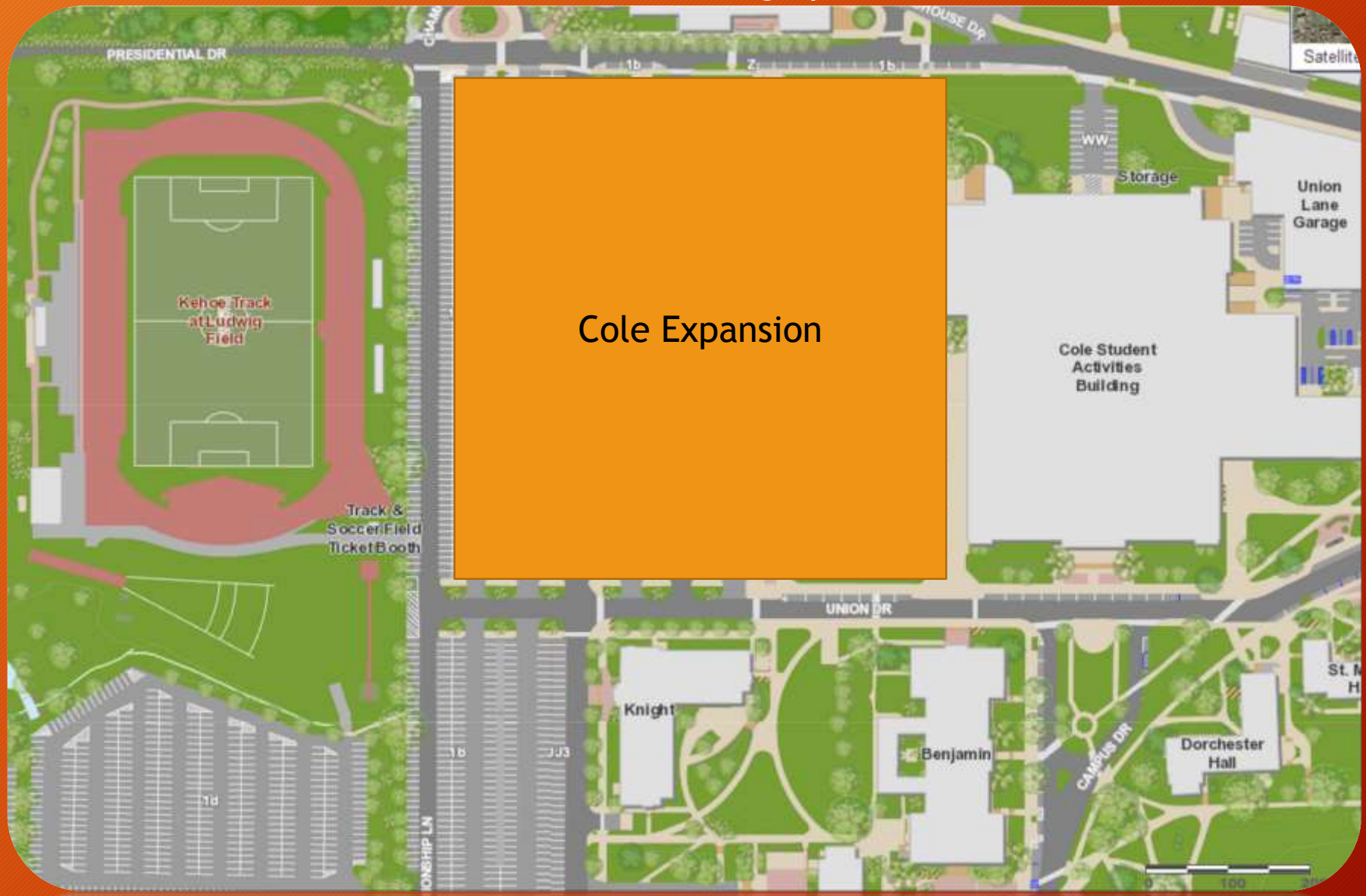


Iribe Center Effect on Employee Parking

Iribe Center Effect on Student Parking
June 2016

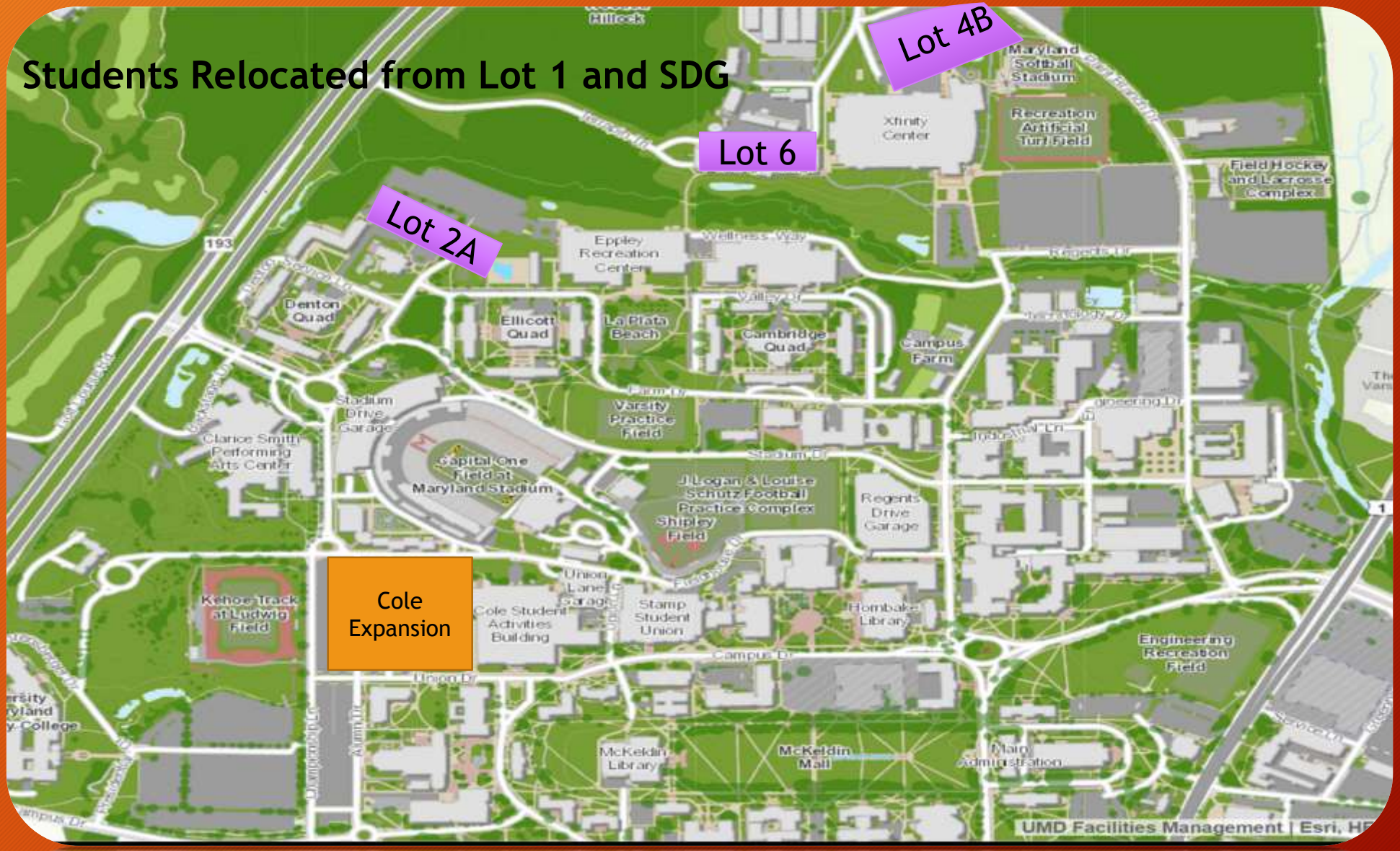


Cole Expansion Effect on Campus Parking
September 2017
964 Lost Parking Spaces



Cole Effect on Employee Parking

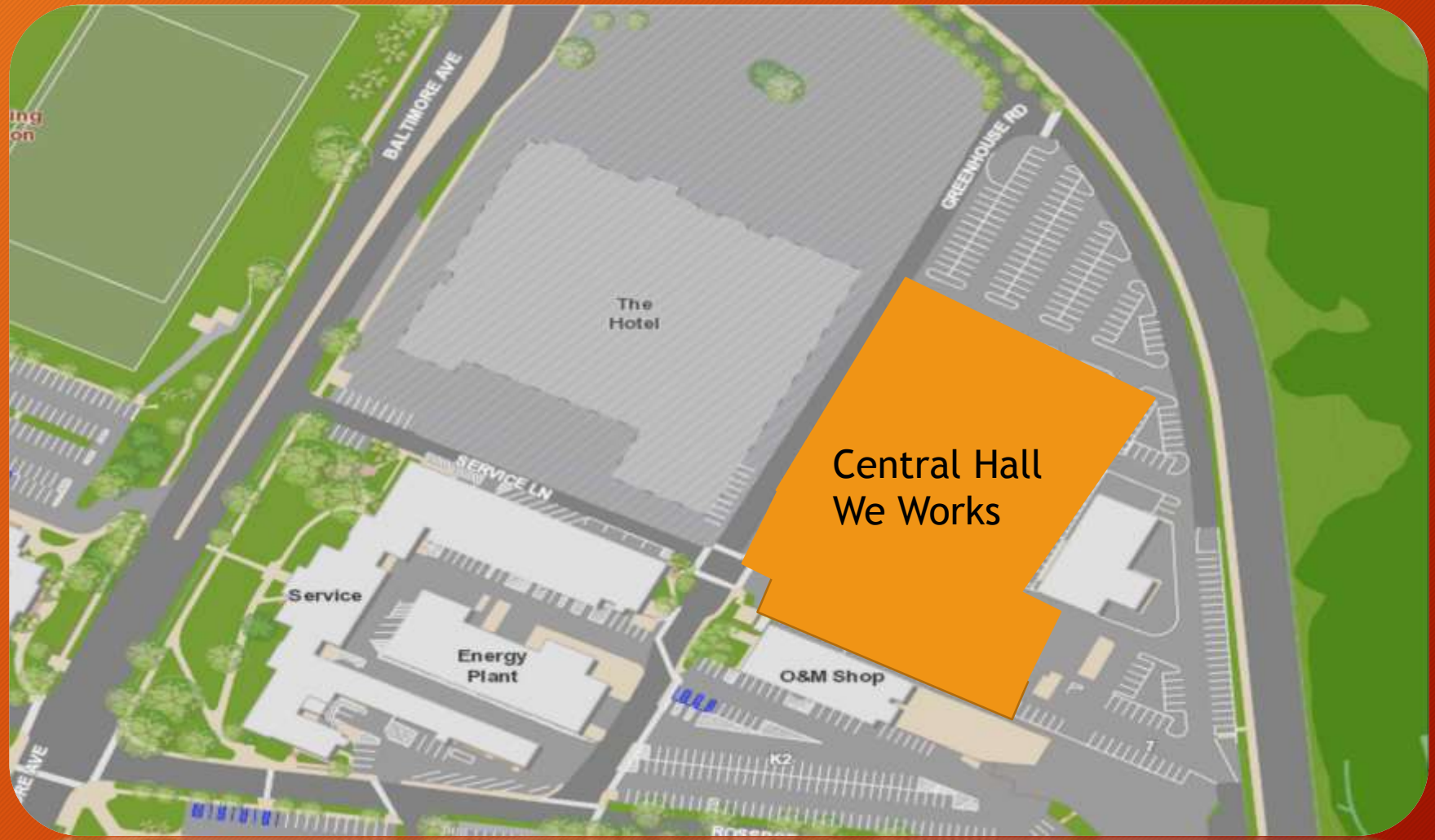
Cole Expansion Effect on Student Parking



Cole Expansion Effect on Campus Parking September 2017

360 Lost Parking spaces

Central Hall Effect on Campus Parking
September 2017
311 Lost Parking Spaces



The Hotel Effect on Campus Parking
September 2017
200 Additional Parking Spaces

Purple Line Effect on Campus Parking
September 2017
550 Lost Parking Spaces

Purple Line

School of Public Policy Effect on Campus Parking Fall 2018

105 Lost Parking Spaces

Solutions

Current Plan for Fall 2017

Few Cars

Restricting Resident Freshmen and Sophomore Students

Net 1063 Spaces

More Parking
Parking Garage?

Percentages include a standard mandatory 3% increase

Project	Affect on Parking	Net Lost Parking Spaces	Net Parking Buffer
Spring 2015			1650
A. James Clark	Fall 2015	(233)	1417
Iribe Center	Summer 2016	(352)	1065
Tennis Court Replacement	Summer 2017	(360)	705
Resident Freshman Reduction	Summer 2017	500	1112
Resident Sophomore Reduction	Summer 2017	563	1768
Purple Line	Summer 2017	(550)	1218
Cole Expansion	Summer 2017	(964)	254
The Hall/We Works	Summer 2017	(265)	-11
Hotel Site Additional Parking	Summer 2017	200	189
School of Public Policy	Fall 2018	(122)	67
Total		(1583)	67

Anticipated Parking Situation Fall 2017

- All parkers will continue to be able to locate parking in their assigned parking lots
- No Freshmen/Sophomore resident parkers on campus (as is the case at many universities)
- Additional Zipcars located on campus to accommodate Freshmen/Sophomore resident students
- Subsidized Vanpool registration and monthly fees
- Daily visitor parking will be available but on a more limited basis
- Parking for some special events will be moved off campus
- Subsidized Mbike registration for all Freshmen/Sophomore residents

Questions?

OFFICE OF
CIVIL RIGHTS &
SEXUAL MISCONDUCT

Highlights of Sexual Assault Climate Survey

Student Experiences & Environment Survey (SEES)

- Administered in Spring 2016 to 3,893 randomly selected full-time undergraduates ages 18-25
- 41% response rate
  - $10 TerrapinExpress Credit given to the first 3000 for completing the survey
- 53% female; 46% male; 1% Transgender/Queer
- 62% White, 20% Asian, 11% Black, 5% Multiple
- 8% Hispanic
- 74% age 20 or younger
  - Mean=19.7, SD=1.3

Sexual Assault Definitions

Sexual Assault I

- Non-Consensual Sexual Intercourse
- Rape

Sexual Assault II

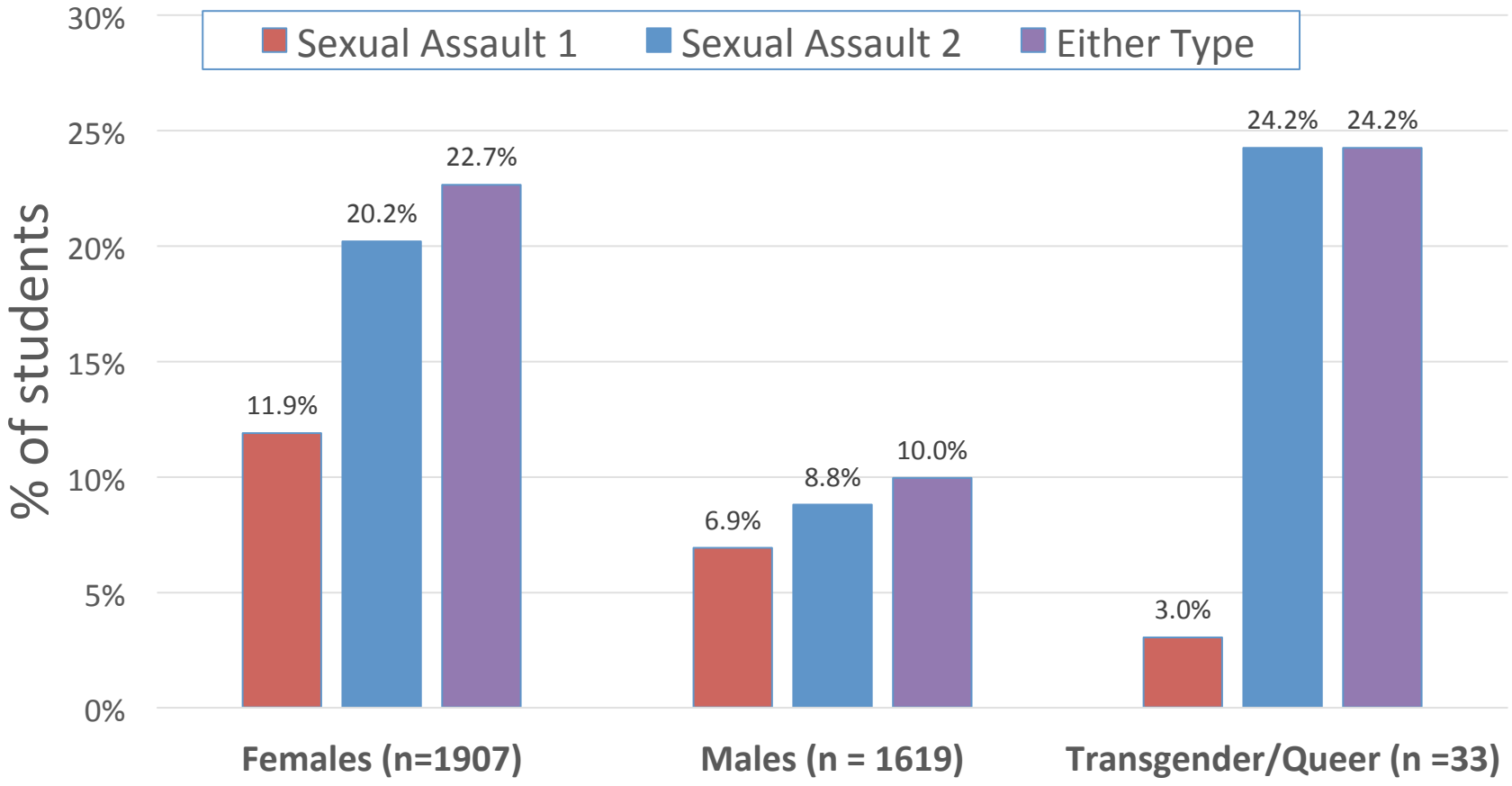
- Non-Consensual Sexual Contact/Touching
- Attempted rape

Conditions assessed for any assault

- Physical force
- Coercion/threat
- Incapacitated

Prevalence of Sexual Assault Since Coming to UMD

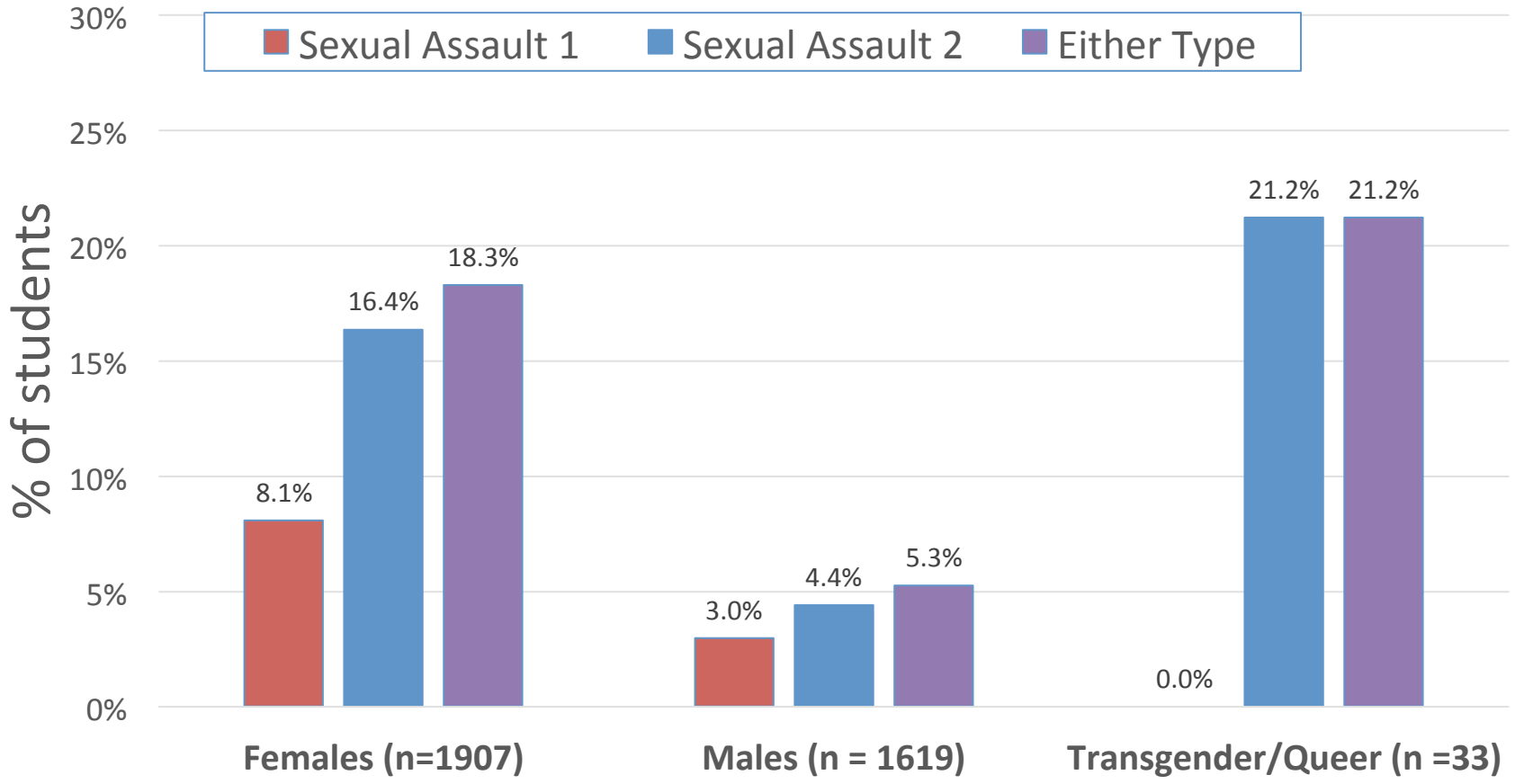
% "Yes" or "Prefer Not to Say"



Note: Includes both "yes" and "prefer not to say" responses.

