UNIVERSITY OF MARY WASHINGTON – NEW PROGRAM REQUIRING STATE APPROVAL

Electronically submit this completed form with attachments to the Chair of the College Curriculum Committee.

COLLEGE (check one):	**Arts and Sciences**	x	**Business**		**Education**	
Proposal Submitted By: Brian Rizzo			Date Prepared: 9/7/2012			
Department /Program:	**Geography/Geospatial Analysis**					

Note: for program changes entailing the addition new courses, or revisions to existing courses, submit separate proposals for those course actions.

PROPOSAL TO CREATE PROGRAM *REQUIRING* STATE ACTION (check **one** of the following)		
New Degree Program* yes		Name: Masters of Geospatial Analysis
* Use this in cases where the proposal would either: (1) seek to award an undergraduate degree in a major not currently offered, such as a new B.S. degree in Biochemistry; or (2) create a new Master's program.		
New Certificate Program		Name: N\A
Revise Academic Program Title, CIP Code or Degree Designation		Current name, Code, or designation: Masters
		Change to: N\A
Program merger		Programs to be merged: N\A
		New Name for Merged Program: N\A
Delete existing major, certificate, concentration, or degree program		Name: N\A
Implementation Date – FALL semester, year:		Fall, 2014
Note: ***After proposal for a new degree is approved by the UMW Provost***, allow at least nine months from that date for the required SCHEV review. Keep this factor in mind when stating the desired implementation date for starting a new degree program. Other program actions reported to SCHEV also require time for review but will not take as long.		

REQUIRED ATTACHMENTS FOR NEW PROGRAMS *REQUIRING* STATE APPROVAL:

1. **Rationale statement** (Why is this additional change needed? What purposes will it serve?)
2. **Impact Statement** (Provide details about the Library, space, budget, and technology impacts created by this program change. Supporting statements from the Library, IT Department, etc. evaluating the resource impact and feasibility of adding the new program are required.)
3. **Catalog Copy** (Provide the complete Catalog Description for the proposed new program)
4. **For new degree or certificate programs,** complete and attach SCHEV's "Program Proposal Cover Sheet" and all narratives and documents as required by SCHEV's instructions.
5. **For program title changes,** complete and attach SCHEV's "Format for Revising Academic Programs Cover Sheet" and all narratives and documents as required by SCHEV's instructions.
6. **For program mergers,** complete and attach SCHEV's "Format for Merging Academic Programs Cover Sheet" and all narratives and documents as required by SCHEV's instructions.
7. **For major, minor, and/or certificate deletions,** also complete and attach the SCHEV "Intent to Discontinue Academic Program" form (form is available at the University Curriculum Committee web site) and provide any additional attachments are required by SCHEV's instructions.

All of the forms required by SCHEV, and instructions for completing them, are available at the University Curriculum Committee website.

Department Chair Approval: Jacqueline Gallagher **Date:** 9/7/2012

CCC Chair Approval: Bradley Hansen **Date:** Sep. 19, 2012

Dean Approval: Richard Finkelstein **Date:** Oct. 5, 2012

UCC Chair Approval:_____ **Date:**_____

Provost Approval:_____ **Date:**_____

REQUIRED ATTACHMENTS FOR NEW PROGRAMS *REQUIRING* STATE APPROVAL:

1. **Rationale statement**

This degree will foster advanced study in the management and the application of geospatial technology to a range of public and private sector application areas. Federal, State and County administrators utilize geospatial analysis extensively for planning and budgeting. Military agencies utilize it to assist in reconnaissance, defense and mission planning. Security agencies utilize it to track and analyze criminal and terrorist activity. Disaster and relief agencies use it to prepare response scenarios for potential emergencies as well as to coordinate and conduct actual emergency relief operations. Within the private sector, geospatial technology is used to identify new retail location sites, track the shipment of goods, calculate efficient routes of travel, visualize assets and inventories, manage facilities, and more.

Our goal in creating this degree is to educate professionals within our area of expertise in order to advance Virginia's economic and technological growth. The program will extend the capacity and capabilities of the University, the College of Arts and Science and the sponsoring department, Geography. It will accommodate 18 students each semester. This program will serve the needs of the nation, state, and region, provide opportunities for current and recent graduates, and establish the university as a regional leader in the field. The proposed degree will meet important educational needs of working professionals and recent graduates seeking to improve their career standing.