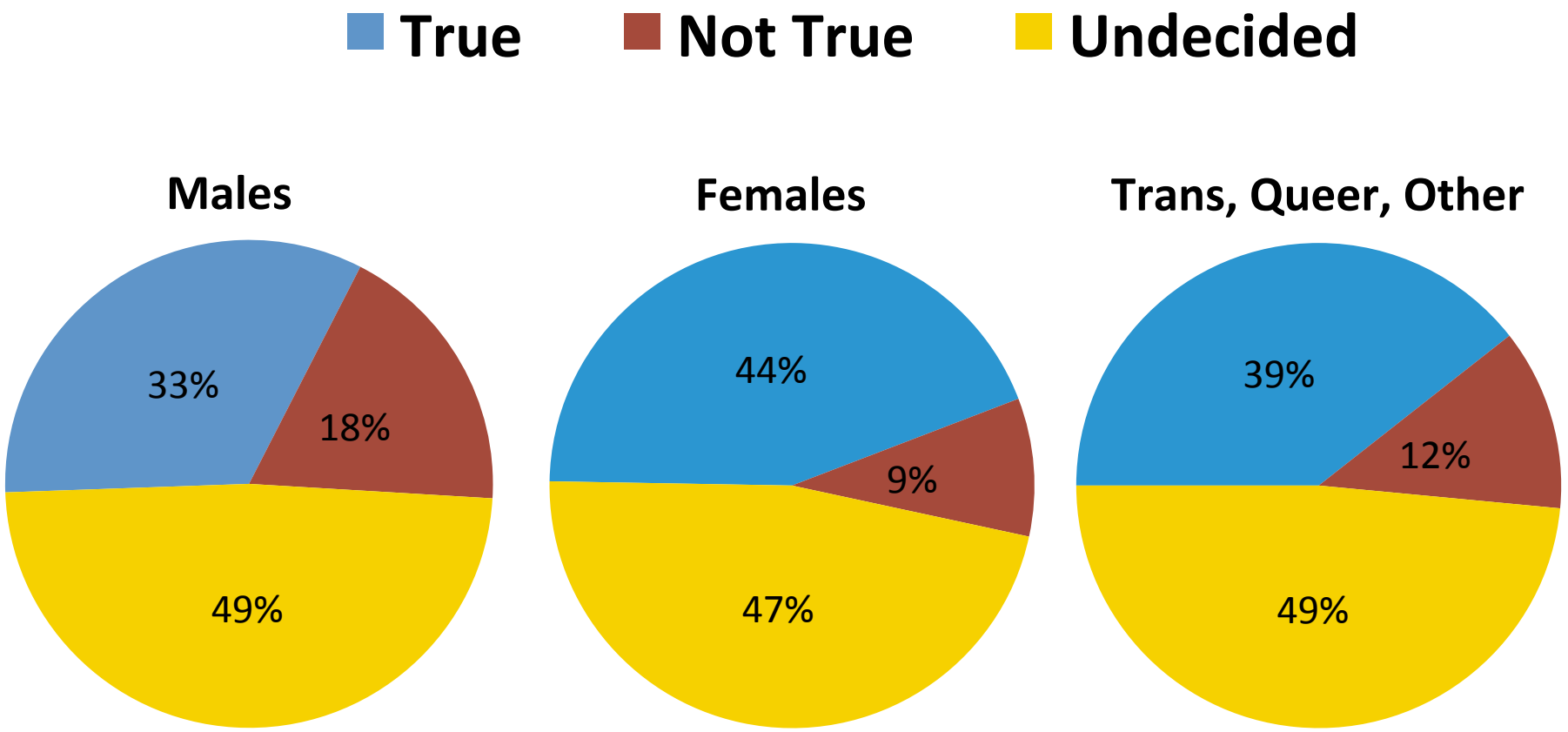
PREVALENCE OF SEXUAL ASSAULT SINCE COMING TO UMD

% "YES"

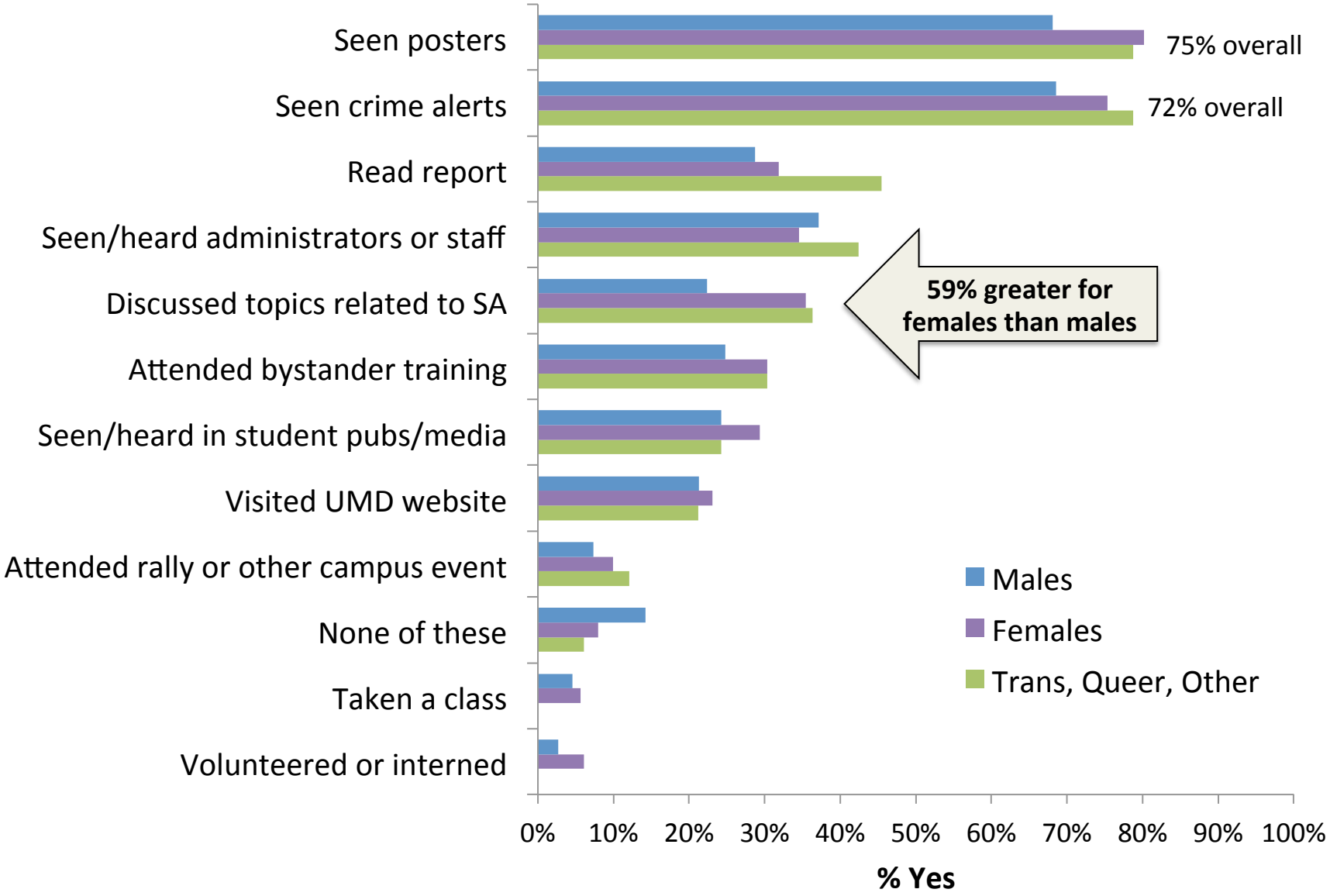


Note: Only includes "YES" responses. "Prefer not to say" responses are treated as "no."

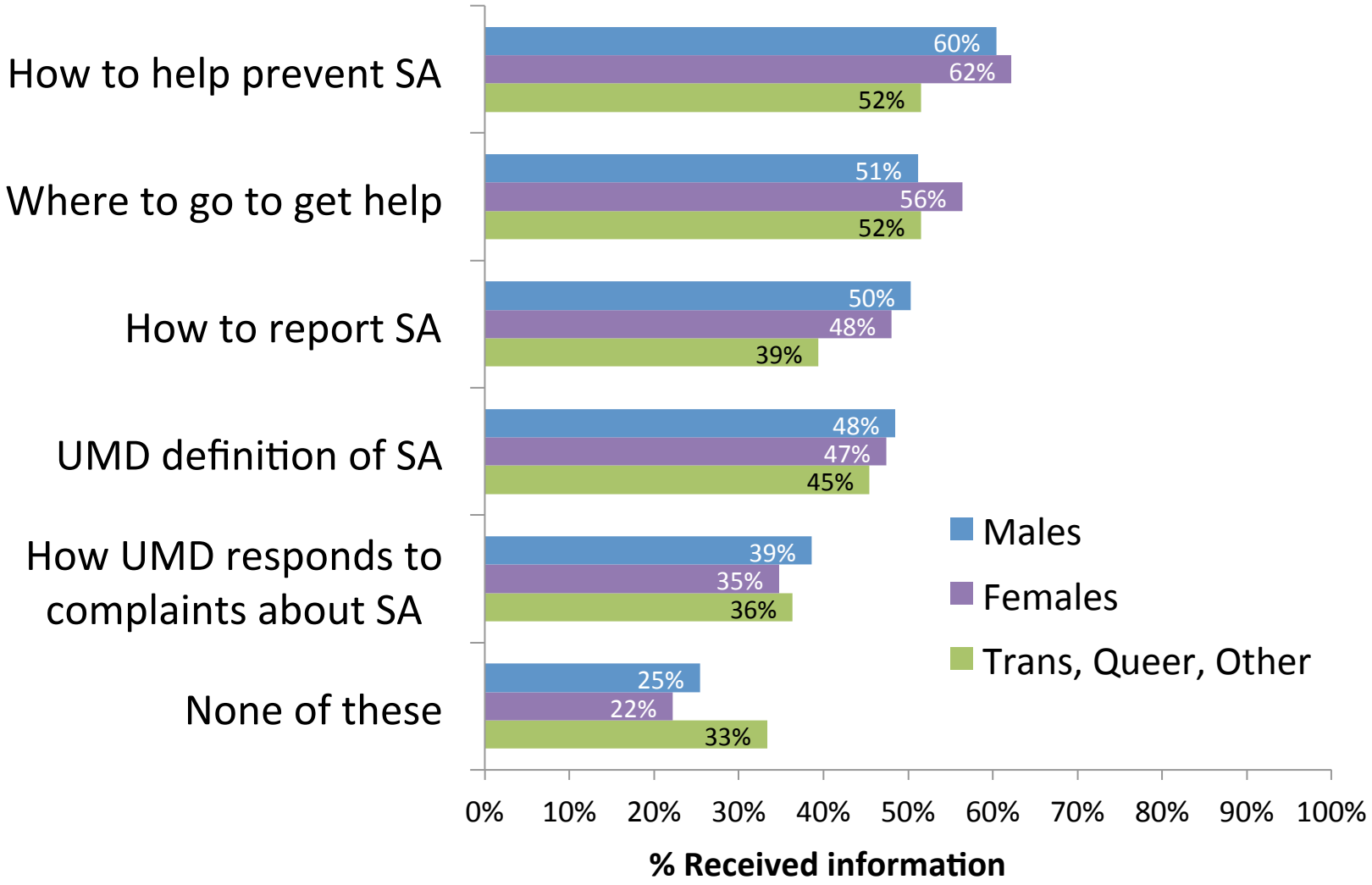
"I think sexual assault is a problem at UMD."



Involvement in SEXUAL ASSAULT-Related PREVENTION Activities Since Attending UMD, by Gender

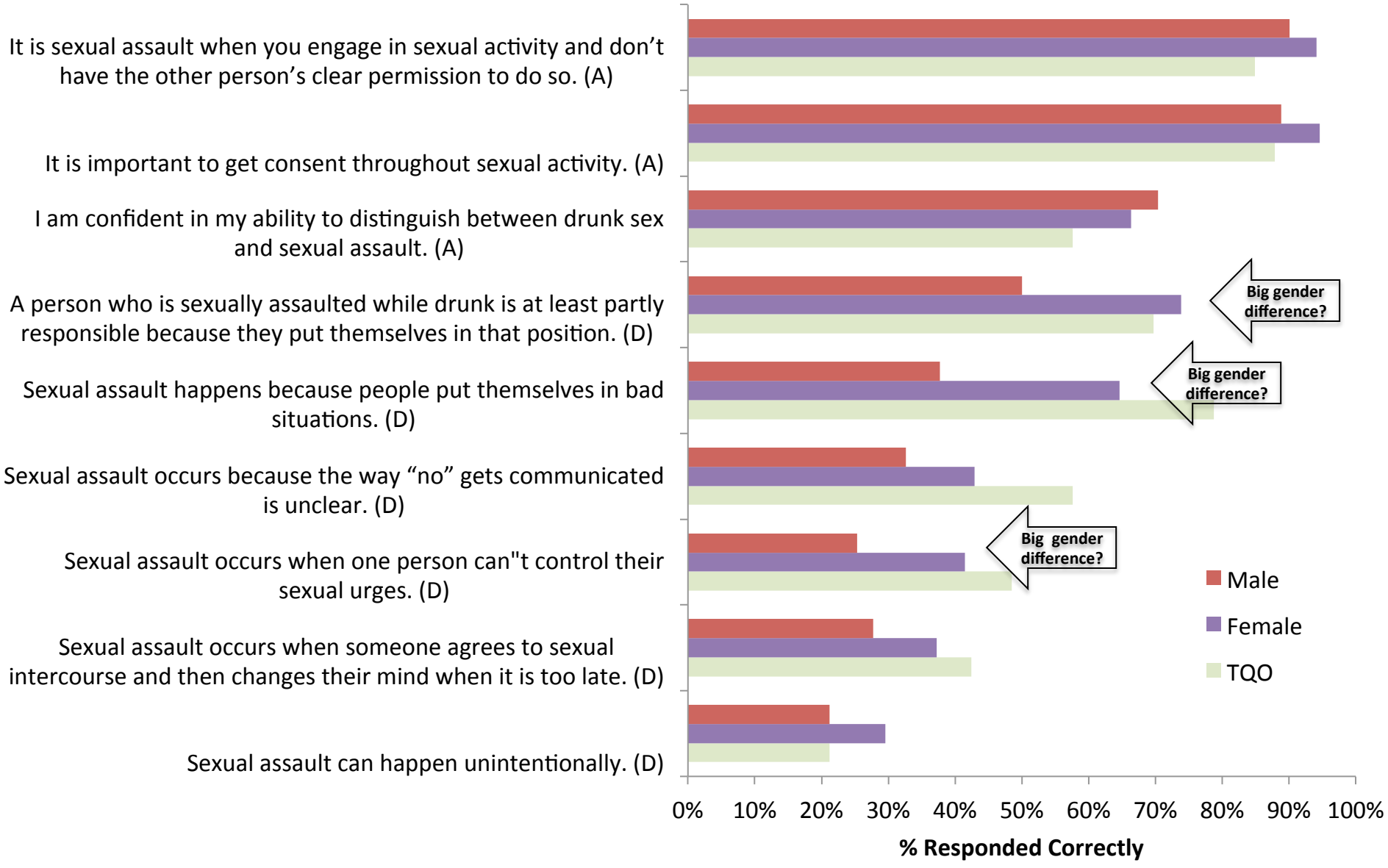


Since coming to UMD, have you received written or verbal information from anyone at UMD about…?



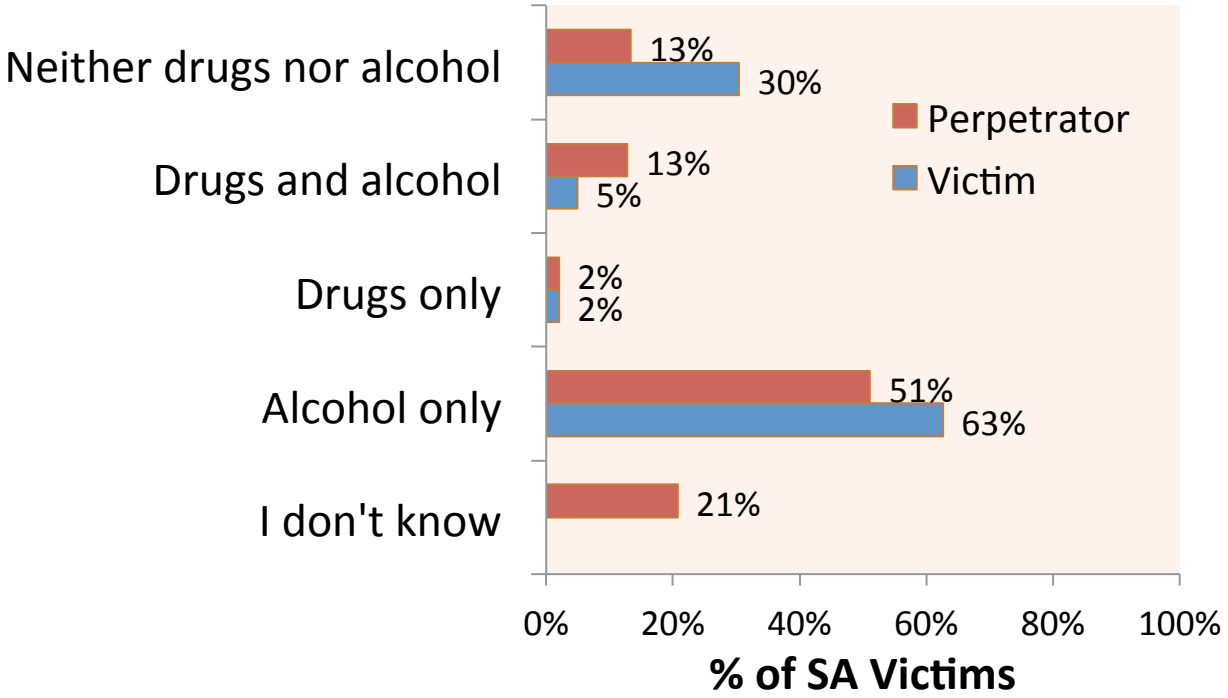
Students' Beliefs about Sexual Assault

Correct responses denoted as (A) for Agree and (D) for disagree.



Alcohol and other drug use at the time of sexual assault

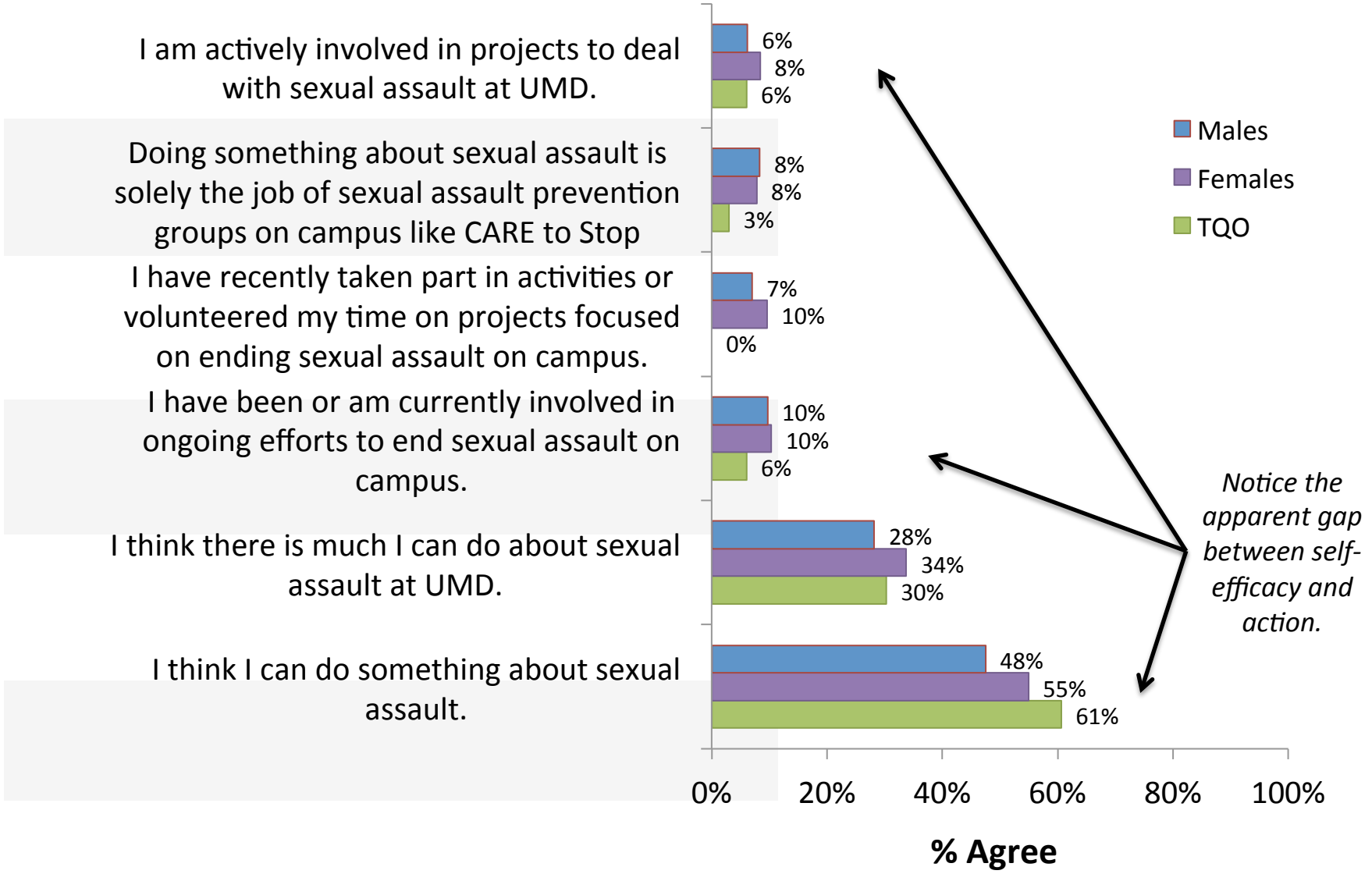
Just prior to the incident, was the other person using…?
Just prior to the incident, were you using…?



66% of victims said their perpetrator had been using alcohol and/or other drugs, and another 21% were not sure.

Alcohol/drug use (by either the perpetrator or the victim) was a possible factor in most of the sexual assaults that victims described (between 78% and 88%).

Do students feel empowered to <u>do something</u> about sexual assault?



QUESTIONS?

University Senate
TRANSMITTAL FORM

Senate Document #:	16-17-18
PCC ID #:	16009
Title:	Establish a Master of Science in Environmental Health Sciences
Presenter:	Andrew Harris, Chair, Senate Programs, Curricula, and Courses Committee
Date of SEC Review:	October 19, 2016
Date of Senate Review:	November 2, 2016
Voting (highlight one):	1. On resolutions or recommendations one by one, or 2. In a single vote 3. To endorse entire report
Statement of Issue:	The School of Public Health and the Maryland Institute for Applied Environmental Health (MIAEH) propose to offer a new Master of Science in Environmental Health Sciences. Environmental health is a branch of public health centered on all aspects of the natural and built environment that may affect human health. This degree will focus on human health, environmental epidemiology, risk assessment, environmental justice, and occupational health. This degree is proposed in tandem with a Ph.D. in Environmental Health Sciences. The M.S. degree is proposed to offer those students who cannot complete the doctoral program with an option to complete the required course work and earn a master's level credential in this field. Though not finishing the Ph.D. degree, students who earn the M.S. degree will still be qualified for careers in environmental health, which has been identified as a critical area of need by the US Department of Health and Human Services and the Centers for Disease Control and Prevention. The proposed program will require 31 credits composed of required courses and electives. Required courses include the following: MIEH600 Foundations of Environmental Health (3 Credits); MIEH720 Principles of Toxicology (3 Credits); MIEH740 Risk Assessment (3 Credits); MIEH771 Exposure Assessment of Environmental Hazards (3 Credits); EPIB610 Epidemiology I (3

	Credits); and EPIB 650 Biostatistics I (3 Credits). Students will also be required to take 7 to 12 supporting credits in areas of environmental health research, ethics, and public health. Students will also be required to take 6 credits of thesis research or take an independent study and a 3-credit elective course if they choose the non-thesis option. No additional resources are requested for this program. The existing administrative and faculty resources that exist in MIAEH are sufficient to offer this program. This proposal was approved by the Graduate School Programs, Curricula, and Courses committee on September 26, 2016, and was approved by the Senate Programs, Curricula, and Courses committee at its meeting on October 7, 2016.
Relevant Policy # & URL:	N/A
Recommendation:	The Senate Committee on Programs, Curricula, and Courses recommends that the Senate approve this new degree program.
Committee Work:	The committee considered this proposal at its meeting on October 7, 2016. Stephen Roth, Associate Dean of the School of Public Health and Interim Director of MIAEH, presented the proposal and responded to questions from the committee. After discussion, the committee voted unanimously to recommend the proposal.
Alternatives:	The Senate could decline to approve this new program.
Risks:	If the Senate declines to approve this new program, the university will lose an opportunity to use existing resources and faculty expertise to address a national need for experts in environmental health.
Financial Implications:	There are no significant financial implications with this proposal.
Further Approvals Required:	If the Senate approves this proposal, it would still require further approval by the President, the Board of Regents, and the Maryland Higher Education Commission.

University of Maryland PCC Program/Curriculum/Unit Proposal

PCC Log No: 16009

Program: Proposal for MS program in Environmental Health Sciences

Department/Unit: Maryland Institute for Applied Environmental Health

College/School: School of Public Health

Proposal Contact Person (with email): Stephen Roth, sroth1@umd.edu

Type of Action (check one):

- ☐ Curriculum change (includes modifying minors, concentrations/specializations and creating informal specializations)
  - ☐ Curriculum change is for an LEP Program
- ☐ *Rename a program or formal Area of Concentration*
- ☐ *Establish/Discontinue a formal Area of Concentration*
- ☐ Other:
- ☑ *Establish a new academic degree/certificate program*
- ☐ Create an online version of an existing program
- ☐ Establish a new minor
- ☐ *Suspend/Discontinue a degree/certificate program*
- ☐ Establish a new Master or Certificate of Professional Studies program
  - ☐ New Professional Studies program will be administered by Office of Extended Studies

Italics indicate that the proposal must be presented to the full University Senate for consideration.