Proposal for the Establishment of a Master of Science in Geospatial Analysis at the University of Mary Washington

Submitted to:

Curriculum Committee
College of Arts and Sciences
University of Mary Washington

Submitted by:

Dr. Brian Rizzo, Associate Professor of Geography
and Director of GIS Programs

and

Dr. Stephen P. Hanna, Professor and Chair of Geography

September 7, 2012

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ii. Completed SCHEV cover page
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   g. Alumni survey and results

I. Program overview

a. Location and sponsoring unit

The Department of Geography and the College of Arts and Sciences proposes the establishment of a Master of Science degree in Geospatial Analysis (MSGA) at the University of Mary Washington, Fredericksburg, Virginia.

b. Purpose

This degree will foster advanced study in the management and the application of geospatial technology to a range of public and private sector application areas. Federal, State and County administrators utilize geospatial analysis extensively for planning and budgeting. Military agencies utilize it to assist in reconnaissance, defense and mission planning. Security agencies utilize it to track and analyze criminal and terrorist activity. Disaster and relief agencies use it to prepare response scenarios for potential emergencies as well as to coordinate and conduct actual emergency relief operations. Within the private sector, geospatial technology is used to identify new retail location sites, track the shipment of goods, calculate efficient routes of travel, visualize assets and inventories, manage facilities, and more.

Our goal in creating this degree is to educate professionals within our area of expertise in order to advance Virginia's economic and technological growth. The program will extend the capacity and capabilities of the University, the College of Arts and Science and the sponsoring department, Geography. It will accommodate 18 students each semester. This program will serve the needs of the nation, state, and region, provide opportunities for current and recent graduates, and establish the university as a regional leader in the field. The proposed degree will meet important educational needs of working professionals and recent graduates seeking to improve their career standing.

c. Background

Geospatial Analysis (GA) is the integration of applications from a field of disciplines that focus on the application, capture, management, analysis, and display of spatial data. GA permits the visual analysis and assessment of the world through the integration and analysis of data captures from myriad sensors (radio wave, light spectrum) and platforms (airborne, space, terrestrial, and ocean) that are used to gather data to monitor the state of the earth systems. There are three technology pillars that are widely accepted as the foundation for GA: Geographic Information Systems (GIS), remote sensing (RS), and Global Positioning Systems (GPS). UMW presently focusses its energy on GIS. GIS is the core geospatial technology. It can be thought of as the central pillar which enables other technologies to integrate relatively seamlessly and across systems.

We currently offer a Certificate in Geographic Information Science (GIS) within the Department of Geography that prepares undergraduate students for careers in the geospatial workforce. Since its approval in the 2007-2008 academic year enrollments in GIS offerings have increased to the current number of 197 as follows:

- 2007-2008, 105
- 2008-2009, 122
- 2009-2010, 197
- 2010-2011, 197
- 2011-2012, TBD

The creation of a Certificate in GIS was initiated with the understanding that students would have no previous experience with or knowledge of the field. As a result, awareness and interest had to be generated from advisors, literature, word of mouth and other sources. Consequently, the first significant cohort of certificate students completed the certificate in 2009-2010. Subsequently, awards have risen to 12 in each of the two succeeding years (2010-2011, 2011-2012). We anticipate reaching

capacity (18 students) within the next 3 years as a result of rising student awareness and interest in GIS, the reassignment of teaching resources to GIS classes enabling the department to offer more classes and the recently approved concentration in GIS within the computer science major.

The GIS Certificate, equivalent to a minor, requires 18 credits. The certificate program is designed to be inter-disciplinary, attracting students from geography, biology, environmental sciences, historic preservation, history, computer science and business as well as others. Students in these disciplines will be able to benefit from the growing application base of geospatial analysis in related fields.

Over the past decade, advances in the geospatial technologies (GIS, RS, and GPS) have brought advanced and highly sophisticated tools and applications that allow for the visualization of data related to both physical and social landscapes. Coupled with vast and growing digital data repositories, GA provides the means to graphically display, visualize, and analyze spatial relationships and patterns in ways previously not possible. Applications such as MapQuest, Google Earth, vehicle navigation systems, and other digital map-based solutions are good examples of how map-based technologies are becoming an integral part of mainstream society. These applications, introduced less than a decade ago, reflect a fast growing trend to translate information into visual and more readily accessible forms.