Approval Signatures - *Please print name, sign, and date. For proposals requiring multiple unit approvals, please use additional cover sheet(s).*

1. Department Committee Chair Amy P. Sapkota 2/29/16
2. Department Chair Stephen M Roth 29 Feb 2016
3. College/School PCC Chair ROBIN SAWYER 4/1/16
4. Dean JANE E. CLARK 4/11/16
5. Dean of the Graduate School (if required) _____
6. Chair, Senate PCC Andrew Harris 10/7/16
7. University Senate Chair (if required) _____
8. Senior Vice President and Provost _____

Instructions:
When approved by the dean of the college or school, please send the proposal and signed form to the Office of the Associate Provost for Academic Planning and Programs, 1119 Main Administration Building, Campus-5031, **and** email the proposal document as an MSWord attachment to pcc-submissions@umd.edu.

Summary of Proposed Action (use additional sheet if necessary):
This proposal seeks to establish a MS degree in Environmental Health Sciences for the School of Public Health, administered by the faculty within the Maryland Institute for Applied Environmental Health (MIAEH). The degree will focus on human health, environmental epidemiology, risk assessment, environmental justice, and occupational health consistent with the areas of expertise of the MIAEH faculty. MIAEH currently offers students flexible and individualized programs of study that lead to the Master of Public Health in Environmental Health Sciences as well as a PhD program in Toxicology that is administered by the USM. This proposal is concurrent with a proposal to establish a PhD degree in Environmental Health Sciences. The present MS degree will initially not admit students, but be available for students who do not complete the PhD program but instead choose to complete the master's degree requirements (i.e., an "off-ramp" MS degree).

Unit Code(s) (to be entered by the Office of Academic Planning and Programs):

PROPOSAL FOR
NEW INSTRUCTIONAL PROGRAM
UNIVERSITY OF MARYLAND AT COLLEGE PARK, MARYLAND

M.S. in Environmental Health Sciences

School of Public Health

Dean Jane Clark

M.S. Fall 2016 (with new admits anticipated Fall 2017 or later)

I. OVERVIEW and RATIONALE

A. Briefly describe the nature of the proposed program and explain why the institution should offer it.

This proposal seeks to establish a M.S. degree in Environmental Health Sciences for the School of Public Health, administered by the faculty within the Maryland Institute for Applied Environmental Health (MIAEH). The degree will focus on human health, environmental epidemiology, risk assessment, environmental justice, and occupational health consistent with the areas of expertise of the MIAEH faculty. MIAEH currently offers students flexible and individualized programs of study that lead to the Master of Public Health in Environmental Health Sciences as well as a Ph.D. program in Toxicology that is administered by the USM.

This proposal is concurrent with a proposal to establish a Ph.D. degree in Environmental Health Sciences. The present M.S. degree will initially not admit students, but will be offered as an exit path for doctoral candidates who cannot or choose not to complete the Ph.D., or to those students who successfully complete the requirements and opt to obtain the additional credential.

MIAEH was established in 2006 with a mission to carry out research on a broad range of environmental factors and their effects on human health. Faculty members in MIAEH collaborate with state, federal, international and private agencies to develop research solutions that address pressing environmental and occupational health problems. Students will gain expertise in areas including exposure assessment, environmental epidemiology, environmental microbiology, children's environmental health, environmental justice, and risk assessment. They will also obtain a broad appreciation of public health as required for students graduating from a School of Public Health accredited by the Council on Education in Public Health.

Thus, this degree program would be distinct from the environmental science-related degrees offered by AGNR and CMNS, which focus primarily on ecosystem health and environmental science (e.g., graduate programs in Environmental Science and Technology, Environmental Science and Policy, and the system program in Marine, Estuarine and Environmental Sciences currently offered by other colleges, AGNR and CMNS, respectively).

Nearly every top 40 School of Public Health in the U.S. offers a M.S. in Environmental Health Sciences and UMD will be more competitive in attracting top students with such a degree. The only M.S. program in Environmental Health Sciences in Maryland is offered at Johns Hopkins University, a private institution. Other masters degree programs in Maryland are related to environmental science or environmental engineering and do not conflict with the proposed program.

Development of the environmental health workforce has been a key concern of the U.S. Department of Health and Human Services for many years. For example, the *Healthy People 2010* publication articulated the concern that public health infrastructure in several areas, including environmental health, was lacking and that workforce development

opportunities need to be expanded. In particular for the present proposal, the Centers for Disease Control and Prevention (CDC) has noted the paucity of leaders in environmental health and raised the concern that impending retirements and vacancies will leave the environmental health leadership ranks severely understaffed (supporting documents and statements can be found at http://www.cdc.gov/nceh/ehs/activities/training.htm). As such, the development of a master's program (linked with a doctoral program) in environmental health sciences at a public land-grant university will help support the workforce development needs of the field.

An important distinction should be made between the currently offered MPH (curriculum shown in Appendix 1) and proposed M.S. degree programs in Environmental Health Sciences. The MPH is a professional, practitioner's degree, and is anticipated as a terminal degree for individuals wishing to pursue career options in public health practice. In contrast, the M.S. degree is a scholarly-based degree and is not envisioned as a terminal degree for most students. For students who complete only an M.S. degree, they would have basic scholarly training and background suitable for some career options in environmental health (e.g., research careers), but those would differ from the careers sought by MPH graduates (e.g., practitioner careers). In our case, the M.S. would be considered a lead-in degree to a Ph.D. program. We envision the M.S. will most typically be used as an off-ramp degree for those students enrolled as bachelor degree carriers who no longer wish to complete the Ph.D. program.

B. How big is the program expected to be? From what other programs serving current students, or from what new populations of potential students, onsite or offsite, are you expecting to draw?

We expect a very small M.S. degree student population of 2-3 students, with the expectation that the M.S. degree will have few if any direct-admits and a small number of former Ph.D. students who do wish to complete the M.S. degree requirements instead. The majority of faculty members anticipate mentoring 1-2 Ph.D. students, with a total of 10-15 Ph.D. students in the Ph.D. program.

II. CURRICULUM

A. Provide a full catalog description of the proposed program, including educational objectives and any areas of concentration.

Students in the M.S. program in Environmental Health Sciences at the Maryland Institute for Applied Environmental Health (MIAEH) in the School of Public Health will complete an essential core of knowledge in environmental health, epidemiology and biostatistics, in addition to a laboratory rotation, an ethics course, and a seminar course.

Degree Requirements

The M.S. program in Environmental Health Sciences consists of a minimum of 31 credit hours of graduate courses. Graduate courses include (1) core courses within environmental

health, epidemiology and biostatistics; (2) supporting courses in environmental health research, ethics, and public health; and (3) non-thesis project or thesis credits. Program requirements for a M.S. degree with the non-thesis project include successful completion of an oral defense of a written non-thesis project proposal, a minimum of 6 credits of independent study credits, a final written project, and a final oral non-thesis project defense. Program requirements for a M.S. degree with the thesis include successful completion of an oral defense of a written thesis research proposal, and a minimum of 6 credits of M.S. thesis research, written thesis, and a final oral thesis defense. The program can be completed on either a full- or part time basis.

Students must file with the graduate program director a preliminary program of study, signed by their advisor, before registering for their first semester of classes and an amended, final plan of study before the start of their second semester approved by their advisor and the graduate director. Because we anticipate students will enter the M.S. after initially beginning the Ph.D. program, we expect students will take greater than the minimum of 31 credits required for the M.S. degree.

The procedures for the thesis defense are as specified in the Graduate School Catalog. In general, a committee of three MIAEH graduate faculty members will serve on non-thesis project and thesis committees.

B. List the courses (number, title, semester credit hours) that would constitute the requirements and other components of the proposed program. Provide a catalog description for any courses that will be newly developed or substantially modified for the program.

See Table 1: M.S. Program in Environmental Health Sciences

No new courses are proposed beyond those already offered in the School of Public Health.

Table 1: M.S. Program in Environmental Health Sciences		
	Course Title	**Credits**
Core Courses *(18 Required Credits)*	MIEH 600 Foundations of Environmental Health	3
	MIEH 720 Principles of Toxicology	3
	MIEH 740 Risk Assessment	3
	MIEH 771 Exposure Assessment of Environmental Hazards	3
	EPIB 610 Epidemiology I	3
	EPIB 650 Biostatistics I	3
Supporting Courses *(7 to 12 Required Credits)*	MIEH 609 Methods in Toxicology and Environmental Health (1 rotation)*	3
	EPIB 641 Ethics in Public Health	1
	MIEH 688 Environmental Health Seminar	2
	Course(s) that will expose the student to concepts in health behavior and health services administration (This could include HLTH 665, HLSA 601 or a survey course that covers all five foundation areas of public health.)	1 to 6
Students must select the Thesis or Non-Thesis Option:		
Non-Thesis Option *(6 Required Credits)*	MIEH 789 Independent Study (completion of a scholarly project)	3
	Elective course	3
OR		
Thesis *(6 Required Credits)*	MIEH 799 Masters Thesis Research	6

* Rotations can be in physical labs or with faculty conducting non-laboratory based research.

C. *Describe any selective admissions policy or special criteria for students selecting this field of study.*

For any students directly admitted into the M.S. program, we will use the same admission requirements as the MPH program in Environmental Health Sciences, included here:

Application Requirements:

1. Minimum 3.0 undergraduate GPA;
2. Undergraduate transcripts;
3. GRE scores taken within the past 5 years;
4. Three letters of recommendation that address the applicant's academic capabilities and probability of success in graduate school;
5. Statement of goals and interests and their congruence with those of the program;
6. Relevant academic/work experience, including previous coursework in biology, chemistry, mathematics, statistical methods, and/or statistical software packages.

To apply to the M.S. program in Environmental Health Sciences, applicants must complete their application in SOPHAS: www.sophas.org

III. STUDENT LEARNING OUTCOMES AND ASSESSMENT

A. *List the program's learning outcomes and explain how they will be measured.*

B. *Include a general assessment plan for the learning outcomes. (In lieu of a narrative for both IIIA and IIIB, you may attach the program's learning outcomes assessment forms.)*

Competencies, Outcomes, and Assessments

1. Demonstrate a comprehensive understanding of the interdisciplinary field of environmental health.

Measure: Successful completion of the final project in MIEH 771, which entails an analysis of exposure data, interpretation of statistical analyses and drafting of a manuscript in a journal article format.

Criterion: 90% of graduates will complete the final project with “satisfactory” or better performance.

Assessment: Student performance will be assessed after there are at least four

graduates from the program and annually thereafter.

2. (for M.S. non-thesis project students) Develop a testable hypothesis that would advance the field of environmental health.

Measure: Successful completion of a non-thesis project that proposes a testable hypothesis related to a current environmental health issue.

Criterion: 90% of graduates will successfully complete the non-thesis project within 2 years of matriculation into the M.S. program.

Assessment: The time to graduation will be assessed after there are at least four graduates from the program and annually thereafter.

3. (for M.S. thesis students) Design and conduct a research study, analyze data and test a hypothesis that advances the science of environmental health.

Measure: Successful completion of thesis research and submission of a completed M.S. thesis.

Criterion: 80% of graduates will successfully defend and submit a thesis within 2 years of matriculation into the M.S. program.

Assessment: The time to graduation will be assessed after there are at least four graduates from the program and annually thereafter.

IV. FACULTY AND ORGANIZATION

A. *Who will provide academic direction and oversight for the program? [This might be a department, a departmental subgroup, a list of faculty members, or some other defined group.]*

The Maryland Institute for Applied Environmental Health (MIAEH) will provide academic direction and oversight for the program, in collaboration with our colleagues in SPH and across campus.

B. *If the program is not to be housed and administered within a single academic unit, provide details of its administrative structure. This should include at least the following:*

V. OFF CAMPUS PROGRAMS

Not applicable.

VI. OTHER ISSUES

A. Describe any cooperative arrangements with other institutions or organizations that will be important for the success of this program.

None.

B. Will the program require or seek accreditation? Is it intended to provide certification or licensure for its graduates? Are there academic or administrative constraints as a consequence?

No.

VII. COMMITMENT TO DIVERSITY

Identify specific actions and strategies that will be utilized to recruit and retain a diverse student body.

The MIAEH faculty are a diverse group (e.g., 50% women; 50% underrepresented minorities) committed to recruiting, retaining, and graduating a diverse student body. Many of the faculty focus their research efforts on issues that impact health disparities. The faculty will use their networks of colleagues and professional organizations to ensure a diverse pool of applicants from which to recruit, retain, and graduate a diverse and excellent student body.

VIII. REQUIRED PHYSICAL RESOURCES

A. Additional library and other information resources required to support the proposed program. You must include a formal evaluation by Library staff.

None required.

B. Additional facilities, facility modifications, and equipment that will be required. This is to include faculty and staff office space, laboratories, special classrooms, computers, etc.

None required.

C. Impact, if any, on the use of existing facilities and equipment. Examples are laboratories, computer labs, specially equipped classrooms, and access to computer servers.

Because we anticipate that nearly all of our future M.S. students will "off-ramp" from our Ph.D. program in Environmental Health Sciences, we foresee little impact on existing facilities.

IX. RESOURCE NEEDS and SOURCES

Describe the resources that are required to offer this program, and the source of these resources. Project this for five years. In particular:

A. *List new courses to be taught, and needed additional sections of existing courses. Describe the anticipated advising and administrative loads. Indicate the personnel resources (faculty, staff, and teaching assistants) that will be needed to cover all these responsibilities.*

We anticipate no significant change in enrollments of our existing courses due to the proposed M.S. degree program. MIAEH has the necessary faculty to teach the necessary courses and advise master's degree students. No new resources are requested.

B. *List new faculty, staff, and teaching assistants needed for the responsibilities in A, and indicate the source of the resources for hiring them.*

None anticipated or needed.

C. *Some of these teaching, advising, and administrative duties may be covered by existing faculty and staff. Describe your expectations for this, and indicate how the current duties of these individuals will be covered, and the source of any needed resources.*

Our current faculty are in a position to provide all necessary teaching and advising support for the M.S. degree program.

D. *Identify the source to pay for the required physical resources identified in Section VIII, above.*

Not applicable.

E. *List any other required resources and the anticipated source for them.*

None.

F. *Provide the information requested in Table 1 and Table 2 (for Academic Affairs to include in the external proposal submitted to USM and MHEC).*

See proposal for the doctoral program. Students will not be directly admitted to the master's program so there is no separate budget.

Appendix 1: Curriculum for MPH in Environmental Health Sciences

Curriculum	Courses	Credits
Core	EPIB 610 Foundations of Epidemiology	3
	EPIB 650 Biostatistics 1	3
	HLSA 601 Intro. to Health Systems	3
	MIEH 600 Foundations of Environmental Health	3
	HLTH 665 Health Behavior I	3
Cognate	MIEH 740 Risk Assessment	3
	MIEH 720 Principles of Toxicology	3
	MIEH 770 Law and Policy in Environmental Health	3
	MIEH 771 Exposure Assessment	3
	MIEH 780 Environmental and Occupational Hygiene	3
	EPIB 641 Public Health and Research Ethics	1
	EPIB 651 Biostatistics II	3
Capstone or Thesis	MIEH 785 Internship in Public Health	3
	MIEH 786 Capstone Project in Public Health or MIEH 799 Thesis**	3/6
Electives*	Public Health Electives, with advisement	3/6
	Total Credits	**46**

**The electives must be public health related. Up to 6 credits may be transferred from another institution and 12 from UMCP, provided that the courses are at a graduate level and have not been counted for any other degree. You must apply to transfer the credits using the form Request for Transfer or Inclusion of Graduate Credit, available on the MIAEH website under Student Forms.*

***If a student chooses the thesis option, he/she must register for 6 credits of thesis to graduate.*

UNIVERSITY OF MARYLAND

Department of Environmental Science and Technology

1426 An. Sci./Ag. Eng. Bldg.
College Park, MD 20742
Phone 301-405-1306
FAX 301-314-9023

February 29, 2016

Dr. Stephen Roth
Professor and Interim Director
Maryland Institute for Applied Environmental Health
School of Public Health
University of Maryland
College Park, Maryland 20742

Dear Dr. Roth,

The faculty of the Department of Environmental Science and Technology in our Ecosystem Health and Natural Resource Management Graduate Program have reviewed both the MS and PhD Program Proposals in Environmental Health Sciences. We strongly support the development of these two degree programs and will collaborate fully with you in ensuring that they are a success.

Please contact me if you have any further questions or need assistance at wbowerma@umd.edu or by phone at 301-405-1306. Good luck.

Sincerely,

William W. Bowerman, Ph.D.
Professor and Chair

Subject: Re: MS Proposal for Env Health Sci
Date: Tuesday, April 12, 2016 at 11:37:28 PM Eastern Daylight Time
From: Wolfgang Losert
To: Stephen M. Roth

Dear Steve

just like the PhD proposal, this proposal has CMNS support. No concerns were raised by the CMNS graduate program directors.

best regards
Wolfgang Losert

On 2/29/2016 2:42 PM, Stephen M. Roth wrote:

> Dear Wolfgang,
>
> Please find attached a forthcoming PCC proposal for a MS program in Environmental Health Sciences coming from SPH (which effectively parallels the PhD proposal you just reviewed last week). Having CMNS approval would be valuable as we move into the PCC process. I would appreciate very much your support of this program. Please contact me with any questions.
>
> Thank you,
> Steve
>
> _____
> Stephen M. Roth, Ph.D.
> Professor & Interim Director
> Maryland Institute for Applied Environmental Health
> School of Public Health
> University of Maryland
> College Park, MD 20742
> 301-405-2504; fax 301-405-8397
> http://www.sph.umd.edu/miaeh

--
Wolfgang Losert, Professor of Physics
Interim Associate Dean
Director, Partnership for Integrative Cancer Research
College of Computer, Mathematical, and Natural Sciences
University of Maryland

Physical Sciences Complex Room 1147, p: 301-405-0629
http://www.ireap.umd.edu/losertlab/

DATE: April 15, 2016

TO: Stephen M. Roth, Professor, Applied Environmental Health (MIAEH), Kinesiology, Office of the Dean & Associate Dean for Educational Innovation; Interim Director of the Maryland Institute for Applied Environmental Health

CC: Daniel Mack, Associate Dean for Collection Strategies and Services, Libraries

Margaret Saponaro, Interim Head, Collection Development, Libraries

FROM: Nedelina Tchangalova, Physical Sciences & Public Health Librarian

RE: Library Resources to Support New Instructional Program – MS in Environmental Health Sciences

The University of Maryland (UM) Libraries' mission is "to enable the intellectual inquiry and learning required to meet the education, research and community outreach mission of the University." Currently they support undergraduate and graduate students in a variety of face-to-face, online and distance learning programs, as well faculty working collaboratively with internal and external partners. The University of Maryland Libraries collections will continue adequately support the instruction and research needs of the newly proposed PhD program in Environmental Health Sciences.

As a department with strong ties with other departments/schools on and off campus, the Maryland Institute for Applied Environmental Health is confident that library resources are readily available and accessible. Ease of access and flexible availability of library materials is paramount, and researchers, as well students expect this flexibility to be coupled with high academic quality and integrity. The current purchasing practices and available collections at the UM Libraries will ensure that these two goals can be met, both now and for the life of the department. In addition, the establishment of the new Collaborative School of Public Health provides even greater access and flexible availability; the School of Public Health (SPH) students and faculty at the University of Maryland—College Park (UMCP) have access to the Health Sciences and Human Services Library at the University of Maryland—Baltimore (UMB). Thus, the broader medical and global health journals available there are a part of UM Libraries available resources without additional expenditures. Moreover, UM Libraries' existing public health and collections of journals and databases will continue to support the research and teaching needs of the Maryland Institute for Applied Environmental Health.

Public & Environmental Health Science Library Collections

While the Maryland Institute for Applied Environmental Health is part of the School of Public Health, many of their faculty members have secondary appointments to other UMCP departments and UMB. McKeldin Library supports the undergraduate and graduate students in SPH, housing the majority of the monographs and serials pertaining to public health in general, and environmental health in particular. A significant portion of these collections are electronically accessible, both on and off campus, and therefore are not location dependent.

1. **Monographs**

The Libraries' current collection of books related to environmental health is sufficient to meet the needs of the department. The ongoing acquisition of scholarly books is expected to be adequately covered through existing acquisition practices and budgeting. As a land grant institution, the University of Maryland already has a tradition of emphasizing public health, including environmental health, epidemiology, environmental justice,

and occupational health, and current collection development practices in the Libraries already support these topics.

At this time, UM Libraries have access to several multidisciplinary ebook collections related to human and environmental health, and health policy and law (*Credo Reference*, *ebrary*, *EBSCo ebook collection*, *Gale Virtual Reference Library, Springer, World Scientific eBooks* and more). Due to the UM Libraries' purchasing preference for electronic materials, especially prevalent across the STEM fields, the number of electronic book collections is expected to continue to increase significantly in the coming years.

2. Electronic Resources: Journals and Databases

The Libraries' current list of subscriptions includes both core and related journals that support research and teaching in public and environmental health, and policy.

A search was performed in *Journal Citation Reports 2014* (JCR), a database that uses citation data to rank and determine the impact factor of journals in an academic field. To support the existing courses, at the present time the Libraries provide access to all of the top ten ranked journals from the JCR categories of *Environmental Sciences*, and *Public, Environment & Occupational Health*.

While other aspects of public and environmental health, and policy do not fall as neatly into a JCR-specified category, the UM Libraries provide access to numerous highly ranked journals from cross-sections of the JCR categories of Agricultural Economics & Policy, Behavioral Sciences, Family Studies, Law, Political Science, Public Administration, as well as the majority of top ten ranked journals from all engineering disciplines.

Relevant top-ranked titles include:

- *Energy & Environmental Science*
- *Nature Climate Change*
- *Global Change Biology*
- *Environmental Health Perspectives*
- *Frontiers in Ecology and the Environment*
- *Lancet Global Health*
- *International Journal of Epidemiology*
- *Epidemiologic Reviews*
- *Annual Review of Public Health*
- *Epidemiology*

In addition to journal subscriptions, the UM Libraries subscribe to the following significant databases, that will support the department by providing access to the previously mentioned journals as well as other relevant resources:

- *Academic Search Complete (EBSCO)*
- *Congressional Publications (ProQuest)*
- *Environmental Science Collection (ProQuest)*
- *Environmental Studies in Video*
- *Environment & Energy Daily*
- *Health Reference Policy Center (EBSCO)*
- *Public Health (ProQuest)*
- *PubMed*

At this time, the UM Libraries' purchasing preference is for electronic materials (i.e. those that can be accessed online), a trend that will serve to enhance research and teaching experience. This is especially relevant to the collaboration initiatives, where online flexibility is presented with no reduction in educational and research quality. The UM Libraries purchasing and access priorities are in line with this goal.

Interlibrary Loan & Article Express

With the admission of the University of Maryland into the Committee for Institutional Cooperation (CIC), the academic arm of the Big Ten, our faculty and students are able to take advantage of a number of new materials access options in the coming years. The Libraries joined the CIC UBorrow[1] program, which allows rapid access to the collections of other CIC member libraries.

When resources are not part of our holdings within the sixteen University System of Maryland and Affiliated Institutions (USMAI) libraries, the Interlibrary Loan unit can obtain materials from other libraries at no charge to the student or faculty. Most recent journal articles can be provided through electronic delivery, allowing students and faculty to make the most flexible use of their time.

Additionally, through the auspices of the Interlibrary Loan unit, graduate students and faculty can make use of Article Express, an electronic document delivery service for in-house materials. Article Express allows graduate students and faculty to place requests for book chapters and journal and/or conference papers that are available in print in the Libraries, and have them scanned and delivered electronically within three business days. This service is also free of charge.

Conclusions

At the present time, UM Libraries holdings are adequate to support the proposed new MS program in environmental health sciences, and current purchasing preferences and trends are especially beneficial for collaborative projects and programs. While it is anticipated that this will continue, the Libraries collections are vulnerable to budget and market fluctuations. Journal collections and other continuing resources remain particularly vulnerable. The level of future support is thus dependent upon ongoing funding and other circumstances affecting continuing subscriptions.

Statement from Associate Dean, Collection Strategies and Services

Nedelina Tchangalova, Physical Sciences and Public Health Librarian, has prepared this report according to standard practices for collection assessment in research libraries. I have reviewed Ms. Tchangalova's report and I concur with her findings.

Daniel C. Mack

[1] http://www.cic.net/projects/library/reciprocal-borrowing/uborrow

University Senate
TRANSMITTAL FORM

Senate Document #:	16-17-17
PCC ID #:	16008
Title:	Establish a Ph.D. in Environmental Health Sciences
Presenter:	Andrew Harris, Chair, Senate Programs, Curricula, and Courses Committee
Date of SEC Review:	October 19, 2016
Date of Senate Review:	November 2, 2016
Voting (highlight one):	1. On resolutions or recommendations one by one, or 2. In a single vote 3. To endorse entire report
Statement of Issue:	The School of Public Health and the Maryland Institute for Applied Environmental Health (MIAEH) propose to offer a new Ph.D. in Environmental Health Sciences. Environmental health is a branch of public health centered on all aspects of the natural and built environment that may affect human health. This doctoral degree will focus on human health, environmental epidemiology, risk assessment, environmental justice, and occupational health. In recent years, national public health organizations such as the US Department of Health and Human Services and the Centers for Disease Control and Prevention have advocated for the increase in the number of environmental health experts. Currently, MIAEH offers a Ph.D. in Toxicology. Toxicology is defined as the study of the effects of chemicals and physical agents on living organisms. The Ph.D. in Toxicology is the focus area of only a small minority of the MIAEH faculty. The Toxicology degree is jointly administered with other University System of Maryland institutions. Most students that are enrolled in the Toxicology program are affiliated with the University of Maryland, Baltimore's Schools of Pharmacy and Medicine. The purpose for offering a Ph.D. in Environmental Health Sciences is to offer a broader doctoral degree that will better align with MIAEH faculty research areas, such as environmental

	epidemiology, risk assessment, environmental justice, and occupational health. The proposed program will require 24 credits of core courses that will cover areas such as environmental health, toxicology, risk assessment, environmental hazards, epidemiology, and biostatistics. The curriculum also requires 11-19 credits of supporting courses in public health topics. A specialization area of 12-15 credits is also required. MIEH899, Doctoral Dissertation Research, will be required for 12 credits. Students may be able to waive some course requirements based on their academic background. No additional resources are requested for this program. The existing administrative and faculty resources that exist in MIAEH are sufficient to offer this program. This proposal was approved by the Graduate School Programs, Curricula, and Courses committee on September 26, 2016, and was approved by the Senate Programs, Curricula, and Courses committee at its meeting on October 7, 2016.
Relevant Policy # & URL:	N/A
Recommendation:	The Senate Committee on Programs, Curricula, and Courses recommends that the Senate approve this new degree program.
Committee Work:	The committee considered this proposal at its meeting on October 7, 2016. Stephen Roth, Associate Dean of the School of Public Health and Interim Director of MIAEH, presented the proposal and responded to questions from the committee. After discussion, the committee voted unanimously to recommend the proposal.
Alternatives:	The Senate could decline to approve this new program.
Risks:	If the Senate declines to approve this new program, the university will lose an opportunity to use existing resources and faculty expertise to address a national need for experts in environmental health.
Financial Implications:	There are no significant financial implications with this proposal.
Further Approvals Required:	If the Senate approves this proposal, it would still require further approval by the President, the Board of Regents, and the Maryland Higher Education Commission.

University of Maryland PCC Program/Curriculum/Unit Proposal

PCC Log No: 16008

Program: Proposal for PhD program in Environmental Health Sciences

Department/Unit: Maryland Institute for Applied Environmental Health

College/School: School of Public Health

Proposal Contact Person (with email): Stephen Roth, sroth1@umd.edu

Type of Action (check one):

- ☐ Curriculum change (includes modifying minors, concentrations/specializations and creating informal specializations)
  - ☐ Curriculum change is for an LEP Program
- ☐ *Rename a program or formal Area of Concentration*
- ☐ *Establish/Discontinue a formal Area of Concentration*
- ☐ Other:
- ☑ *Establish a new academic degree/certificate program*
- ☐ Create an online version of an existing program
- ☐ Establish a new minor
- ☐ *Suspend/Discontinue a degree/certificate program*
- ☐ Establish a new Master or Certificate of Professional Studies program
  - ☐ New Professional Studies program will be administered by Office of Extended Studies

Italics indicate that the proposal must be presented to the full University Senate for consideration.

Approval Signatures - *Please print name, sign, and date. For proposals requiring multiple unit approvals, please use additional cover sheet(s).*

1. Department Committee Chair Amy E. Sapkota, 2/22/16
2. Department Chair Stephen M Roth 22Feb 2016
3. College/School PCC Chair ROBIN SAWYER 4/1/16
4. Dean JANE E. CLARK 4/11/16
5. Dean of the Graduate School (if required) _____
6. Chair, Senate PCC Andrew Harris 10/7/16
7. University Senate Chair (if required) _____
8. Senior Vice President and Provost _____

Instructions:
When approved by the dean of the college or school, please send the proposal and signed form to the Office of the Associate Provost for Academic Planning and Programs, 1119 Main Administration Building, Campus-5031, **and** email the proposal document as an MSWord attachment to pcc-submissions@umd.edu.

Summary of Proposed Action (use additional sheet if necessary):
This proposal seeks to establish a PhD degree in Environmental Health Sciences for the School of Public Health, administered by the faculty within the Maryland Institute for Applied Environmental Health (MIAEH). The degree will focus on human health, environmental epidemiology, risk assessment, environmental justice, and occupational health consistent with the areas of expertise of the MIAEH faculty. MIAEH currently offers the Master of Public Health in Environmental Health Sciences as well as a PhD program in Toxicology that is administered by the USM. Because toxicology is the focus area of only a small minority of our faculty, student recruitment is a challenge (e.g., students are reluctant to be perceived as toxicologists when they are training and developing research foci within other areas of environmental health science). Thus, in order to better support the training of doctoral students and provide a better alignment of career aspirations with faculty expertise, we are proposing this new PhD program.

Unit Code(s) (to be entered by the Office of Academic Planning and Programs):

PROPOSAL FOR
NEW INSTRUCTIONAL PROGRAM
UNIVERSITY OF MARYLAND AT COLLEGE PARK, MARYLAND

Ph.D. in Environmental Health Sciences

School of Public Health

Dean Jane Clark

Ph.D. Fall 2016 (with new admits anticipated Fall 2017)

I. OVERVIEW and RATIONALE

A. Briefly describe the nature of the proposed program and explain why the institution should offer it.

This is a proposal to establish a Ph.D. program in Environmental Health Sciences within the School of Public Health, administered by the faculty of the Maryland Institute for Applied Environmental Health (MIAEH). The degree will focus on human health, environmental epidemiology, risk assessment, environmental justice, and occupational health, consistent with the areas of expertise of the MIAEH faculty. MIAEH currently offers students flexible and individualized programs of study that lead to the Master of Public Health in Environmental Health Sciences. In 2010, MIAEH also became the UMD home of the USM-wide doctoral program in Ph.D. Toxicology (Toxicology Ph.D. curriculum shown in Appendix 1). Because toxicology is the focus area of only a small minority of our faculty, student recruitment has been challenging: students are reluctant to be perceived as toxicologists when they are training and developing research foci within other areas of environmental health science. Thus, in order to better support the training of doctoral students and provide a better alignment of career aspirations with faculty expertise, we are proposing a new Ph.D. program better matched to the full range of research within MIAEH.

Clarifying the differences between toxicology and environmental health sciences is important to understanding the basis for the present proposal. *Environmental health* is a branch of public health centered on all aspects of the natural and built environment that may affect human health. In contrast, *toxicology* is the study of the effect of chemicals and physical agents on living organisms. While there is overlap between the two fields (e.g., the study of chemical agents on human health), the research foci are quite different. Environmental health research includes environmental epidemiology, risk assessment, environmental justice, occupational health, among others, while toxicology has a stronger linkage with chemistry and pharmacology. As an example, the USM-administered Ph.D. in Toxicology has its largest student base from the UMB Schools of Pharmacy and Medicine with research primarily aligned with pharmacology faculty. Revising the Ph.D. in Toxicology would not serve the needs of environmental health students or faculty, nor would it serve UMB's needs; the fields are different, and students will anticipate different career options. The breadth of research areas in environmental health sciences necessitates the establishment of a doctoral degree dedicated to the study and advancement of environmental health sciences, considered one of the five core elements of the field of public health.

MIAEH was established in 2006 with a mission to carry out research on a broad range of environmental factors and their effects on human health. Faculty members in MIAEH collaborate with state, federal, international and private agencies to develop research solutions that address pressing environmental and occupational health problems. Students will become experts in areas including exposure assessment, environmental epidemiology, environmental microbiology, children's environmental health, environmental justice, occupational health, and risk assessment. They will also obtain a broad appreciation of public health as required for students graduating from a School of Public Health accredited

by the Council on Education in Public Health.

This degree program is also quite distinct from the environmental science-related Ph.D. programs offered by AGNR and CMNS, which focus primarily on ecosystem health and environmental science (e.g., graduate programs in Environmental Science and Technology and the system program in Marine, Estuarine and Environmental Sciences currently offered by other colleges, AGNR and CMNS, respectively).

Nearly every top 40 School of Public Health in the U.S. offers a Ph.D. in Environmental Health Sciences, and UMD will be more competitive in attracting top doctoral students with such a degree. The only Ph.D. program in Environmental Health Sciences within the state of Maryland is offered by Johns Hopkins University, a private institution, with one of the largest programs in the U.S. (15-20 doctoral enrollments per year). The only other Environmental Health Sciences doctoral programs near the mid-Atlantic region are at the following locations (enrollment data included, as determined from accreditation reports): West Virginia University (enrolled 2 students per year AY2013 and 2014); University of Pittsburgh (program size of 11 students in 2014); University of North Carolina (reports 5-10 enrolled students per year); and Rutgers University (enrolled 1-4 students per year in AY2013-15 – 4-7 MPH). UMD has lost top-quality doctoral students to peer programs because of the lack of a Ph.D. program. Our unique focus areas in environmental justice, cumulative burden of exposure, water re-use innovations (USDA-funded CONSERVE Center of Excellence), and climate change consequences on health will continue to distinguish UMD from peer schools to ensure strong recruitment of top-quality students.

Development of the environmental health workforce has been a key concern of the U.S. Department of Health and Human Services for many years. For example, the *Healthy People 2010* publication articulated the concern that public health infrastructure in several areas, including environmental health, was lacking and that workforce development opportunities need to be expanded. In particular for the present proposal, the Centers for Disease Control and Prevention (CDC) has noted the paucity of leaders in environmental health and raised the concern that impending retirements and vacancies will leave the environmental health leadership ranks severely understaffed (supporting documents and statements can be found at http://www.cdc.gov/nceh/ehs/activities/training.htm). As such, the development of a doctoral program in environmental health sciences at a public land-grant university will help support the workforce development needs of the field.

B. How big is the program expected to be? From what other programs serving current students, or from what new populations of potential students, onsite or offsite, are you expecting to draw?

We expect a typical doctoral student population of approximately 15 students, with few if any students joining the existing Toxicology Ph.D. program into the future. As such, we are effectively transitioning our recruitment efforts away from the Toxicology Ph.D. program to the Ph.D. program in Environmental Health Sciences and foresee no substantial change in resource requirements or administrative burden with the establishment of this degree program. The Toxicology Ph.D. program currently has 7 students, reflecting the challenges

with recruitment into this program. The majority of faculty anticipate mentoring 1-3 doctoral students, based mainly on the ability to fund through extramurally funded research assistantships. Thus, we anticipate a slightly increased enrollment with higher quality students compared to our current program size, and enrollments will be matched to extramural funding to ensure adequate student funding support. We expect many existing Toxicology students will transition to the new Ph.D. program once available (especially those early in their programs), although we will maintain both degrees into the foreseeable future to ensure support for student completion.

II. CURRICULUM

A. Provide a full catalog description of the proposed program, including educational objectives and any areas of concentration.

Students in the doctoral program in Environmental Health Sciences at the Maryland Institute for Applied Environmental Health (MIAEH) in the School of Public Health will master an essential core of knowledge in environmental and occupational health, epidemiology and biostatistics. Elective courses and rotations with faculty field studies and laboratories will offer students the knowledge and skills needed to specialize within the broader area of environmental health and become independent researchers.

Degree Requirements

The Ph.D. program in Environmental Health Sciences consists of a minimum of 46 credit hours of graduate courses depending on the incoming student's previous coursework. In particular, students without an MPH degree will require additional coursework as required by the public health accrediting body (CEPH). Graduate courses include (1) core courses within environmental health, epidemiology and biostatistics; (2) supporting courses in environmental health research, ethics, public health, and grant writing; (3) specialized courses selected within the research foci; and (4) dissertation credits. Program requirements for a Ph.D. degree also include successful completion of a written and oral comprehensive exam, oral defense of a written dissertation research proposal, and a minimum of 12 credits of Ph.D. dissertation research, written dissertation, and a final dissertation defense. The program can be completed on either a full- or part time basis. It is anticipated that students will complete more than the minimum number of credits.

The curriculum for the Environmental Health Sciences Ph.D. program is designed to provide an essential core of knowledge in environmental and occupational health, together with elective courses that offer students the background needed to specialize within this broad area.

Students are able to customize their selection of courses and lab rotations based on their specific career objectives. Students must file a preliminary program of study with the graduate program director before registering for their first semester of classes. They will submit an amended, final plan of study before the start of their second semester, approved by a program of study committee.

All students will complete a comprehensive written and oral qualifying examination overseen by a committee of graduate faculty, of whom the majority of members will be from within MIAEH. After passing the qualifying examinations, the student will be advanced to candidacy. Generally, the examining committee will serve as the dissertation committee. The candidate will then write a dissertation research proposal in consultation with the committee, submit the written proposal to the committee at least two weeks prior to a scheduled oral defense of the proposal, and finalize the proposal following the oral defense. The procedures for the dissertation defense and examining committee are as specified in the Graduate School Catalog. In general, student committees are formed with three MIAEH graduate faculty, with additional committee members coming from supporting units across campus and occasionally off-campus. A graduate committee oversees admissions and ensures that faculty workload burdens around advising and committee support are equitably spread across research foci (in addition to considering extramural funding support).

B. List the courses (number, title, semester credit hours) that would constitute the requirements and other components of the proposed program. Provide a catalog description for any courses that will be newly developed or substantially modified for the program.

See Table 1: Ph.D. Program in Environmental Health Sciences

The only newly developed course will be MIEH700 (bold in Table 1), planned as a follow-up (advanced) course after MIEH600. VPAC for MIEH700 will be submitted in tandem with this PCC proposal. The catalog description for MIEH700 is as follows:

MIEH700: (Pre-req: MIEH600) Advanced analysis of the chemical, physical and biological hazards present in our living and working environment and their effects on human health. A focus on analysis of recent research and development of new hypotheses. Topics include: exposure assessment, environmental justice, occupational health and safety, children's environmental health, ambient and indoor air pollution, food-borne diseases, solid and hazardous wastes, water resources, risk assessment, ecological issues and environmental laws.

Table 1: Ph.D. Program in Environmental Health Sciences		
	Course Title	**Credits**
Core Courses *(24 Required Credits)**	MIEH 600 Foundations of Environmental Health	3
	MIEH 700 Applied Environmental Health	3
	MIEH 720 Principles of Toxicology	3
	MIEH 740 Risk Assessment	3
	MIEH 771 Exposure Assessment of Environmental Hazards	3
	EPIB 610 Epidemiology I	3
	EPIB 650 Biostatistics I	3
	EPIB 651 Biostatistics II	3
Supporting Courses *(11 to 19 Required Credits)**	MIEH 609 Methods in Toxicology and Environmental Health (1 or 2 rotations)**	3 to 6
	EPIB 641 Ethics in Public Health	1
	MIEH 688 Environmental Health Seminar**	3
	Course(s) that will expose the student to concepts in health behavior and health services administration (This could include HLTH 665, HLSA 601 or a survey course that covers all five foundation areas of public health.)	1 to 6
	KNES 771 Grant Writing or Equivalent	3
Specialization Area *(12 to 15 Credits)****	*The specialization area would be created by and tailored to each student. If the student takes 2 lab rotations, s/he would take 12 credits of specialization. If s/he takes 1 lab rotation, s/he would take 15 credits of specialization.*	12 to 15
Dissertation *(12 Required Credits)*	MIEH 899 Doctoral Dissertation Research	12
* Students could waive out of some of these courses with coursework taken at UMD or in previous master's programs.		

** Students would not be able to waive out of all rotations or the seminar requirements. Rotations can be in physical labs or with faculty conducting non-laboratory based research. At least 1 rotation must be outside of the students focus area.		
***Students would not be able to waive out of any of the 12 to 15 credits required for the specialization area. No more than 6 credits of MIEH 898 could be taken as part of the specialization area.		

Table 2: Typical Program Plan for Ph.D. in Environmental Health Sciences (for a B.S. degree holder)

Academic Year	Course Title	Credits
Year 1	MIEH 600 Foundations of Environmental Health	3
	MIEH 609 Methods in Toxicology and Environmental Health	3
	EPIB 650 Biostatistics I	3
	MIEH 688 Environmental Health Seminar	1
	MIEH 700 Applied Environmental Health	3
	EPIB 610 Epidemiology I	3
	MIEH 688 Environmental Health Seminar	1
	HLTH 665 – Health Behavior	3
Year 2	MIEH 740 Risk Assessment	3
	MIEH 771 Exposure Assessment of Environmental Hazards	3

	MIEH 688 Environmental Health Seminar	1
	MIEH 609 Methods in Toxicology and Environmental Health	3
	EPIB 651 Biostatistics II	3
	MIEH 720 Principles of Toxicology	3
Year 3	EPIB 641 Ethics in Public Health	1
	HLTH 665 – Health Behavior I	3
	MIEH 688 Environmental Health Seminar	1
	Specialization Course	3
	Specialization Course	3
	Specialization Course	3
	HLSA 601 - Introduction to Health Systems	3
	MIEH 689 – Independent Study	3
Year 4	KNES 771 Grant Writing or Equivalent	3
	MIEH 688 Environmental Health Seminar	1
	Specialization Course	3
	Specialization Course	3
	MIEH 689/898 Independent Study	3-4
	MIEH 899 Doctoral Dissertation Research	6
Year 5	MIEH 899 Doctoral Dissertation Research	6
	MIEH 899 Doctoral Dissertation Research	6

C. Describe any selective admissions policy or special criteria for students selecting this field of study.

Admission to the program is limited to Ph.D. students. We plan to admit both BS and MS (or equivalent) degree holders depending on their qualifications. Applicants will typically hold degrees in biology, environmental sciences, engineering, public health, chemistry, or related fields. While we are submitting a separate MS program in Environmental Health Sciences, we will not actively recruit students into the MS program. The MS program is offered as an exit path for doctoral candidates who cannot or choose not to complete the Ph.D., or to those students who successfully complete the requirements and opt to obtain the additional credential.

Program requirements for the MS degree include a minimum of 31 course credits, including completion of either a non-thesis project or MS thesis.

Application Requirements:

1. Minimum 3.0 undergraduate GPA; 2. Undergraduate transcripts; 3. GRE scores taken within the past 5 years; 4. 3 letters of recommendation that address the applicant's academic capabilities and probability of success in graduate school; 5. Statement of goals and interests and their congruence with those of the program; 6. Relevant academic/work experience, including previous coursework in biology, chemistry, mathematics, statistical methods, and/or statistical software packages.

To apply to the Ph.D. program in Environmental Health Sciences, applicants must complete their application in SOPHAS: www.sophas.org

III. STUDENT LEARNING OUTCOMES AND ASSESSMENT

A. List the program's learning outcomes and explain how they will be measured.

B. Include a general assessment plan for the learning outcomes. (In lieu of a narrative for both IIIA and IIIB, you may attach the program's learning outcomes assessment forms.)

Competencies, Outcomes, and Assessments

1. Synthesize environmental health knowledge, including explaining and analyzing key theories, principles, methods and controversies, and identify opportunities to advance the field of environmental health.

Measure: Successful completion of the qualifying examination.

Criterion: 100% of graduates will pass the examination.

Assessment: Student comprehensive examination performance will be assessed yearly.

2. Develop testable hypotheses that will advance the field of environmental health.

Measure: Successful completion of the qualifying examination, dissertation research proposal, and oral defense of the dissertation proposal.

Criterion: 100% of graduates will pass the examination, and prepare and defend a research proposal.

Assessment: The rigor and quality of the research proposal components of these activities will be assessed for each student and compiled annually.

3. Design and conduct research studies, analyze data and test hypotheses that advance the science of environmental health.

Measure: Successful completion of dissertation research and submission of a completed dissertation.

Criterion: 80% of graduates will successfully defend and submit a dissertation within 5 years and 95% within 6 years of matriculation.

Assessment: The time to graduation will be assessed after there are at least six graduates from the program and annually thereafter.

4. Effectively communicate results of environmental health research to the scientific community.

Measure: Successful publication of research in peer reviewed journals and acceptance of abstracts at scientific conferences.

Criterion: 100% of graduates will present research either as posters or podium presentations at scientific meetings; 100% will have submitted three research papers to peer reviewed journals; 80% will have at least one paper accepted; and 50% will have two papers accepted for publication prior to defending their dissertation.

Assessment: Student CVs will be reviewed at program completion and publications and presentations will be confirmed by the advisor or other faculty.

IV. FACULTY AND ORGANIZATION

A. Who will provide academic direction and oversight for the program?

The Maryland Institute for Applied Environmental Health (MIAEH) will provide academic direction and oversight for the program, in collaboration with our colleagues in SPH and across campus.

B. If the program is not to be housed and administered within a single academic unit, provide details of its administrative structure.

N/A

V. OFF CAMPUS PROGRAMS

Not applicable.

VI. OTHER ISSUES

A. Describe any cooperative arrangements with other institutions or organizations that will be important for the success of this program.

None.

B. Will the program require or seek accreditation? Is it intended to provide certification or licensure for its graduates? Are there academic or administrative constraints as a consequence?

No.

VII. COMMITMENT TO DIVERSITY

Identify specific actions and strategies that will be utilized to recruit and retain a diverse student body.

The MIAEH faculty are a diverse group (e.g., 50% women; 50% underrepresented minorities) committed to recruiting, retaining, and graduating a diverse student body. Many of the faculty focus their research efforts on issues that impact health disparities. The faculty will use their networks of colleagues and professional organizations to ensure a diverse pool of applicants from which to recruit, retain, and graduate a diverse and excellent student body.

VIII. REQUIRED PHYSICAL RESOURCES

A. *Additional library and other information resources required to support the proposed program. You must include a formal evaluation by Library staff.*

No additional library resources are required, as evaluated by the UMD Libraries staff.

B. *Additional facilities, facility modifications, and equipment that will be required. This is to include faculty and staff office space, laboratories, special classrooms, computers, etc.*

None required.

C. *Impact, if any, on the use of existing facilities and equipment. Examples are laboratories, computer labs, specially equipped classrooms, and access to computer servers.*

Because we anticipate that nearly all of our future Ph.D. students will matriculate into the Ph.D. program in Environmental Health Sciences rather than the Ph.D. program in Toxicology, we foresee little impact on existing facilities. Student numbers should be very close to those anticipated for the Ph.D. in Toxicology. The School of Public Health and MIAEH have adequate desk space for funded students and the research staff of our faculty.

IX. RESOURCE NEEDS and SOURCES

Describe the resources that are required to offer this program, and the source of these resources. Project this for five years. In particular:

A. *List new courses to be taught, and needed additional sections of existing courses. Describe the anticipated advising and administrative loads. Indicate the personnel resources (faculty, staff, and teaching assistants) that will be needed to cover all these responsibilities.*

MIAEH will offer MIEH700, the only new course required for the proposed curriculum, every 2-3 semesters as needed to ensure student progress to degree completion. Any of our MIAEH faculty would be able to teach this course and we anticipate a rotation of faculty instructors. We anticipate no significant change in enrollments of our other courses due to these changes. MIEH700 would be a potential elective course for students in other SPH and campus master's and doctoral programs; we expect as many as 20% of seats would come from such students.

MIAEH has the necessary faculty to teach the necessary courses and advise doctoral candidates. No new resources are requested.

B. *List new faculty, staff, and teaching assistants needed for the responsibilities in A, and indicate the source of the resources for hiring them.*

None anticipated or needed.

C. *Some of these teaching, advising, and administrative duties may be covered by existing faculty and staff. Describe your expectations for this, and indicate how the current duties of these individuals will be covered, and the source of any needed resources.*

Our current faculty are in a position to add MIEH700 to our existing course schedule by minor shifting of some elective course offerings. We anticipate no significant burden with this course addition.

D. *Identify the source to pay for the required physical resources identified in Section VIII above.*

Not applicable.

E. *List any other required resources and the anticipated source for them.*

None.

F. *Provide the information requested in Table 1 and Table 2 (for Academic Affairs to include in the external proposal submitted to USM and MHEC).*

See attached.

Appendix 1: Toxicology Ph.D. curriculum requirements

The doctoral program in Toxicology is a 58-credit (minimum) professional degree. Dependent upon entry level qualifications, all Ph.D. students will complete a minimum of:

- 12 credits in Toxicology and Environmental and Occupational Health
- two Laboratory Rotations for 3 credits each
- 3 credits of Environmental Health seminar
- 6 credits each to cover the Basic Biostatistics and Epidemiology courses
- 1 credit in Scientific Ethics
- 6 credits in each of two specialized areas:
    - Advanced Epidemiology and Biostatistics
    - Analytical Chemistry
    - Pharmacology
    - Pathology/Immunology/Microbiology
    - Environmental Science/Ecology/Climate
    - Environmental Justice

TABLE 1: RESOURCES

Resources Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1.Reallocated Funds	$736,820	$906,874	$934,080	$962,102	$990,965
2. Tuition/Fee Revenue (c+g below)	$121,115	$124,748	$128,491	$132,346	$136,316
a. #FT Students	13	13	13	13	13
b. Annual Tuition/Fee Rate	$8,315	$8,564	$8,821	$9,086	$9,359
c. Annual FT Revenue (a x b)	$108,095	$111,338	$114,678	$118,118	$121,662
d. # PT Students	2	2	2	2	2
e. Credit Hour Rate	$651	$671	$691	$711	$733
f. Annual Credit Hours	10	10	10	10	10
g. Total Part Time Revenue (d x e x f)	$13,020	$13,411	$13,813	$14,227	$14,654
3. Grants, Contracts, & Other External Sources	$698,750	$606,591	$624,788	$643,532	$662,838
4. Other Sources	$0	$0	$0	$0	$0
TOTAL (Add 1 - 4)	**$1,556,685**	**$1,638,213**	**$1,687,359**	**$1,737,980**	**$1,790,120**

TABLE 2: EXPENDITURES

Expenditure Categories	Year 1	Year 2	Year 3	Year 4	Year 5
1.Faculty (b+c below)	$585,200	$753,445	$776,048	$799,330	$823,310
a. #FTE	4.0	5.0	5.0	5.0	5.0
b. Total Salary	$440,000	$566,500	$583,495	$601,000	$619,030
c. Total Benefits	$145,200	$186,945	$192,553	$198,330	$204,280
2.Admin. Staff (b+c below)	$75,810	$75,345	$77,605	$79,933	$82,331
a. #FTE	1.0	1.0	1.0	1.0	1.0
b. Total Salary	$57,000	$56,650	$58,350	$60,100	$61,903
c. Total Benefits	$18,810	$18,695	$19,255	$19,833	$20,428
3.Total Support Staff (b+c below)	$75,810	$78,084	$80,427	$82,840	$85,325
a. #FTE	1.0	1.0	1.0	1.0	1.0
b. Total Salary	$57,000	$58,710	$60,471	$62,285	$64,154
c. Total Benefits	$18,810	$19,374	$19,956	$20,554	$21,171
4. GA stipends	$442,635	$342,792	$353,076	$363,668	$374,578
5. GA health benefits	$135,000	$139,050	$143,222	$147,518	$151,944
5. Tuition Remission	$121,115	$124,748	$128,491	$132,346	$136,316
6. Equipment	$0	$0	$0	$0	$0
7. Library	$0	$0	$0	$0	$0
8. New or Renovated Space	$0	$0	$0	$0	$0
9. Other Expenses: Operational Expenses	$0	$0	$0	$0	$0
TOTAL (Add 1 - 9)	**$1,435,570**	**$1,513,464**	**$1,558,868**	**$1,605,634**	**$1,653,804**

UNIVERSITY OF MARYLAND

Department of Environmental Science and Technology

1426 An. Sci./Ag. Eng. Bldg.
College Park, MD 20742
Phone 301-405-1306
FAX 301-314-9023

February 29, 2016

Dr. Stephen Roth
Professor and Interim Director
Maryland Institute for Applied Environmental Health
School of Public Health
University of Maryland
College Park, Maryland 20742

Dear Dr. Roth,

The faculty of the Department of Environmental Science and Technology in our Ecosystem Health and Natural Resource Management Graduate Program have reviewed both the MS and PhD Program Proposals in Environmental Health Sciences. We strongly support the development of these two degree programs and will collaborate fully with you in ensuring that they are a success.

Please contact me if you have any further questions or need assistance at wbowerma@umd.edu or by phone at 301-405-1306. Good luck.

Sincerely,

William W. Bowerman, Ph.D.
Professor and Chair

Subject: Re: FW: PhD Proposal for Env Health Sci
Date: Sunday, February 28, 2016 at 10:29:20 PM Eastern Standard Time
From: Wolfgang Losert
To: Robert L. Infantino Jr, Stephen M. Roth

Dear Steve

the proposal has CMNS support. No concerns were raised by the CMNS graduate program directors.

best regards
Wolfgang Losert

On 2/19/2016 8:38 AM, Robert L. Infantino Jr wrote:

> Hi Steve,
> I am forwarding this proposal to Wolfgang Losert. He is serving as my fellow Associate Dean for faculty affairs/research and graduate programs. Wolfgang has been shepherding PCC related grad program matters. I suspect he will consult with our grad directors about your proposal to see if they have any inputs, and then will get back to you with support.
> Bob
>
> =|=|=|=|=|=|=|=|=|=|=|=|=|=|=|=|=|=|=|=|=|=|=|
> Robert L. Infantino, Ph.D.
> Associate Dean
> College of Computer, Mathematical, and Natural Sciences
> 2300 Symons Hall
> University of Maryland College Park, MD 20742-5511
> Phone: (301) 405-6892 FAX: (301) 314-9949
> email: rinfanti@umd.edu
> http://biology.umd.edu/faculty/robertinfantino
>
> ---
>
> **From:** Stephen M. Roth
> **Sent:** Friday, February 19, 2016 8:35 AM
> **To:** Robert L. Infantino Jr <rinfanti@umd.edu>
> **Cc:** Stephen M. Roth <sroth1@umd.edu>
> **Subject:** PhD Proposal for Env Health Sci
>
> Dear Bob,
>
> Please find attached a forthcoming PCC proposal for a PhD program in Environmental Health Sciences coming from SPH. Though CMNS doesn't have anything that really crosses over this program, having

your CMNS approval would be valuable as we move into the PCC process. I would appreciate very much your support of this program. Please contact me with any questions.

Thank you,
Steve

Stephen M. Roth, Ph.D.
Professor & Interim Director
Maryland Institute for Applied Environmental Health
School of Public Health
University of Maryland
College Park, MD 20742
301-405-2504; fax 301-405-8397
http://www.sph.umd.edu/miaeh

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Wolfgang Losert, Professor of Physics
Interim Associate Dean
Director, Partnership for Integrative Cancer Research
College of Computer, Mathematical, and Natural Sciences
University of Maryland

Physical Sciences Complex Room 1147, p: 301-405-0629
http://www.ireap.umd.edu/losertlab/

DATE: April 15, 2016

TO: Stephen M. Roth, Professor, Applied Environmental Health (MIAEH), Kinesiology, Office of the Dean & Associate Dean for Educational Innovation; Interim Director of the Maryland Institute for Applied Environmental Health

CC: Daniel Mack, Associate Dean for Collection Strategies and Services, Libraries

Margaret Saponaro, Interim Head, Collection Development, Libraries

FROM: Nedelina Tchangalova, Physical Sciences & Public Health Librarian

RE: Library Resources to Support New Instructional Program – PhD in Environmental Health Sciences

The University of Maryland (UM) Libraries' mission is "to enable the intellectual inquiry and learning required to meet the education, research and community outreach mission of the University." Currently they support undergraduate and graduate students in a variety of face-to-face, online and distance learning programs, as well faculty working collaboratively with internal and external partners. The University of Maryland Libraries collections will continue adequately support the instruction and research needs of the newly proposed PhD program in Environmental Health Sciences.

As a department with strong ties with other departments/schools on and off campus, the Maryland Institute for Applied Environmental Health is confident that library resources are readily available and accessible. Ease of access and flexible availability of library materials is paramount, and researchers, as well students expect this flexibility to be coupled with high academic quality and integrity. The current purchasing practices and available collections at the UM Libraries will ensure that these two goals can be met, both now and for the life of the department. In addition, the establishment of the new Collaborative School of Public Health provides even greater access and flexible availability; the School of Public Health (SPH) students and faculty at the University of Maryland—College Park (UMCP) have access to the Health Sciences and Human Services Library at the University of Maryland—Baltimore (UMB). Thus, the broader medical and global health journals available there are a part of UM Libraries available resources without additional expenditures. Moreover, UM Libraries' existing public health and collections of journals and databases will continue to support the research and teaching needs of the Maryland Institute for Applied Environmental Health.

Public & Environmental Health Science Library Collections

While the Maryland Institute for Applied Environmental Health is part of the School of Public Health, many of their faculty members have secondary appointments to other UMCP departments and UMB. McKeldin Library supports the undergraduate and graduate students in SPH, housing the majority of the monographs and serials pertaining to public health in general, and environmental health in particular. A significant portion of these collections are electronically accessible, both on and off campus, and therefore are not location dependent.

1. **Monographs**

The Libraries' current collection of books related to environmental health is sufficient to meet the needs of the department. The ongoing acquisition of scholarly books is expected to be adequately covered through existing acquisition practices and budgeting. As a land grant institution, the University of Maryland already has a tradition of emphasizing public health, including environmental health, epidemiology, environmental justice,

and occupational health, and current collection development practices in the Libraries already support these topics.

At this time, UM Libraries have access to several multidisciplinary ebook collections related to human and environmental health, and health policy and law (*Credo Reference*, *ebrary*, *EBSCo ebook collection*, *Gale Virtual Reference Library, Springer, World Scientific eBooks* and more). Due to the UM Libraries' purchasing preference for electronic materials, especially prevalent across the STEM fields, the number of electronic book collections is expected to continue to increase significantly in the coming years.

2. Electronic Resources: Journals and Databases

The Libraries' current list of subscriptions includes both core and related journals that support research and teaching in public and environmental health, and policy.

A search was performed in *Journal Citation Reports 2014* (JCR), a database that uses citation data to rank and determine the impact factor of journals in an academic field. To support the existing courses, at the present time the Libraries provide access to all of the top ten ranked journals from the JCR categories of *Environmental Sciences*, and *Public, Environment & Occupational Health*.

While other aspects of public and environmental health, and policy do not fall as neatly into a JCR-specified category, the UM Libraries provide access to numerous highly ranked journals from cross-sections of the JCR categories of Agricultural Economics & Policy, Behavioral Sciences, Family Studies, Law, Political Science, Public Administration, as well as the majority of top ten ranked journals from all engineering disciplines.

Relevant top-ranked titles include:

- *Energy & Environmental Science*
- *Nature Climate Change*
- *Global Change Biology*
- *Environmental Health Perspectives*
- *Frontiers in Ecology and the Environment*
- *Lancet Global Health*
- *International Journal of Epidemiology*
- *Epidemiologic Reviews*
- *Annual Review of Public Health*
- *Epidemiology*

In addition to journal subscriptions, the UM Libraries subscribe to the following significant databases, that will support the department by providing access to the previously mentioned journals as well as other relevant resources:

- *Academic Search Complete (EBSCO)*
- *Congressional Publications (ProQuest)*
- *Environmental Science Collection (ProQuest)*
- *Environmental Studies in Video*
- *Environment & Energy Daily*
- *Health Reference Policy Center (EBSCO)*
- *Public Health (ProQuest)*
- *PubMed*

At this time, the UM Libraries' purchasing preference is for electronic materials (i.e. those that can be accessed online), a trend that will serve to enhance research and teaching experience. This is especially relevant to the collaboration initiatives, where online flexibility is presented with no reduction in educational and research quality. The UM Libraries purchasing and access priorities are in line with this goal.

Interlibrary Loan & Article Express

With the admission of the University of Maryland into the Committee for Institutional Cooperation (CIC), the academic arm of the Big Ten, our faculty and students are able to take advantage of a number of new materials access options in the coming years. The Libraries joined the CIC UBorrow[1] program, which allows rapid access to the collections of other CIC member libraries.

When resources are not part of our holdings within the sixteen University System of Maryland and Affiliated Institutions (USMAI) libraries, the Interlibrary Loan unit can obtain materials from other libraries at no charge to the student or faculty. Most recent journal articles can be provided through electronic delivery, allowing students and faculty to make the most flexible use of their time.

Additionally, through the auspices of the Interlibrary Loan unit, graduate students and faculty can make use of Article Express, an electronic document delivery service for in-house materials. Article Express allows graduate students and faculty to place requests for book chapters and journal and/or conference papers that are available in print in the Libraries, and have them scanned and delivered electronically within three business days. This service is also free of charge.

Conclusions

At the present time, UM Libraries holdings are adequate to support the proposed new PhD program in environmental health sciences, and current purchasing preferences and trends are especially beneficial for collaborative projects and programs. While it is anticipated that this will continue, the Libraries collections are vulnerable to budget and market fluctuations. Journal collections and other continuing resources remain particularly vulnerable. The level of future support is thus dependent upon ongoing funding and other circumstances affecting continuing subscriptions.

Statement from Associate Dean, Collection Strategies and Services

Nedelina Tchangalova, Physical Sciences and Public Health Librarian, has prepared this report according to standard practices for collection assessment in research libraries. I have reviewed Ms. Tchangalova's report and I concur with her findings.

Daniel C. Mack

[1] http://www.cic.net/projects/library/reciprocal-borrowing/uborrow

University Senate
TRANSMITTAL FORM

Senate Document #:	16-17-16
PCC ID #:	16004
Title:	Establish a Post-Baccalaureate Certificate in Computer Networking
Presenter:	Andrew Harris, Chair, Senate Programs, Curricula, and Courses Committee
Date of SEC Review:	October 19, 2016
Date of Senate Review:	November 2, 2016
Voting (highlight one):	1. On resolutions or recommendations one by one, or 2. In a single vote 3. To endorse entire report
Statement of Issue:	The A. James Clark School of Engineering and Department of Electrical and Computer Engineering propose to establish a 12-credit Post-Baccalaureate Certificate in Computer Engineering. This certificate program will be for students who are enrolled in the Master of Science in Telecommunications program. Computer networks have become ubiquitous and relied upon every day for work, communication, and entertainment. Current trends such as cloud-based services, software-defined platforms, and large data centers reflect a need for engineers and technologists who can design, build, maintain, trouble-shoot, and secure complex and ever-growing networking infrastructures. Course requirements for the certificate program include four elective courses from the following set: ENTS689G, Special Topics: Design and Analysis of Communication Networks, and ENTS689N, Special Topics: Network Programming, or from the following course sequences: ENTS649, Special Topics in Networking, and ENTS749, Advanced Topics in Networking. These courses can also be used to fulfill the elective requirements for the Master of Science program. Students who pursue the certificate would then typically have to take one or two additional courses in addition to satisfying the minimum course requirements for the MS degree.

	This proposal was approved by the Graduate School Programs, Curricula, and Courses committee on September 26, 2016, and was approved by the Senate Programs, Curricula, and Courses committee on October 7, 2016.
Relevant Policy # & URL:	N/A
Recommendation:	The Senate Committee on Programs, Curricula, and Courses recommends that the Senate approve this new certificate program.
Committee Work:	The committee considered this proposal at its meeting on October 7, 2016. Zoltan Safar, director of the Master of Science in Telecommunications program, presented the proposal. The proposal was unanimously approved by the committee.
Alternatives:	The Senate could decline to approve this new certificate program.
Risks:	If the Senate declines to approve this certificate program, students in the Master of Science in Telecommunications program will lose an opportunity to have their focus in computer networking formally recognized.
Financial Implications:	There are no significant financial implications with this proposal.
Further Approvals Required:	If the Senate approves this proposal, it would still require further approval by the President, the Chancellor, and the Maryland Higher Education Commission.

University of Maryland PCC
Program/Curriculum/Unit Proposal

PCC Log No: 16004

Program: Master's in Telecommunications Program (ENTS)

Department/Unit: Department of Electrical and Computer Engineering

College/School: A. James Clark School of Engineering

Proposal Contact Person (with email): Zoltan Safar zsafar@umd.edu

Type of Action (check one):

- ☐ Curriculum change (includes modifying minors, concentrations/specializations and creating informal specializations)
  - ☐ Curriculum change is for an LEP Program
- ☐ *Rename a program or formal Area of Concentration*
- ☐ *Establish/Discontinue a formal Area of Concentration*
- ☐ Other:
- ☒ *Establish a new academic degree/certificate program*
- ☐ Create an online version of an existing program
- ☐ Establish a new minor
- ☐ *Suspend/Discontinue a degree/certificate program*
- ☐ Establish a new Master or Certificate of Professional Studies program
  - ☐ New Professional Studies program will be administered by Office of Extended Studies

Italics indicate that the proposal must be presented to the full University Senate for consideration.

Approval Signatures - *Please print name, sign, and date. For proposals requiring multiple unit approvals, please use additional cover sheet(s).*

1. Department Committee Chair Dr. Zoltan Safar Zoltan Safar 04.14.16.
2. Department Chair Dr. Rama Chellappa Rama Chellappa 4/14/16
3. College/School PCC Chair Jenna Bucci Jenna E. Bucci 5/3/16
4. Dean Dr. Peter Konfinas Peter Kofinas 5/2/2016
5. Dean of the Graduate School (if required) _____
6. Chair, Senate PCC _____
7. University Senate Chair (if required) _____
8. Senior Vice President and Provost _____

Instructions:
When approved by the dean of the college or school, please send the proposal and signed form to the Office of the Associate Provost for Academic Planning and Programs, 1119 Main Administration Building, Campus-5031, **and** email the proposal document as an MSWord attachment to pcc-submissions@umd.edu.

Summary of Proposed Action (use additional sheet if necessary):

The Master's in Telecommunications Program is proposing a new Graduate Certificate program in Computer Networking to be a subset of the existing ENTS (Master of Science) program.

Unit Code(s) (to be entered by the Office of Academic Planning and Programs):

Proposal to Establish a Graduate Certificate in Computer Networking

I. OVERVIEW

A. Overview and Rationale

Established in 1992, the Master of Science in Telecommunications (ENTS) program provides a unique cross-disciplinary industry-oriented graduate education in telecommunications. It is administered by the Department of Electrical and Computer Engineering in the A. James Clark School of Engineering. Students complete coursework in both the ECE Department and the Robert H. Smith School of Business. Combining rigorous technical education with invaluable business insight and entrepreneurial skills, the ENTS program offers students a unique perspective on the telecommunications industry and profession. The ENTS program caters to both full-time students and working professionals. Most ENTS courses are offered once a week and are scheduled in the afternoon or evening to suit working professionals, while some courses additionally offer daytime sections. All ENTS courses are "traditional" (residential) courses; the program does not offer off-campus locations or online options. ENTS students are responsible for a differential tuition rate and the program is considered a self-support unit within the University of Maryland. Currently, approximately 240 students are enrolled and approximately 110-120 MS degrees are awarded each year.

To be considered for admission, applicants to the ENTS program must have earned a bachelor's degree, typically in a technical field (engineering, computer science, etc.) and have an undergraduate GPA of 3.0. Applicants must also submit a personal statement and three letters of recommendation. To earn the MS in Telecommunications degree, students must successfully complete 30 credits of course work (10 three-credit courses) with a GPA of 3.0 or more and a scholarly paper. A typical ENTS student takes 6-8 core courses (up to 2 of the 8 core courses may be waived if justified) and 2-4 elective courses.

The ENTS program is taught by full-time and part-time instructors employed by the Electrical and Computer Engineering Department and the Robert H. Smith School of Business. They all hold PhDs in their respective fields (engineering/computer science or business), and they all have worked in the industry for several years and have considerable industrial experience.

As our society and technology evolves, there will be more demand for professionals who have well-rounded specialized knowledge in computer networking. Computer networks have become ubiquitous and we rely on them every day for work, communication and entertainment. Observing the current trends in networking, such as cloud-based services, software-defined platforms, large data centers and Internet of Things (IoT), our society will need more and more engineers and technologists who can design, build, maintain, trouble-shoot and secure our complex and ever-growing networking infrastructure.

We propose the creation of a Graduate Certificate Program in Computer Networking embedded in the ENTS program. The Certificate Program will be offered to current ENTS students, and its

aim is to provide official acknowledgment for acquiring focused knowledge in a particular subfield of telecommunications. Over the past years, many of our students opt to take additional electives (i.e. electives in addition to meeting the minimum degree requirements) to improve their skill sets and their marketability to employers after graduation. This trend is beneficial to both students and the program as it results in better prepared and more marketable graduates with stronger, focused technical background, thus improving the quality of our graduates. This enhances their transcripts, resumes, and chances of finding employment or promotion in their current employment, further improving the reputation of the ENTS program and alumni base. We would like to encourage, organize and recognize such efforts by offering the Graduate Certificate in Computer Networking, a well-defined, focused area within telecommunications. The certificate will be comprised of existing ENTS elective courses, which include special topics and advanced topics courses in computer networking. Within the telecommunications industry, certificates are widely accepted proof of expertise in a given technical subfield such as routing, computer security, etc. A Graduate Certificate is an appropriate recognition for the additional coursework, time and effort the student needs to invest to obtain the knowledge/expertise. The Graduate Certificate in Computer Networking will be one of several proposed certificates designed to strengthen the ENTS program.

The Master's in Telecommunications program is unique to the University System of Maryland, and thus adding certificate programs for current ENTS students would not replicate or detract from any existing programs. Since the ENTS program specializes in Telecommunications, we offer a wide range of special-topics and advanced-topics courses in Computer Networking that no other units offer. The ENTS electives will serve as the basis for the proposed Graduate Certificate Program.

In comparison, the University of Colorado Boulder (UCB) offers the "Interdisciplinary Telecom Program" (ITP). UCB has marketed ITP as "a highly-integrated and comprehensive program combining technology, policy, and business with hands-on experience." As a peer program to ENTS, ITP offers a Master of Science in Telecom. MS students have the option to pursue "tracks" in network engineering, wireless engineering, network security and telecom policy. These tracks enable students to tailor the technical content of their degree to prepare themselves for careers in industry. Embedded with the tracks is the opportunity for students, who complete the requirements, to earn the corresponding 12-credit Graduate Certificate. Students may be awarded the certificate while completing the MS degree. The Graduate Certificates include: Computer and Network Security; Network Architecture; Telecom Policy and Strategy; and Wireless Networks and Technologies.

The Graduate Certificate in Computer Networking allows ENTS students to have the option of enhancing their MS degree with specific technical knowledge and also enable them to remain competitive in the marketplace with graduates from similar degree programs at peer institutions.

Additional information:
http://www.colorado.edu/itp/
http://www.colorado.edu/itp/masters-degree
http://www.colorado.edu/itp/prospective-students/graduate-certificates

B. Student Audience

The Certificate in Computer Networking will only be available to current ENTS students. For a typical ENTS student, this will mean taking 1-2 extra electives in addition to the courses taken to satisfy the MS degree requirements.

Based on the results of a survey we have recently conducted among current ENTS students, there is a significant interest in obtaining Graduate Certificates. Out of 58 responses, 46.6% found a Graduate Certificate very valuable to their portfolios, and 36.2% found it somewhat valuable. Demonstrating their interest, 58.6% responded that they would most definitely obtain a Graduate Certificate if offered, and 32.8% responded that they would most likely obtain one. Finally, 72.4% of the responding students showed interest in obtaining a Graduate Certificate in computer networking.

We also reached out to 39 ENTS alumni to poll their opinions on the value a Graduate Certificate program. Out of 18 responses, 44.4% found it very valuable, and 44.4% found it somewhat valuable to their portfolios. We also asked if they would encourage current ENTS students to obtain a Graduate Certificate if it was offered, and 33.3% responded "yes, most definitely", and 50.0% responded "yes, most likely". Out of the responding alumni, 61.1% responded that they found a Graduate Certificate in the area of computer networking valuable.

C. Eligibility

Enrollment in this program will be limited to ENTS students, so the admission requirements are the same as for the ENTS program.

II. THE GRADUATE CERTIFICATE

A. Title

The proposed title is: Graduate Certificate in Computer Networking

B. The Award

A physical Graduate Certificate issued by the UMD Diploma Office; the achievement will also be noted on the students' transcripts.

III. CURRICULUM STRUCTURE AND REQUIREMENTS

The ENTS program has grouped its electives into course series according to specialization areas within telecommunications. The course series relevant to computer networking are Special Topics in Networking and Advanced Topics in Networking. These courses series will be included in the certificate program in order to maintain dynamic and up-to-date program offerings. New courses are offered almost every year to effectively respond to the dynamic changes in the telecommunications industry and to produce graduates who are well versed in the latest technology and telecommunications industry trends. At the end of this section, we will provide an example set of courses satisfying the certificate requirements based on our Spring 2015 and Fall 2015 offerings.

The Graduate Certificate in Computer Networking is a 12-credit program, by coursework only. The courses taken to earn the Graduate Certificate may also be counted toward meeting the MS degree requirements, and the MS degree and the Graduate Certificate may be earned and awarded in the same semester. Each student must complete four 3-credit courses from the following course list; at least two courses must be at the 700-level.

- ENTS 689G Special Topics: Design and Analysis of Communication Networks
- ENTS 689N Special Topics: Network Programming
- 649X Series: Special Topics in Networking
- 749X Series: Advanced Topics in Networking

Sample Course Descriptions:

ENTS689G: Special Topics: Design and Analysis of Communication Networks
Prerequisite: ENTS 640. This advanced-level graduate course is designed to build on the material covered in ENTS640 and to provide a practical and more in-depth view of the protocols and architectures used in real-world communication networks. The objective of this course is to give the students a reasonable combination of analytical and practical knowledge that is expected from graduate-level network engineers. Due to its practical nature, this course is highly project-oriented and multiple network design problems are visited both in the class and also as homework assignments. OPNET simulation and modeling software is used as the main tool for homeworks and projects. This course covers a combination of theoretical and practical concepts and a tentative list of covered subjects is as follows: Delay calculation in communication networks; QoS techniques in IP networks; Wired/Wireless medium access protocols and LAN technologies; Routers, Switches and other networking devices; Network planning and design; TCP protocol and traffic analysis. The course material and its projects are designed to highlight the main properties of some well-known protocols used in today's networks. Students will learn the role of fundamental theories in the initial stage of a design cycle and subsequent use of modeling and simulation tools for performance evaluation and tuning of their designs.

ENTS689N: Special Topics: Network Programming
This course teaches the fundamentals of programming in C including skills that students need for solving typical telecommunications engineering problems. Data structures, control flow, memory allocation, pointers, and sockets will be covered. In addition to the weekly

classes and bi-weekly homework assignments, students are required to complete a final group project and make a short presentation. Students taking this course do not need to have any prior programming experience.

ENTS649X: Series Special Topics in Networking

ENTS649A Special Topics in Networking: Optical Communication Networks
Optical communication has become a classic networking technology. This course will present the state-of-the art in optical communication networks and their applications. It will provide coverage of basic optical technology and networking topics, presented in a format that is easy to understand for practical engineers and networking specialists. The course will start with a broad coverage of different physical aspects of light propagation, basic components and modulation/demodulation methods, and fundamentals of the physical-layer design. It will then proceed with optical networking, starting with a description of technologies for which optical networking is used. The course will also provide an overview of next-generation SONET technologies along with optical transport network, the generic framing procedure, and Ethernet solutions. The IEEE new resilient packet ring (RPR) protocol will be discussed. Besides the theoretical coverage, the students will be engaged in developing their understanding of optical communication networking through hands on projects.

ENTS649B Special Topics in Networking: Cloud Computing
The course will present the state of the art in cloud computing technologies and applications. The course will explore potential research directions, as well as the technologies that will facilitate the creation of a global marketplace for cloud computing services that support scientific, industrial, business, and consumer applications. Topics will include: telecommunications needs; architectural models for cloud computing; cloud computing platforms and services; security, privacy, and trust management; resource allocation and quality of service; cloud economics and business models; pricing and risk management; interoperability and internetworking; legal issues; and novel applications. Course projects will expose students to different tools and technologies used to build and utilize clouds and the related security, privacy and trust management issues.

ENTS749X: Advanced Topics in Networking

ENTS749A Advanced Topics in Networking: Network Traffic and Application Performance Analysis
Prerequisite: ENTS 640. This graduate-level course covers the fundamentals of network traffic measurement and how the information in traffic traces can be used for different purposes. We will target an important use-case of traffic analysis which is application performance management. Due to the growing trend in online services, application performance management has become an important requirement for all organizations. Furthermore, maintaining the necessary infrastructure to guarantee acceptable user experience is critical to their success. This course will take a top-down approach by reviewing the basics of application and transport layer protocols as well as the effects of various network components on the performance of an application. Through lecture and lab sessions, students will learn different traffic measurement tools and how the traffic traces can be used to evaluate the performance of an application under different conditions. The

course also briefly discusses another use-case of traffic measurement i.e., network security, through hands-on experiments with available software packages. Cryptography and security fundamentals are not covered and they are presented in detail by other specialized courses.

ENTS749B Advanced Topics in Networking: Software Defined Networking
Prerequisite: ENTS 640 and ENTS 641. This advanced-level graduate course covers software-defined networking (SDN), its key principles, building blocks, and design as well as its recent applications and uses cases in industry. SDN is a new paradigm in telecommunications that re-thinks conventional network design/operations/abstractions and makes networks openly programmable, controllable, and affordable. SDN is widely accepted by industry as a game changer, with use in domains ranging from home networks to large-scale wide-area backbone networks. The objective of this course is to provide students with practical knowledge and in-depth understanding of SDN along with the ability to design and program the control plane of networks. Programming assignments and a project in this course provide students with opportunities to work hands-on with Python programming language and with popular open-source SDN tools. Students will gain familiarity with networking needs, opportunities, and challenges in environments such as data centers.

ENTS749C Advanced Topics in Networking: Vehicular Networks
Prerequisite: ENTS 640 and ENTS 622. Modern vehicles on roads and in air use telecommunication networking for enhancing their features, operations, controls, and performance. These "connected vehicles" have in-vehicle networks of embedded systems and can communicate with passenger carried devices, neighboring vehicles, and the Internet for new features and applications. This advanced topics course studies communication network principles, designs, protocols, and standards of connected vehicles and offers practical insight into this rapidly growing networking industry. Students get hands-on experience with building Python-based applications using automobile and aircraft networked embedded systems data. Students will also learn to simulate realistic vehicular networks (e.g., in ns-3 and Matlab).

ENTS749D Advanced Topics in Networking: Networking Design and Configuration Lab
Prerequisite: ENTS 640 and ENTS 641. This networking lab course will provide hands-on experience with the configuration and management of routers and switches in a real-world networking environment using Juniper Networks devices. Students will learn how to interact with networking devices through the Junos OS and how to navigate the command line interface (CLI). Topics will include router HW and SW architecture, interfaces, routing policies, static route configuration, configuring RIP and OSPF, VLANS and their configuration, firewall filters and security policies, class of service (CoS) management, network operation monitoring, and troubleshooting. During the lab sessions, students will write and test configurations for routers and switches given a set of network specifications, policies and conditions.

An example course sequence:

1. **ENTS 689N Special Topics: Network Programming** (3 credits)
2. **ENTS 649B Special Topics in Networking: Cloud Computing** (3 credits)
3. **ENTS 749B Advanced Topics in Networking: Software-Defined Networking** (3 credits)
4. **ENTS 749D Advanced Topics in Networking: Network Design and Configuration Lab** (3 credits)

IV. STUDENT LEARNING OUTCOMES AND ASSESSMENT MEASURES

Since this graduate certificate program will be embedded in the standard ENTS curriculum, the learning outcomes will also be similar to those of the ENTS program. The items relevant to the Graduate Certificate Program are as follows:

1. Academic outcome goals:
   - Students acquire specialized knowledge and skills in the technical area of computer networking.
   - Students acquire/develop practical problem-solving, programming and analytical skills necessary to succeed in industry.
2. Academic outcome assessment measures:
   - Percentage of students scoring B or higher in relevant elective courses
   - Percentage of students who work on course-related projects requiring programming
   - Percentage of students acquiring hands-on lab experience using state-of-the art networking equipment, network design, trouble-shooting and performance evaluation tools.
3. Non-academic outcome goals:
   - Diversity: The ENTS program promotes diversity and strives to admit and educate a diverse student population.
   - Degree completion and student retention: The ENTS program will make every effort to help its students from admission to degree completion and minimize the number of students who leave the program without a degree.
   - Quality of learning experience: The ENTS program will actively improve the student experience and increase its perceived value.
4. Non-academic outcome assessment measures:
   - Diversity: Percentage of female students; percentage of female faculty /instructors; percentage of minority faculty /instructors
   - Degree completion and student retention: Percentage of students who obtain the graduate certificate within two years after entering the program
   - Quality of learning experience: Graduate student to faculty ratio in the classroom; number of students receiving education in state-of-the art facilities/labs or using state-of-the-art tools; number of offered elective courses in computer networking

V. PROGRAM ADMINISTRATION

Administrative oversight and program management will be provided by ENTS staff. This includes student services, academic advising, marketing and outreach, program evaluation and assessment, and degree requirement verification.

A. Program Faculty

The courses for this certificate program are all ENTS courses, so they will be taught by ENTS instructors.

B. Program Offerings

The program will be wholly residential. There will be no off-campus locations nor distance/online education components.

VI. FINANCE (Budget Resources)

The ENTS program is a self-support unit and the Graduate Certificate in Computer Networking program will be administered through its resources.

VII. ADDITIONAL RESOURCES

A. Library

No additional resources are needed. See library assessment (Appendix A.)

B. Facilities

No new facilities are required.

C. Outside Academic Units

This program will not rely upon courses provided through other academic units.

D. Personnel

No new personnel are required. The new program will involve a small increase in administrative work for some staff. Existing staff members have experience in handling ENTS student records.

APPENDIX A: Library Assessment

DATE: April 7, 2016

TO: Kerrie Moyseenko

Program Coordinator, Masters in Telecommunications Program

FROM: On behalf of the University of Maryland Libraries:

Elizabeth Soergel, Engineering Librarian

Maggie Saponaro, Interim Head of Collection Development

Daniel Mack, Associate Dean, Collection Strategies & Services

RE: Library Collection Assessment

We are providing this assessment in response to a proposal by the Department of Electrical and Computer Engineering's Masters in Telecommunications program in the A. James Clark School of Engineering to create Graduate Certificate in Computer Networking. We were asked to assess our collections to determine how well the Libraries will be able to support the curriculum of this proposed graduate certificate. We offer the following assessment and conclude that the Libraries are able to support this program.

Serial Publications and Research Databases

The University of Maryland Libraries currently subscribe to a large number of scholarly journals, most in online format, that publish current research in areas relating to telecommunications and computer networking. Most articles in journals that we do not own electronically are available through either the Libraries' Article Express Program or via Interlibrary Loan. The Libraries' "Database Finder" offers online access to databases that provide indexing and access to popular and scholarly journal articles, and other information sources. Many of these databases cover subject areas that would be relevant to this proposed graduate certificate. These databases can be accessed remotely by authenticating using UMD login credentials.

Most of the relevant research is available through the following databases to which the Libraries subscribe:

- IEEExplore
- ACM Digital Library
- Web of Science

In addition, the general, multidisciplinary database Academic Search Complete provides information for nearly every area of academic study. Includes an enormous collection of the

most valuable peer-reviewed full text journals, as well as additional journals, magazines, newspapers and books.

As noted previously, in those instances in which either the Libraries do not subscribe to the journal or the journal articles are available only in print format, the Libraries can supply copies through the Libraries' Article Express Program or via Interlibrary Loan.

Monographs

The Libraries' current collection of books related to computer networking is sufficient to meet the needs of the program. The ongoing acquisition of scholarly books is expected to be adequately covered through existing acquisition practices and budgeting. As the University of Maryland already has a robust tradition of acquiring materials related to computer networking, current collection development practices in the Libraries should adequately support the new graduate certificate. Monographs not already part of the collection can usually be added upon request.

While electronic format books are typically purchased, students will be able to take some advantage of the print book collection by checking out these items or requesting specific chapters be sent to them through the Libraries' Article Express program. Faculty can also request, within fair use copyright guidelines, that sections of print books be made available digitally through course reserves.

Article Express and Interlibrary Loan

These services offer online delivery of bibliographic materials that otherwise would not be available online. Article Express and Interlibrary Loan are available free of charge. As a program developed specifically to support advanced research and teaching for graduate students and faculty, the Article Express service scans and delivers journal articles and book chapters within three business days of the student's request, provided that the items are available in print on the UM Libraries' shelves. In the event that an article or chapter is not available on campus, Article Express will automatically refer the request to Interlibrary Loan (ILL). Interlibrary Loan is a service that enables borrowers to obtain online articles and book chapters from materials not held in the University System of Maryland. In addition to chapters and articles, monographs not available through the UM Libraries can also be requested through Interlibrary Loan.

Conclusion

The University of Maryland Libraries' serials holdings and research databases have an established record for providing bibliographic support for researchers and professionals in subject disciplines that are relevant to computer networking. These materials are supplemented by relevant monograph collections. In addition, the Libraries' Article Express and Interlibrary Loan services make materials that otherwise would not be available online or through the UM Libraries. The Libraries also offer students a wide range of services to ensure their success.

APPENDIX A: Library Assessment

Additionally, the libraries are already supporting the Master of Science in Telecommunications, so no additional library resources should be necessary for the proposed graduate certificate, which compliments the Masters program. As a result, our assessment is that the University of Maryland Libraries are able to meet the curricular and research needs of the proposed Graduate Certificate in Computer Networking.

University Senate
TRANSMITTAL FORM

Senate Document #:	16-17-19
PCC ID #:	16010
Title:	Establish a Master of Quantitative Finance
Presenter:	Andrew Harris, Chair, Senate Programs, Curricula, and Courses Committee
Date of SEC Review:	October 19, 2016
Date of Senate Review:	November 2, 2016
Voting (highlight one):	1. On resolutions or recommendations one by one, or 2. In a single vote 3. To endorse entire report
Statement of Issue:	The Robert H. Smith School of Business proposes to offer a new Master of Quantitative Finance program. Students in this program will develop a rigorous understanding of how to apply mathematical and statistical models to financial securities and markets. The financial crisis on Wall Street and around the globe has shown that financial decision-making depends on building sophisticated models that facilitate better pricing of securities and more sophisticated risk management. The Smith School currently offers a Master of Finance degree, which will continue to be offered. The Master of Finance, which trains students interested in corporate finance and investment banking, is not sufficient for students interested in working in hedge funds or corporate risk management, which require significantly more mathematical and statistical modeling skills. Other universities have begun to offer programs in Quantitative Finance as prospective students are increasingly choosing finance programs that feature training in sophisticated computational and mathematical skills. The proposed program will require 36 credits composed of required courses and electives. Required courses include the following: BUSI640 Financial Management (2 Credits); BUFN650 Financial Mathematics (2 Credits); BUFN741 Advanced Capital Markets (2 Credits); BUFN745 Financial Programming (2 Credits);

	BUFN750 Valuation in Corporate Finance (2 Credits); BUGN758N and 758O Financial Econometrics I & II (2 Credits); and BUFN761 Derivative Securities (2 Credits). The elective courses (20 credits) will be offered in fields related to Asset Management, Advanced Mathematical Finance, Risk Management, Corporate Finance, and other areas in Finance. With the approval of the academic advisor, students may also choose up to 8 electives in related fields. No additional resources are requested for this program. The existing administrative and faculty resources that exist for the current Master of Finance program are sufficient to offer this program. This proposal was approved by the Graduate School Programs, Curricula, and Courses committee on September 26, 2016, and was approved by the Senate Programs, Curricula, and Courses committee at its meeting on October 7, 2016.
Relevant Policy # & URL:	N/A
Recommendation:	The Senate Committee on Programs, Curricula, and Courses recommends that the Senate approve this new degree program.
Committee Work:	The committee considered this proposal at its meeting on October 7, 2016. Michael Faulkender, Associate Professor of Finance, and Mike Marcellino, Assistant Dean of M.B.A. and M.S. programs for the Smith School, presented the proposal and responded to questions from the committee. After discussion, the committee voted unanimously to recommend the proposal.
Alternatives:	The Senate could decline to approve this new program.
Risks:	If the Senate declines to approve this new program, the university will lose an opportunity to use existing resources to create an academic program that meets a growing need in quantitative finance.
Financial Implications:	There are no significant financial implications with this proposal.
Further Approvals Required:	If the Senate approves this proposal, it would still require further approval by the President, the Board of Regents, and the Maryland Higher Education Commission.

THE UNIVERSITY OF MARYLAND, COLLEGE PARK
PROGRAM/CURRICULUM/UNIT PROPOSAL

- Please email the rest of the proposal as an MSWord attachment to pcc-submissions@umd.edu.
- Please submit the signed form to the Office of the Associate Provost for Academic Planning and Programs, 1119 Main Administration Building, Campus.

PCC LOG NO. 16010

College/School:
Please also add College/School Unit Code-First 8 digits: **01202900**
Unit Codes can be found at: https://hyperion.umd.edu/reports/units.htm

Department/Program:
Please also add Department/Program Unit Code-Last 7 digits: **1291501**

Type of Action (choose one):

- ☐ Curriculum change (including informal specializations)
  - ☐ Curriculum change for an LEP Program
- ☐ *Renaming of program or formal Area of Concentration*
- ☐ *Addition/deletion of formal Area of Concentration*
- ☐ *Suspend/delete program*
- ☒ *New academic degree/award program*
- ☐ New Professional Studies award iteration
- ☐ New Minor
- ☐ Request to create an online version of an existing program

Italics indicate that the proposed program action must be presented to the full University Senate for consideration.

Summary of Proposed Action:

The Robert H. Smith School of Business proposes launching a Masters in Quantitative Finance (MQF) program designed to provide students with a rigorous understanding of how to apply mathematical and statistical models to financial securities and markets. The financial crisis on Wall Street and around the globe has forever changed the way we think about finance. Now more than ever, financial decision making depends on building sophisticated models that facilitate better pricing of securities and more sophisticated risk management. Students who complete the MQF degree will possess the knowledge and skills necessary to address the challenges confronting financial decision makers and financial market participants.

Departmental/Unit Contact Person for Proposal: _____

APPROVAL SIGNATURES - *Please print name, sign and date. Use additional lines for multi-unit programs.*

1. Department Committee Chair MARK TARANTO Mark Taranto
2. Department Chair V. Makismovic. Vojislav Makismovic
3. College/School PCC Chair Michael Faulkender M Faulkender 7/13/2016
4. Dean A. J. Triantis, ALEX TRIANTIS, 7/14/2016
5. Dean of the Graduate School (if required) _____
6. Chair, Senate PCC _____
7. University Senate Chair (if required) _____
8. Senior Vice President and Provost _____

PROPOSAL FOR
NEW INSTRUCTIONAL PROGRAM
UNIVERSITY OF MARYLAND AT COLLEGE PARK, MARYLAND
MASTERS IN QUANTITATIVE FINANCE (MQF)

ROBERT H. SMITH SCHOOL OF BUSINESS

DEAN Alex Triantis

MASTERS IN QUANTITATIVE FINANCE

Award to Be Offered Fall 2017

I. OVERVIEW and RATIONALE

A. Briefly describe the nature of the proposed program and explain why the institution should offer it. [You may want to refer to student demand, market demand for graduates, institutional strengths, disciplinary trends, synergy with existing programs, and/or institutional strategic priorities.]

Goal and Contribution to the Strategic Plan

The Robert H. Smith School of Business proposes launching a Masters in Quantitative Finance (MQF) program designed to provide students with a rigorous understanding of how to apply mathematical and statistical models to financial securities and markets. The financial crisis on Wall Street and around the globe has forever changed the way we think about finance. Now more than ever, financial decision making depends on building sophisticated models that facilitate better pricing of securities and more sophisticated risk management. Students who complete the MQF degree will possess the knowledge and skills necessary to address the challenges confronting financial decision makers and financial market participants.

The Robert H. Smith School of Business houses one of the strongest academic finance departments in the world as well as the Center for Financial Policy (CFP). The research and experience of the faculty are particularly suited to attract some of the brightest students in the world who are seeking a more thorough understanding of how to rigorously model financial issues and markets. Faculty and staff currently affiliated with the Robert H. Smith School of Business and the Center for Financial Policy hold appropriate degrees in finance, mathematics, and economics that are relevant and necessary for the Quantitative Finance Master's degree. One of our faculty members, Dilip Madan, was previously the Managing Editor of the academic journal *Mathematical Finance* and is still a member of the advisory board for that journal.

The mission of the Robert H. Smith School of Business is to "create knowledge, promote a learning environment that fosters intellectual discovery, and equip current and future leaders to assess complex problems and deliver innovative solutions." The University of Maryland College Park mission statement sets a goal to "continue to build a strong, university-wide culture of graduate and professional education" and to provide knowledge-based programs and services that are responsive to the needs of the citizens of the state and the nation. Faculty and students in the Masters of Quantitative Finance program will be exposed to the increasingly complex nature of financial products and markets. Given UMCP's proximity to the nation's capital, our facility in Washington DC, and the significant changes in financial regulation resulting from the Dodd-Frank financial reform bill, we are in a unique position to offer students opportunities unmatched by competitor institutions.

The School currently offers a Master of Finance (MFin) degree. The program generates a strong applicant pool every year and has been well-received in the marketplace, both for applicants and placement. However, some of our students would benefit from an even more mathematically rigorous program and degree. While students interested in corporate finance or investment banking are sufficiently served by the current degree program, those interested in working for hedge funds or doing financial institution risk management require significantly more mathematical and statistical modeling skills. This proposed degree program fills that gap in the school's degree portfolio. In addition, greater competition for these students necessitates ongoing innovation in our degree portfolio. We believe that demand for this proposed program will facilitate maintaining our graduate finance population at levels we have realized the past four years.

The Smith School also offers joint Specialty Masters and MBA degrees in several fields. We also seek to offer an option for a joint MQF-MBA degree.

This program is also an ideal path for some of our students to pursue PhD programs in finance. Many of our MFin graduates have gone on to pursue their PhD degree, including our own PhD program. Given that PhD programs in finance are highly mathematical, students obtaining an MQF degree would be even better prepared to pursue PhD level work. Having a Masters in Quantitative Finance will likely improve the marketability of our students seeking to pursue a PhD specializing in finance.

Market Demand for Graduates

In light of the financial crisis, employers are looking for finance specialists who have a thorough understanding of how to mathematically model financial products. Proper risk management conducted by financial institutions requires understanding the factors that will alter prices and the dynamics of the markets in which those securities trade. Hedge fund management is entirely about modeling the movements of securities and forming portfolios to trade on those movements in ways that mitigate risk but still generate trading profits. Both of these actions require sophisticated understanding of mathematical and statistical models that have been applied to financial products and markets. Many of our existing MFin students find placement in these jobs and we anticipate that an even more rigorous set of courses as well as better differentiating our students for potential employers will enhance the placement success that we have realized.

Student Demand

Business schools are undergoing a significant shift in the applicant pool for Master's degree programs. Applications for traditional MBA programs that provide a general management focus have seen a sustained reduction nationwide. Contemporaneously, more students are seeking Master's degrees that specialize in a particular business field, particularly finance and accounting. More recently, we are seeing even greater competition in the specialized Masters portfolios of schools. For instance, Washington University in St. Louis offer both a Master of Science in Finance as well as a Master of Science in Quantitative Finance. Georgetown University recently launched an online Master of Finance program. Schools such as Fordham University, Rutgers University, and the University of Minnesota currently or are about to offer Masters degrees in Quantitative Finance (CIP code 27.0305). In our most recent admissions cycle, five students declined our offer of admission so that they could instead attend the MQF program at Fordham University. We anticipate interest in this degree program to continue its growth and would like to be the premier institution offering such a degree.

Student demand for a Master's in Finance program is high. For the 2015-2016 academic year, we received 1,128 applications and had 129 students register in our MFin program. For the 2014-2015 academic year, we received 1,380 applications. As these statistics demonstrate, the market is becoming more competitive and we must remain attractive. Admitted student statistics demonstrate the quality of students demanding this offering:

	Fall 2015	Fall 2014
Average GMAT	709	712
Average GPA	3.5	3.5

B. How big is the program expected to be? From what other programs serving current students, or from what new populations of potential students, onsite or offsite, are you expecting to draw?

Enrollment in our Master of Finance degree (MFin) has recently ranged between 129 and 220. Our goal is approximately 180 newly admitted students per year. If this new program is approved, we would anticipate staying at a goal of 180 students per year, with approximately 120 in the Master of Finance program and 60 in the Master of Quantitative Finance program.

Most of the students we attract to this program are international, primarily from East Asia. The strategic plan for this program seeks to expand domestic enrollment, primarily by targeting students receiving Bachelor's degrees in mathematics, statistics, and physics who are looking for an opportunity to apply their skill set to the financial industry. We have recently launched dual degree programs that facilitate UMCP undergrads getting their Bachelor's and Master of Finance degrees in four to five years. We would anticipate creating a dual degree option for the MQF, if approved.

II. CURRICULUM

A. Provide a full catalog description of the proposed program, including educational objectives and any areas of concentration.

The Masters in Quantitative Finance degree (MQF) is a professional degree for students wishing to pursue careers in money management, financial research, risk management, and financial market regulation. Core courses provide excellent fundamentals in the economic, statistical, and mathematical models used in the finance industry. Our electives will allow students the flexibility to become specialists within these career paths.

The proposed MQF program offered by the Robert H Smith School of Business will provide students with:

a) Comprehensive knowledge of foundational financial concepts, products, and financial market structure necessary for engaging in any form of analytical financial analysis.
b) In-depth understanding of the mathematical models that are widely used in pricing financial securities
c) The statistical models used to parameterize these mathematical models
d) Analytical skills including detailed financial modeling, the ability to design and empirically estimate financial relationships, and simulation methods to understand risk and return tradeoffs
e) Knowledge of the legal and ethical issues related to financial management and an understanding of the role of all stakeholders when capital allocation decisions are made
f) An understanding of the regulatory structure of financial markets and the role that policymakers and regulators play in the efficient operation of financial markets
g) Skills that will endure beyond the next business cycle and that facilitate institutional sustainability, even during times of economic downturn
h) Expertise in financial management that will make our students valuable contributors to a variety of employers and organizations in diverse communities

B. List the courses (number, title, semester credit hours) that would constitute the requirements and other components of the proposed program. Provide a catalog description for any courses that will be newly developed or substantially modified for the program.

Students will enter the MQF program with a Bachelor's degree. The proposed MQF program requires 36 credit hours comprised of core courses (16 credits) and electives (at least 20 credits). Completion of the degree is feasible within one academic year though many students may choose to spread their coursework over two academic years to offer an opportunity to gain experience from an internship during the summer.

The Smith School also offers joint Specialty Masters and MBA degrees in several fields. We also seek to offer an option for a joint MQF-MBA degree.

While not required, some students may pursue the option of writing a master's thesis as part of reaching their 36 credit hours requirement. Others may take advantage of experiential learning opportunities for

course credit. In both cases, such credit would be limited to 8 credit hours and be overseen by a faculty member. Appendix 2 provides a curriculum comparison of the Finance Programs offered by our peers.

Core Courses
Course descriptions are provided below. All core courses are currently 2 credits.

BUSI 640 Financial Management: The course outlines the financial concepts and mathematical techniques used to evaluate corporate decisions. The topics include the time value of money, valuation of common securities, discounted cash flow, estimating opportunity costs of capital, and capital structure. The objectives are to introduce the language and structure of finance and to develop the tools to analyze financial decisions.

BUFN 650 Financial Mathematics: Introduction to the mathematical models used in finance and economics with emphasis on pricing derivative instruments. Topics include elements from basic probability theory, distributions of stock returns, elementary stochastic calculus, Ito's Lemma, arbitrage pricing theory, and continuous time portfolio theory. Particular focus is on the financial applications of these mathematical concepts.

BUFN741 Advanced Capital Markets: Building upon the financial mathematics course, this class provides an introduction to the mathematical and statistical models used to price securities and analyze financial markets. Topics include portfolio theory, asset pricing, market efficiency, fixed income, options and futures.

BUFN 745 Financial Programming: Building upon the statistical programming foundations in Econometrics, this course introduces students to advanced programming in Matlab, SAS, R, and Python with specific applications to financial modeling. Applications potentially include estimating interest rate models, developing derivatives pricing models, backtesting financial strategies using large datasets, and scraping of financial data off the internet. In addition, students will gain competency in financial platforms such as those provided by Bloomberg.

BUFN 750 Valuation in Corporate Finance: This is an advanced topics course in quantitative corporate finance focusing on valuation. The main objective is to apply the concepts covered in the introductory finance class through real-life applications (cases). The topics include building Pro Forma statements and forecasting future cash flows, dynamic cash flow models, estimating the cost of capital, implementing the Weighted Average Cost of Capital (WACC) and Adjusted Present Value (APV) methods, and using real options techniques (binomial and Black and Scholes models as well as Monte Carlo simulations) to value companies and projects.

BUFN 758N and 758O Financial Econometrics I/II: Introduces the skills and computing languages for analyzing financial data and testing financial models. The course includes linear optimization for use in factor models, the statistical properties of asset returns, event studies, time series analysis and models of stochastic volatility. The course will include theory mixed with several finance applications in widely used statistical languages.

BUFN 761 Derivative Securities: Introduces options and futures contracts, and the mathematical foundations of their valuation. Topics include binomial model, Black-Scholes model, delta hedging, and convexity. Derivative securities on various underlying assets (equities, indices, commodities, foreign exchange, etc.) are analyzed, using different application contexts.

Elective Courses

All BUFN courses listed below are 2 credit courses. In addition to these finance electives and upon approval of the academic advisor, students may take up to eight credits in related fields, including those referenced below. Elective courses within finance are listed by topic:

Asset Management

BUFN 760 Applied Equity Analysis: Applies financial models and statistical tools to the analysis and valuation of equity securities. In addition to focusing on economic (DCF based) analysis of corporations, the course covers topics such as the EIC (Economy/Industry/Company) framework, financial statement analysis, relative value analysis, and contingent value analysis. Students will apply statistical tools to value stocks and provide stock recommendations.

BUFN 762 Fixed Income Analysis: Focuses on economic and mathematical models of financial instruments whose market values are tied to interest rate movements. Develops tools such as discount functions, duration, convexity, and immunization to analyze the interest rate sensitivity and value of fixed income securities and portfolios. A variety of fixed income securities are examined, particularly zero coupon and coupon bearing bonds.

BUFN 763 Portfolio Management: Examines the theory and application of portfolio management techniques in detail, including the use of various asset classes in constructing efficient portfolios. Various risk and performance measurements for portfolios are examined, drawing on classic portfolio theory, as well as more recent index and factor models. The course develops tools for quantitative portfolio management, including computation and simulation methods.

BUFN 764 Quantitative Investment Strategies: Provides an advanced treatment of asset allocation strategies and performance evaluation. Quantitative techniques are applied to examine equity and fixed-income portfolio management strategies. The course provides a deeper understanding of the measurement of risk and its relationship to return, as well as of multi-factor models. Implementation issues, including statistical estimation, backtesting and portfolio construction, are covered, as are strategic versus tactical asset allocation, and performance evaluation.

BUFN 773 Institutional Asset Management: Examines how money is managed by organizations such as university endowments, pension funds, mutual funds, hedge funds, and private equity funds. Emphasizes the incentives professional money managers face within the context of the organizational structure in which they operate. Particular attention will be paid to compensation structures and monitoring mechanisms.

BUFN 774 Market Microstructure: The course examines---from theoretical, institutional, and empirical perspectives---how prices in speculative markets are determined by the interaction of traders. Topics covered include market making, informed trading strategies, liquidity, bid-ask spreads, transactions costs, market impact, price manipulation, and high-frequency trading. The course examines markets for equities, bonds, commodities, and foreign exchange. There are several empirical exercises using transactions data.

Advanced Mathematical Finance

BUFN 765 Fixed Income Derivatives: Introduces the use and valuation of fixed income assets such as exchange-traded bond futures and options, forward contracts on interest rates, fixed and floating rate bonds with embedded options, floating rate notes, caps, collars, floors, interest rate swaps, and mortgage

backed securities. Tools include the application of binomial option pricing trees, and the analysis of stochastic yield curves.

BUFN 766 Financial Engineering: Introduces and applies various computational techniques useful in the management of equity and fixed income portfolios and the valuation of financial derivatives and fixed income securities. Techniques include Monte Carlo Simulation and binomial/lattice pricing models. Emphasis is on bridging theory with the design of algorithms and models that can be directly applied in practice.

BUFN 767 Applied Conic Finance: This advanced course applies conic theory to the field of finance including applications such as portfolio theory, dynamic hedging, structured products, derivatives and construction of dynamic trading strategies.

Risk Management

BUFN 754 Corporate Risk Management: Explores the theory and practice of financial risk identification, modeling, statistical measurement, and mitigation of risk at financial and non-financial firms. Topics include hedging with options and futures, interest rate risk management, Value-at-Risk (VaR), Cashflow-at-Risk (CaR), Earnings-at-risk (EaR), credit risk, equity risk, commodities risk, exchange rate risk, and lessons from risk management disasters.

BUFN 772 Bank Management: Examines the economic role and regulation of banks and other financial institutions, and the structure of assets, liabilities and capital in these institutions. Tools are presented to analyze the various risks faced by banks, including interest rate risk, market risk, operational risk and off-balance sheet risk. Topics also include liquidity risk, liability risk, reserve management, deposit insurance, and capital requirements.

BUFN 758R Special Topics in Finance: Financial Risk Management: This course surveys the theory and practice of financial risk management focusing on identification, measurement, and mitigation of risks associated with financial institutions. It focuses on the risk of a stylized large systemically important financial institution (Sifi Bank) using synthetic transactions and portfolios allowing the student to directly apply various concepts using a variety of models and Excel/VBA tools to test their sensitivity to important changes in assumptions.

Corporate Finance

BUFN 751 Financial Strategy for Corporations: An advanced course in corporate finance, focusing on the issues that firms face when they plan to raise external capital from financial markets. The focus is on the financing problems faced by mid-market to large firms and on capital raised from public markets. The forms of external finance vary from simple debt or equity to more complex securities that bundle with an element of risk management.

BUFN 752 Financial Restructuring: Examines alternative ways to increase firm value through corporate restructuring, including domestic and international acquisitions, spin-offs, carve-outs, and leveraged buy-outs. Focus is on theory, practice, and empirical evidence related to each of these forms of restructuring, and emphasis is placed on mathematical models use to conduct valuation analysis and evaluate strategic considerations.

BUFN 753 Corporate Governance: Examines corporate governance and its impact on shareholder value. Topics include conceptual foundation for corporate governance, the role and duties of the board of directors, indicators of board effectiveness and best practices, design features of executive compensation

contracts, the significance and prevalence of stock options, the perverse incentives of stock options and controversy over compensation practices, corporate governance failures and anatomy of corporate scandals, the essentials of the Sarbanes-Oxley Act, Dodd-Frank, and other regulatory reforms.

BUFN 755 Entrepreneurial Finance and Private Equity: Explores advanced topics in corporate finance, with major emphasis on how financiers help firms plan for growth and develop finance strategies firms use for different types of securities at different points in the industry's and firm's life. Securities will include private financing and placements, Venture Capital (VC), Initial Public Offerings (IPOs), Private Equity and Leveraged Buyouts.

Other Finance Courses

BUFN 770 International Investment: Addresses exchange rates, international interest rates, exchange rate derivatives (such as forwards, futures, swaps, and options), and international stock markets. Applications may include dynamic exchange rate hedging, and portfolio optimization under country constraints.

BUFN 771 International Corporate and Project Finance: Focuses on the role of financial management in the multinational firm, and the financing and management of international projects. Topics include international capital budgeting, global cost of capital, project financing, and the measurement and management of exchange rate exposure by corporations.

BUFN 758? Special Topics in Finance: Experiential Learning Project: These courses allow students to work under the direction of a faculty member on applied projects done in partnership with outside organizations and corporations. Recent partners include Freddie Mac, Danaher, the World Bank, FINRA, and the Securities and Exchange Commission.

Electives outside of Finance:

AMSC 460 Computational Methods: Basic computational methods for interpolation, least squares, approximation, numerical quadrature, numerical solution of polynomial and transcendental equations, systems of linear equations and initial value problems for ordinary differential equations. Emphasis on methods and their computational properties rather than their analytic aspects. Intended primarily for students in the physical and engineering sciences.

AMSC612 Numerical Methods in Partial Differential Equations: Finite difference methods for elliptic, parabolic, and hyperbolic partial differential equations. Additional topics such as spectral methods, variational methods for elliptic problems, stability theory for hyperbolic initial-boundary value problems, and solution methods for conservation laws.

AMSC670 Ordinary Differential Equations I: Existence and uniqueness, linear systems usually with Floquet theory for periodic systems, linearization and stability, planar systems usually with Poincare-Bendixson theorem.

AMSC673 Partial Differential Equations I: Analysis of boundary value problems for Laplace's equation, initial value problems for the heat and wave equations. Fundamental solutions, maximum principles, energy methods. First order nonlinear PDE, conservation laws. Characteristics, shock formation, weak solutions. Distributions, Fourier transform.

AMSC674 Partial Differential Equations II: Boundary value problems for elliptic partial differential equations via operator-theoretic methods. Hilbert spaces of functions. Duality, weak convergence. Sobolev spaces. Spectral theory of compact operators. Eigenfunction expansions.

AMSC 808 Advanced Topics in Applied Mathematics

BUDT758B Special Topics in Decision, Operations and Information Technologies; Big Data

BUDT758P Special Topics in Decision, Operations and Information Technologies; Decision Analytics

BUDT758T Special Topics in Decision, Operations and Information Technologies; Data Mining and Predictive Analytics

STAT600 Probability Theory I: Probability space; distribution functions and densities; Poissson limit theoreom; de Moivre-Laplace theorem; measure-theoretic definition of expectation; classification of measures on R; convergence of random variables; Radon-Nikodym theorem;LP spaces; conditional probabilities; independence of events, sigma-algebras and random variables; Bayes' theo rem; pi-systems and Dynkin systems; discrete Markov chains; random walks; gambler's ruin problem; Markov chains on a general phase space; Borel-cantelli lemmas; Kolmogorov inequality; three series theorem; laws of large numbers.

STAT601 Probability Theory II: Weak convergence of measures; characteristic functions; Central Limit Theorem and local limit theorem; stable laws; Kolmogorov consistency theorem (without proof); conditional expectations and martingales; optimal stopping theorem; convergence of martingales; Brownian motion; Markov processes and families; stochastic integral and Ito formula.

STAT650 Applied Stochastic Processes: Basic concepts of stochastic processes. Markov processes (discrete and continuous parameters), Random walks, Poisson processes, Birth and death processes. Renewal processes and basic limit theorems. Discrete time martingales, stopping times, optional sampling theorem. Applications from theories of stochastic epidemics, survival analysis and others.

STAT700 Mathematical Statistics I: Sampling distributions including noncentral chi-squared, t, F. Exponential families, completeness. Sufficiency, factorization, likelihood ratio. Decision theory, Bayesian methods, minimax principle. Point estimation. Lehmann-Scheffe and Cramer-Rao theorems. Set estimation.

STAT705 Computational Statistics: Modern methods of computational statistics and their application to bot practical problems and research. S-Plus and SAS programming with emphasis on S-Plus. S-Plus objects and functions, and SAS procedures. Topics include data management and graphics, Monte Carlo and simulation, bootstrapping, numerical optimization in statistics, linear and generalized linear models, nonparametric regression, time series analysis.

Sample Student Schedule

Below are tables showing how a typical MQF student can complete the required coursework over a three-semester period as a full-time student and over a two-year time period as a full-time student. The courses listed below are all currently two-credit courses which are scheduled as half semester courses (7 weeks). The meeting times are one hour and fifty minutes in duration and meet twice a week so each course will meet the following total number of contact hours: 14 sessions X 1:50 per meeting = 25 hours & 40 minutes.

Student Schedule for Full-time MQF, completed in three semesters

Fall A	Fall B	Spring C	Spring D
BUSI 640* BUFN 758N* BUFN 650*	BUFN 741* BUFN 758O* BUFN 772	BUFN 750* BUFN 761* BUFN 745*	BUFN 753 BUFN 754 BUFN 762
BUFN 763 BUFN 774 BUFN 758R	BUFN 764 BUFN 765 BUFN 766		

Student Schedule for Full-time MQF, completed in two years

	Fall A	Fall B	Spring C	Spring D
First Year	BUSI 640* BUFN 758N* BUFN 650*	BUFN 741* BUFN 758O*	BUFN 750* BUFN 761* BUFN 745*	BUFN 754 BUFN 762
Second Year	BUFN 774 BUFN 763	BUFN 764 BUFN 765	BUFN 766 BUFN 773	BUFN 758R BUFN 753

*Core MQF Course

C. Describe any selective admissions policy or special criteria for students selecting this field of study.

Applicants to the MQF program must have completed all of the requirements for a baccalaureate degree prior to their acceptance into the program, with particular emphasis on the student having sufficient mathematical background. All applicants must submit: Transcripts from all undergraduate and graduate institutions that have been previously attended, Graduate Record Examination (GRE) scores or the Graduate Management Admissions Test (GMAT) scores, a complete online application form that includes a written essay articulating qualifications and motivation for pursuing advanced education, two letters of recommendation from supervisors or from professors competent to judge the applicant's probability of success in graduate school.

In addition, an admissions interview may be required. After initial screening, the Admissions Office may select candidates for interviews which may be done in person or by telephone. Proof of English language proficiency (TOEFL or IELTS official scores) is also required unless the applicant has received an undergraduate or graduate degree from a select list of countries. For international student needing an F1 visa, a completed certification of finance form and supporting financial documentation are required.

In addition to Graduate School requirements, admission decisions for the MQF program will be based on the quality of previous undergraduate and graduate course work (if applicable), the strength of Graduate

Record Examination scores or the Graduate Management Admissions Test scores, the relevance of prior work and research experience, and the congruence of professional goals with those of the program. Students should submit application materials for the fall semester by April 1. This program does not accept applications for Spring semester admission.

D. STEM CERTIFICATION

STEM is an acronym for Science, Technology, Engineering, and Mathematics. The Master of Quantitative Finance (MQF) program is designed to prepare students for productive careers in our high-tech global economy, therefore numerous courses embrace and include the integration of one or more of these STEM areas, particularly technology and mathematics.

The foundation of financial securities analysis is a set of mathematical and statistical models that estimate the relationships between the risks of a security with its expected return. Mastering these models requires rigorous courses in mathematics, statistics, and computational methods, with applications to finance. Our proposed degree program exposes students to these tools, primarily focused on those commonly used in financial institutions.

The Master of Quantitative Finance (MQF) should qualify to be assigned an approved STEM Classification of Instructional Programs (CIP) code of 27.0305, Financial Mathematics.

III. STUDENT LEARNING OUTCOMES AND ASSESSMENT

List the program's learning outcomes and explain how they will be measured and assessed

Learning Outcome 1: Knowledge of Business Functional Areas. *Smith MQF graduate students understand key principles underlying the functional areas of finance.*

o Rigorously model time value of money analyses and determine capital structure
o Use mathematical and statistical models to characterize capital markets
o Value financial securities
o Analyze derivatives markets

Learning Outcome 2: Integrative Knowledge. *Smith MQF graduate students apply learned concepts*

o Apply accounting concepts to discounted cash flow models
o Apply concepts in Economics to defend valuation analyses

Learning Outcome 3: Analytical Thinking. *Smith MQF graduate students evaluate and articulate investment strategy and opportunities*

o Evaluate investment opportunities using computational methods and simulations
o Articulate economic trade-offs for investors in financial securities

Learning Outcome 4: Statistical Proficiency. *Smith MQF graduate students demonstrate statistical knowledge through interpreting financial models*

o Apply statistical methods to financial decision making
o Use economic techniques to parameterize financial models

For all learning objectives, the measures, criterion and method of assessment are:

Measure:	Students will be required to pass a set of questions delivered as part of the final exam in each core course.
Criterion:	At least 90% of students will receive an average rating of "Meets Standards" or better on the core course final exam questions. The Academic Director will meet with students rated below "Meets Standards" to help improve their performance or determine their continued participation in the program.
Assessment:	Every Year, starting in the 2017-2018 academic year.

IV. FACULTY AND ORGANIZATION

A. Who will provide academic direction and oversight for the program? [This might be a department, a departmental subgroup, a list of faculty members, or some other defined group.]

Primary oversight of this program will be provided by a faculty member assigned as the director of the program. A committee of faculty members has been created to address issues including admissions, academic policies, student activities, and internship / placement opportunities. The program would also be overseen by the chair of the finance department and the Dean's office.

The finance department of the Robert H Smith School of Business currently has 28 FTE faculty. Twenty-two of these are tenure / tenure track. All of these twenty-two faculty have doctoral degrees in economics, finance, or industrial engineering. Six additional clinical faculty also have graduate degrees in economics, finance, or business.

Finance Faculty Expected to Teach in the Proposed MFin Program

Alex Triantis, PhD, Professor of Finance and Dean
Teaching / research focus: corporate finance, risk management, real options
Course: BUSI 640 Financial Management
BUFN 750 Valuation in Corporate Finance

Vojislav Maksimovic, PhD, Dean's Chair Professor of Finance and Area Chair
Teaching / research focus: corporate finance, industrial organization, international finance
Course: BUFN 752: Corporate Restructuring

Michael Faulkender, PhD, Associate Professor of Finance and MFin Director
Teaching / research focus: empirical corporate finance, risk management, executive compensation
Course: BUFN 751 Financial Strategy For Corporations

Mark Taranto, PhD, Associate Clinical Professor and MFin Academic Director
Teaching / research focus: empirical corporate finance
Courses: BUFN 765 Fixed Income Derivatives
BUFN 766 Financial Engineering

Gurdip Bakshi, PhD, Dean's Professor of Finance
Teaching / research focus: asset pricing, international finance, fixed income, derivatives
Course: BUFN 740 Capital Markets
BUFN 770 International Investment

Steve Heston, PhD, Professor of Finance
Teaching / research focus: asset pricing, derivatives, volatility, international finance
Courses: BUFN 770 International Investment
BUFN 771 International Corporate and Project Finance

Albert "Pete" Kyle, PhD, Charles E. Smith Chair Professor of Finance
Teaching / research focus: asset pricing, market microstructure
Course: BUFN 774 Market Microstructure

Dilip Madan, PhD, Professor of Finance, former Managing Editor of *Financial Mathematics*
Teaching / research focus: asset pricing, mathematical finance, derivatives
Course: BUFN 767 Applied Conic Finance

Lemma Senbet, PhD, William E. Mayer Chair Professor of Finance
Teaching / research focus: corporate governance, financial institutions, international finance
Course: BUFN 753 Corporate Governance

N.R. Prabhala, PhD, Professor of Finance
Teaching / research focus: empirical corporate finance, executive compensation
Course: BUFN 751 Financial Strategy For Corporations

Haluk Unal, PhD, Professor of Finance
Teaching / research focus: financial institutions and banking, executive compensation
Course: BUFN 762 Fixed Income Analysis

Russ Wermers, PhD, Professor of Finance, Director: Center for Financial Policy
Teaching / research focus: empirical asset pricing, institutional money management
Courses: BUFN 764 Quantitative Investment Strategies

Mark Loewesnstein, PhD, Associate Professor of Finance
Teaching / research focus: theoretical asset pricing, portfolio selection
Course: BUFN 763 Portfolio Management

Richmond Matthews, PhD, Associate Professor of Finance
Teaching / research focus: theoretical corporate finance, corporate governance
Course: BUFN 752 Corporate Restructuring

Cecilia Bustamante, PhD, Assistant Professor of Finance
Teaching / research focus: theoretical corporate finance
Course: BUFN 750 Valuation in Corporate Finance

Julien Cujean, PhD, Assistant Professor of Finance
Teaching / research focus: Asset Pricing, General Equilibrium, Information Economics, Liquidity
Course: BUFN 761: Derivative Securities

Francesco D'Acunto, PhD, Assistant Professor of Finance
Teaching / research focus: empirical corporate finance
Course: BUFN 755 Entrepreneurial Finance and Private Equity

Laurent Fresard, PhD, Assistant Professor of Finance
Teaching / research focus: empirical corporate finance, international corporate finance
Course: BUFN 750 Valuation in Corporate Finance
BUSI 640 Financial Management

William Mullins, PhD, Assistant Professor of Finance
Teaching / research focus: empirical corporate finance
Course: BUFN 751 Financial Strategy For Corporations

Alberto Rossi, PhD, Assistant Professor of Finance
Teaching / research focus: empirical asset pricing, financial econometrics
Courses: BUFN 758N Financial Econometrics I
BUFN 758O Financial Econometrics II

Shrihari Santosh, PhD, Assistant Professor of Finance
Teaching / research focus: empirical asset pricing
Courses: BUFN 740 Capital Markets

Yajun Wang, PhD, Assistant Professor of Finance
Teaching / research focus: theoretical and empirical asset pricing, market microstructure
Course: BUFN 740 Capital Markets

Liu Yang, PhD, Assistant Professor of Finance
Teaching / research focus: empirical corporate finance
Course: BUSI 640 Financial Management

David Kass, PhD, Clinical Professor
Teaching / research focus: corporate finance, industrial organization
Course: BUFN 752 Financial Restructuring

Elinda Kiss, PhD, Associate Clinical Professor
Teaching / research focus: financial institutions, bank regulation
Course: BUFN 772 Bank Management

Sarah Kroncke, MBA, Senior Lecturer
Teaching / research focus: investment banking, equity analysis
Courses: BUFN 760 Applied Equity Analysis

Cliff Rossi, PhD, Professor of the Practice
Teaching / research focus: financial institutions, risk management
Courses: BUFN 754 Corporate Risk Management
BUFN 761 Derivative Securities
BUFN 772 Bank Management

Susan White, PhD, Clinical Professor
Teaching / research focus: corporate finance, taxes and payout policy
Courses: To be Determined

B. If the program is not to be housed and administered within a single academic unit, provide details of its administrative structure. This should include at least the following:

Not applicable. All classes will be housed and administered within the Robert H Smith School of Business

V. OFF CAMPUS PROGRAMS

A. If the program is to be offered to students at an off-campus location, with instructors in classrooms and/or via distance education modalities, indicate how student access to the full range of services (including advising, financial aid, and career services) and facilities (including library and information facilities, and computer and laboratory facilities if needed) will be assured.

In addition to holding classes on the UMCP campus, some sections of the program may meet at our DC location in the US Department of Commerce building, our Baltimore facility in the Baltimore BioPark, or our facility at the Universities of Shady Grove. Those facilities already contain adequate classrooms, computer facilities, study rooms, and administrative space for academic advising, career advising, and student activity support.

B. If the program is to be offered mostly or completely via distance education, you must describe in detail how the concerns in Principles and Guidelines for Online Programs are to be addressed.

Currently, the program is structured to be entirely delivered in a traditional classroom setting. Over time, we may evaluate online learning opportunities, but nothing is currently scheduled. Should we move towards some courses being offered online, all online courses would adhere to the policies and concerns outlined in the University of Maryland document, Principles and Guidelines for Online Programs.

Program Development, Control and Implementation Would Be By Faculty - The faculty would have overall control over the design, development, and will have the overall bulk of any online academic instruction. Smith school technical support personnel would be available, as well as agreements with the off-campus sites for technical support during classroom hours. Support will be available to faculty during course development, as well as during the offering of the program.

VI. OTHER ISSUES

A. Describe any cooperative arrangements with other institutions or organizations that will be important for the success of this program.

Not applicable. All aspects of the program from admissions to academic programming to career advising will be provided by the Robert H Smith School of Business. While the program will reach out to local companies and institutions for guest speakers, internship opportunities, experiential learning projects, and job placement, no particular relationship is pivotal to the success of the program.

B. Will the program require or seek accreditation? Is it intended to provide certification or licensure for its graduates? Are there academic or administrative constraints as a consequence?

The University of Maryland's Robert H. Smith School of Business is already accredited by the AACSB (American Association of Collegiate Schools of Business). No accreditation is sought for this individual program.

VII. COMMITMENT TO DIVERSITY

Identify specific actions and strategies that will be utilized to recruit and retain a diverse student body.

The Robert H. Smith School of Business community is multifaceted at every level – students, staff and faculty represent a diverse blend of backgrounds, nationalities, ethnicities and experiences. About a dozen Smith School and student clubs are focused on bringing members together who have similar interests in gender, nationality, religion, and sexual orientation.

To attract the most diverse population possible for the proposed Master of Quantitative Finance program, Smith School recruiting staff will focus on domestic efforts. These efforts will be targeted at recruiting U.S. minorities and American women of all ethnicities.

Current efforts include:

- Representing Masters programs in U.S. MBA and Masters Fairs and Tours
- Representing Masters programs in International MBA and Masters Fairs and Tours
- Online Chats
- U.S. College Visits
- International College Visits
- GMASS-based Mailings
- GRE-based Mailings
- Direct Mail
- Email Campaigns
- Outreach to College and Campus Organizations and Clubs
- Participating in Career/Graduate Study Panels or Workshops
- Presentations at Professional Conferences
- Creation of "Leap Your Career Forward" for Current UMD Students Looking At MBA and Masters Study Post-Undergraduate Studies (An Annual Event)
- Advertising in UMD Campus Newspapers
- Masters Only Education Fairs (Fall And Spring) Throughout the U.S.
- Participation in a Masters-focused Business School Alliance
- Participant in Graduate Business Education Events Targeted for Underrepresented Populations, Particularly U.S. Minorities and Women

Future efforts include**:**

- Including Master's Level Programming in Marketing Content Targeted to U.S. Military/Veterans
- Outreach to College Organizations in the Washington, D.C. Area
- Enhancement of Website for All Masters Programs
- Inclusion of Spotlight and Vignettes of Masters Alumni and Current Students who Reflect Diversity
- Participation in Events Targeted for Women Seeking Graduate Study (General And Non-MBA Based Events)
- Social Media and Online Advertising within U.S. Markets
- Partnerships with Academic Testing Centers and Overseas Advisors For International Graduate Study
- Marketing Targeting Young UMD Alumni and Young University Of Maryland System Alumni

VIII. REQUIRED PHYSICAL RESOURCES

The proposed Masters in Quantitative Finance (MQF) program students will replace enrollment slots currently provided to our existing Masters of Finance (MFin) degree. We do not anticipate combined enrollment in these two programs in the future exceeding historic enrollment in our MFin program. The proposed program can be implemented in accordance with Section 11 206.l in which programs developed under this provision can be implemented within existing resources of the campus. In proceeding with the submission of this program, the institution's president certifies that no new general funds will be required for the implementation of this master's-level program.

A. Additional library and other information resources required to support the proposed program. You must include a formal evaluation by Library staff.

The evaluation is attached.

B. Additional facilities, facility modifications, and equipment that will be required. This is to include faculty and staff office space, laboratories, special classrooms, computers, etc.

As this proposed program supplements a current program with no net growth in the number of students, and we do not at this time anticipate growing the combined programs beyond current scale, no additional facilities or facility modification is required. The School has adequate space in Van Munching Hall to house current faculty and students in the proposed program. No additional classrooms or computer laboratories are required.

C. Impact, if any, on the use of existing facilities and equipment. Examples are laboratories, computer labs, specially equipped classrooms, and access to computer servers.

See response to VIII.B above.

IX. RESOURCE NEEDS and SOURCES

Describe the resources that are required to offer this program, and the source of these resources. Project this for five years. In particular:

A. List new courses to be taught, and needed additional sections of existing courses. Describe the anticipated advising and administrative loads. Indicate the personnel resources (faculty, staff, and teaching assistants) that will be needed to cover all these responsibilities.

The following five courses will be added as part of this new program:
BUFN 650 Financial Mathematics: Introduction to the mathematical models used in finance and economics with emphasis on pricing derivative instruments. Topics include elements from basic probability theory, distributions of stock returns, elementary stochastic calculus, Ito's Lemma, and arbitrage pricing theory.

BUFN741 Advanced Capital Markets: Building upon the financial mathematics course, this class provides an introduction to the mathematical and statistical models used to price securities and analyze financial markets. Topics include portfolio theory, asset pricing, market efficiency, fixed income, options and futures.

BUFN 745 Financial Programming: Building upon the statistical programming foundations in Econometrics, this course introduces students to advanced programming in Matlab, SAS, R, and Python with specific applications to financial modeling.

BUFN 767 Market Microstructure: The course examines---from theoretical, institutional, and empirical perspectives---how prices in speculative markets are determined by the interaction of traders. Topics covered include market making, informed trading strategies, liquidity, bid-ask spreads, transactions costs, market impact, price manipulation, and high-frequency trading. The course examines markets for equities, bonds, commodities, and foreign exchange. There are several empirical exercises using transactions data.

BUFN 767 Applied Conic Finance: This advanced course applies conic theory to the field of finance including applications such as portfolio theory, dynamic hedging, structured products, derivatives and construction of dynamic trading strategies.

The faculty in the Robert H. Smith School of Business have the requisite degrees and knowledge to teach these courses. The existing administrative structure for the MFin program will be tasked with serving this new degree program. As we do not anticipate net additional students above our historical enrollment levels, we do not anticipate incremental resources being necessary.

B. List new faculty, staff, and teaching assistants needed for the responsibilities in A, and indicate the source of the resources for hiring them.

Faculty resources of the Robert H Smith School of Business and in particular the finance department of the School (as described herein) are adequate to cover the size of the proposed MQF program. Approval of this proposal would not alter the responsibilities of the faculty beyond those already generated by the MFin program that this proposal seeks to supplement.

C. Some of these teaching, advising, and administrative duties may be covered by existing faculty and staff. Describe your expectations for this, and indicate how the current duties of these individuals will be covered, and the source of any needed resources.

As described above, teaching, advising, and administrative duties will be handled by existing faculty members (who are already teaching and conducting research on finance topics).

D. Identify the source to pay the for the required physical resources identified in Section VIII. above.

No additional resources are required.

E. List any other required resources and the anticipated source for them.

Not applicable.

F. Provide the information requested in Table 1 and Table 2 (for Academic Affairs to include in the external proposal submitted to USM and MHEC).

Given that this degree supplements a degree already offered, there are no incremental revenues or expenses. We anticipate that absent the approval of this new program, our enrollment in our MFin program would decline. Approval of this program, we believe, will allow us to continue at our current scale.

Appendix 1: Peer Comparisons – Characteristics of Competitor Institutions

School	Number of Students	Percent International	Number of Credits	Elective Credits
Johns Hopkins University	500	90	36	12
George Washington University	93	83	48	0
Ohio State University	56	71	30	20
Arizona State	18	78	36	0
University of Rochester	188	*	28	12
Washington University in St Louis Mfin	32	28	30.5	7.5
Washington University in St Louis Quant Fin	20	90	39	3
Tulane	184	93	34	6
University of Southern California	50	40	36	9
Vanderbilt	50	26	32	18
Boston College	45	70	30	9
University of Illinois	*	*	40	24
Fordham University Quant Fin	*	76	36	21
Fordham University Global Fin	*	76	36	8
Brandeis University	*	*	44	20

* Data not obtained

Appendix 2: Peer Comparisons – Curriculum Content Comparisons of Finance Programs offered by MBA Ranked Peers

Key:

Bold - Class currently offered by UMCP as part of our core.

Italics – Class currently offered by UMCP but not as part of the core.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
MIT **Masters in Finance** **#4**	**Finance Theory I** *Corporate Fin Accounting* **Analytics of Finance** **Electives:** *Corporate Risk Management* **Investments** *Advanced Corporate Finance* **Options and Futures** *Fixed Income* *International (Cap Mkts)* *International (Corp)* *Analytics of Finance II* *Business Analysis/Fin Statements* *Mergers & Acquisitions* **Valuation** *Applied Fixed Income Strategies* Data Technologies for Quant Fin Retirement Finance Learning Project a. Financial Engineering b. Financial Management c. Research Practicum	Suggested Math Background: Linear Algebra Calculus Probability Statistics Computer Literacy	Despite its reputation, this MIT degree is a general one comparable to ours. While students could get a more quantitative degree there, it is not required. They actually have fewer requirements. The Financial Engineering class looks different from ours, with teams assigned to tackle a problem for a sponsoring organization.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
UC Berkeley **MFE** **#7**	**28 units to graduate. 16 units required,** **Investments & Derivatives** **Empirical Methods in Finance** Intro to Stochastic Calculus *Financial Institutions Seminar* Derivatives: Quant Methods *Fixed Income Markets* Credit Risk Modeling Accounting/Taxation Derivatives Financial Institutions Seminar II *Fin Risk Management* Advanced Comp Finance Fin Innovation in Global Mkt *International Equity/Currency* Topics in Fin Eng Required Internship Finance Project ABS Markets *Dynamic Asset Management* Behavioral Finance Real Options	Programming experience in C or C++ Background in Calculus, Linear Algebra, Differential Equations, **Statistics** and Numerical Analysis Training in Finance **Language Skills**	Berkeley's MFE is a very different degree from ours. It is not aimed at generalists, but is specifically designed for students who want to work as financial engineers who already have a strong quantitative background. Many of their students already have a MS in engineering or a PhD in a quantitative field. The first course combines our Capital Markets class and our Derivatives class. Quant Methods has some overlap with our Fin Engineering class, but also emphasizes continuous time models. Some of the material in the Credit Risk course is covered in Fixed Income Derivatives and Risk Management. Some of the topics in ABS Markets are covered in Fixed Income Derivatives.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
UCLA **MFE** **#15**	Earn 52 units through coursework and the hands-on applied finance project. Nov-Dec (Foundation): Fundamentals of Investments, Financial Accounting, and introduction to Econometrics. Jan-Mar (Winter): Corporate Finance, Stochastic Calculus, Empirical Methods in Finance, Derivatives. Mar-Jun (Spring): Financial Risk Management, Fixed Income Markets, Computational Methods in Finance, Quantitative Asset Management. Sep-Dec (Fall): Introduction to Credit Markets, Special Topics in Financial Engineering, Applied Finance Project.	Strong quantitative background including linear algebra, multivariate calculus, differential equations, numerical analysis, and advanced statistics and probability. Some experience or coursework in computer programming (C++) plus statistical and econometric modeling (MATLAB).	UCLA's MFE is very similar to the one at Berkeley. Originally, it was a joint program between the two schools.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
University of Texas **MS Finance** **#17**	***Required*** **Financial Management** **Valuation** **Financial Accounting** **Statistics for Fin Applications** *Security Analysis* Practicum **Investments** *Advanced Corporate Finance* *Financial Mkts and Institutions* **Derivatives** *Fixed Income* Advanced Valuation Practicum II *Raising Capital* Alternative Investments *Risk Management* *Global Fin Strategies*	Complete a three-credit-hour statistics course and a three-credit-hour economics course before beginning the program.	It looks like Texas has a lockstep program which incorporates many of the classes that we offer. It includes two practicums, but does not offer the flexibility that we have and may be a little less quantitative.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
CMU **MS-Computational Finance** **#18**	It is unclear what is required. The program offers 25 courses. I see no corporate classes offered. There are many capital markets classes that look extremely quantitative. There are also a number of mathematics classes, IT classes and economics classes. There are two classes on Stochastic Calculus	An undergraduate degree in a technical discipline such as mathematics, computer science, engineering or economics. At least two full semesters of study in differential and integral calculus, the caliber of which is required of engineering, math or science majors as well as ordinary differential equations, linear algebra, and a calculus based probability course. Strong academic performance in mathematics and probability coursework. Be fluent in a general purpose programming language such as C or C++. Relevant professional experience is preferred but not required.	This program is nothing like ours. It is sponsored jointly by four different schools within the university.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
University of Wisconsin **Quantitative MFin** **#25**	***Core*** Microeconomics **Econometrics I & II** **Investments** **Futures and Options** *Derivatives* Theory of Finance I Independent Study Project Brownian Motion (Math) Computational Math (Math) ***Electives*** *Security Analysis* Intermediate Investments Courses offered by Economics, Statistics, Mathematics and Real Estate-	None.	Wisconsin's program seems lighter than ours on finance and heavier on mathematics and statistics than ours. It is more quantitative, but does not look very strong in terms of finance training.

University **Degree** **MBA Ranking**	**Curriculum/Required Classes**	**Prerequisites**	**Comments**
Vanderbilt University **MS in Finance** **#25**	***Required*** **Financial Economics I & II** **Financial Accounting** **Econometrics I & II** *Financial Modeling* **Corporate Valuation** **Derivatives** ***Electives*** *Financial Reporting* *Game Theory* *Corp Fin Policy* *International Markets* *International Corporate* *Equiies Markets* *Bond Markets* *Financial Institutions* Real Estate I & II *Active Portfolio Analysis*	At a minimum, it is expected that students will have completed one year of calculus as well as courses in statistics. It is helpful to have taken an introduction to economics course to help you understand the theory of economic principles.	The degree looks very similar to ours.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
Ohio State University **Specialized Master-Finance** **#25**	***Required*** Economics I & II Data Analysis I & II **Intro Finance** Leadership **Corporate Finance** **Derivatives** ***Electives*** Standard electives in Corporate Finance, Investments, Risk Management and Real Estate.	None.	Ohio State requires MBA type classes outside of Finance and offers courses very similar to ours. We have more requirements. They do not offer Econometrics, and we do not offer Real Estate classes.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
University of Rochester **MS in Finance** **#37**	***Required without MBA*** *MBA Economics* *MBA Statistics* **Financial Accounting** ***Required*** **MBA Accounting** **Capital Budgeting** *Economic* *Theory/Organizations* *Managerial Accounting* **Investments** **Corporate Finance** Business Communications **Electives** *Accounting/Economics classes* *Corporate Financial Policy* **Derivatives** *Financial Institutions* Cases in Finance *Investment Mgt/Trading Strat* *International Finance* Financial Information Systems *Fixed Income Securities* *Advanced Financial Economics* *Advanced Topics/Corporate Governance*	Students without an MBA must start in the Summer and take foundation classes	Rochester is one of our closest peers. It is a generalist degree. They require more core classes outside of finance and fewer inside finance.

University Degree	Curriculum/Required Classes	Prerequisites	Comments

MBA Ranking			
Boston College **MS Finance** **#37**	***Required*** **Investments** **Corporate Finance** *Financial Institutions* **Financial Econometrics** Corporate Finance Theory *Portfolio Theory* **Derivatives**/*Risk Management* *Fixed Income* *Financial Policy* ***Electives*** These were not listed on the page	Calculus Linear Algebra Statistics Accounting	Boston College offers an MSF that looks pretty standard. However, they also offer a quantitative track that includes PhD level courses in economics and finance.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
Tulane University **Master of Finance** **#43**	***Required*** **Financial Accounting** **Corporate Finance** Financial Communications **Valuation** **Investments** *Fixed Income* **Derivatives** *Equity Analysis* ***Electives*** Cases in Real Estate *International Finance* Real Estate Planning *Private Equity and VC* *Student Managed Fund* Energy/Environmental Econ Energy Markets	Currently, the Tulane MFIN does not require any specific course prerequisites; however, the Admissions Committee will look for demonstrable quantitative skills. Typical candidates have business, economics, engineering or computer science academic backgrounds or have taken coursework in finance, statistics, economics, accounting, engineering, or some other quantitatively oriented field.	The degree looks very similar to ours.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
Michigan State University **MS Finance** **#44**	***Required*** 30 Credits including 18 Credits in Finance. It must include Managerial Finance.	Cumulative GPA of 3.0 or higher. Have at least two years of full time work experience after earning the bachelor degree. This condition can be waived for exceptional candidates. Students should complete equivalents of MTH 124: Survey of Calculus I and STT 315: Introductory Probability and Statistics for Business. GMAT score (minimum of 600) (school code: QH0-5P-69) or GRE score (minimum of 310 verbal and quantitative) is required.	There is no strong core, and they do not offer a large number of electives.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
University of Florida **MS Finance** **#44**	It is difficult to see the requirements, however, they offer standard MBA type classes.	None.	It looks like Florida's program is aimed at combined BS/MS students. The degree looks less quantitative than ours.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
American University **MS Finance** **N/A**	***Required*** **Financial Management** *Financial Modeling* **Derivatives**/*Risk Management* **Quantitative Methods I & II** *Fixed Income* **Electives** Similar to our MBA electives	None.	American requires courses similar to our core and to our MBA level courses. It does not look like it offers the same level of flexibility nor does it offer as many quantitative classes.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
George Washington **MS Finance** **N/A**	***Required*** **Financial Econometrics** *Global Financial Markets* I-Banking Cases **Corporate Finance** **Investments** *Fin Eng* and **Derivatives** *Market Regulation* Financial Theory and Research *Real Estate/Fixed Income* *Financial Institutions* Cases in Financial Modeling **Advanced Fin Econometrics**	Bachelor's degree with credit hours in: • Advanced mathematics (6) (3 credits must be calculus) • microeconomics (3) • macroeconomics (3) • financial accounting (3) • managerial finance (3) • statistics (3)	GW is a lockstep program that hits many of the same themes as our program. It is less flexible, and does not allow for deeper study as our program does.

University Degree MBA Ranking	Curriculum/Required Classes	Prerequisites	Comments
Princeton University **Masters in Finance** **N/A (No MBA)**	Core **Financial Investments** Asset Pricing I **Regression and Time Series** **Corp Fin/Fin Accounting** Asset Pricing II **Financial Econometrics** Electives. Some electives are similar to our classes. Many are more quantitative.	A solid math background is required. At a minimum, we expect applicants to be familiar in mathematics with linear algebra, multivariable calculus, differential equations and with probability and statistics at the level of an intermediate undergraduate course. In addition, we offer incoming MFin students a two-week refresher course in mathematics and probability prior to the beginning of classes in the Fall semester. This course is required.	The Asset Pricing classes are more like our PhD level classes. **Asset Pricing I:** Topics include: no arbitrage, Arrow-Debreu prices and equivalent martingale measures, security structure and market completeness, mean-variance analysis, Beta-pricing, CAPM, and introduction to derivative pricing. **Asset Pricing II** Stochastic calculus and stochastic differential equations Topics include Brownian motion, martingales, and diffusions and their uses in stochastic volatility; volatility smiles; risk management; interest-rate models; and derivatives, swaps, credit risk, and real options.