Visualization of data and information concerning the location and position of events, places, and assets falls primarily within the realm of geotechnologies. There is a growing interest in GA and other geotechnologies in research as well. Economic globalization, climate change, urban, regional, and transportation planning, ecological conservation, and biodiversity, along with a vast and growing number of applications in business, the social sciences, political science, and history, represent a trend that is signaling a change akin to the quantitative revolution experienced in the 1960's. Building off the successful GIS certificate will ease the transition into graduate studies and provide undergraduate students with an option to remain at UMW to continue their graduate studies.

d. What will graduates be able to do?

Employment for our graduates will fall within three categories: the geospatial analyst, the image analyst, and the geospatial web developer. Geospatial analysts will work primarily with data, addressing issues that have a geographic focus. For example, numerous points on a map could be associated with information on temperature, wind speed, and rainfall, crime, vehicle accidents, disease outbreaks, etc. Together, these points might be used to depict and analyze regional patterns and trends. A geospatial analyst will be able to analyze the data identifying any relationships that might support an hypothesis. In more general terms a geospatial analyst can assist with research, development and implementation of systems that use maps as the primary means of disseminating and visualizing data. GA is now being used for a host of applications: locating new headquarters or retail outlets (business), tracking and organizing road and sewer repair (municipal), identifying and analyzing environmental damage (environment), identifying crime patterns (crime/emergency services support), and cataloging the locations of utility features (government support).

Image analysts focus their attention on the application of imagery; aerial photographs and satellite imagery and more recently Light Detection and Ranging (LiDAR). The duties of an image analyst typically involve the interpretation of computer maps using specialized software as well as traditional paper maps. They employ a wide range of techniques and methods that allows them to manipulate the image in an effort to better identify features on the map. This enables them to assess change over time, and the type and nature of activity with an area. LiDAR is a relatively new field that allows analyst to generate very high resolution digital elevation models of the surface. These models can

then be used in a wide range of civilian applications in forestry, ecology, hydrology, geology, urban planning and more. There are also a growing number of application areas in the military domain and security arena where it can be used to identify 'hidden' structures, enemy combatants and their vehicles as well as to generate high resolution 3-D landscapes that are crucial to planning reconnaissance missions.

The recent and rapid growth of web-based map development will provide students with the opportunity to prepare as geospatial web developers. As geospatial web developers, students will have the skills that will allow them to implement server based spatial applications, develop customized computer programs to address problems, maintain spatial servers as well as provide ethical and philosophical advice related to privacy and other matters that have become a concern in the field.

Upon successfully completing the program, graduates will find jobs analyzing various kinds of data in a spatial context. We have prepared and included a recent list of employment opportunities in the justification section below. Graduates from the Geospatial Analysis Master's degree will have the ability to:

- Formulate spatial systems requirements as they pertain to particular applications
- Formulate methodologies for collecting, integrating, and analyzing various forms of spatial data
- Convert and transform spatial data to and from various spatial applications
- Design and manage projects
- Develop customized programs to work within commercial and open source GA applications
- Develop, implement and support web-based mapping projects

Geospatial analysis, image analysis, LiDAR and web-based map development are now firmly embedded as fundamental information technology components in a host of industries. Therefore, employment opportunities for students with a MS in Geospatial Analysis exist and will continue to grow across a broad spectrum of economic sectors and throughout all levels of government. Below is a sample of the job titles that can be expected for each of the three categories of jobs.

Geospatial Analyst (GA)	Geospatial Developer (GD)	Image Analyst (IA)
Wetland Ecologist	Geospatial Web Developer	Government Remote Sensing Analyst
Environmental/Database Management Specialist	Web Developer	Image Analyst
Geospatial/GIS Technical Trainer		
GIS Coordinator		
Geospatial Analyst		
Sr. Geospatial Analyst		
GIS Technician		
Geospatial Analysis Instructor		
Transportation Planner		
Transportation Planner II		
GIS Specialist		

Note that with the exception of positions for geospatial analyst, job titles for geospatial developers and Image Analysts are very narrowly defined as the nature of the work requires a specific skill set.

e. Proposed start date

Students would enroll in the program beginning in the fall 2014. During the intervening time we will further develop the curriculum, hire the necessary faculty, establish the class and lab space, and develop a network of businesses that would be interested in hiring our graduates.

f. Admissions

Students must have completed an undergraduate level degree with a GPA of 3.0, and have successfully earned credits in at least two university level GIS classes. In lieu of completed course work, students can gain admission by providing documented evidence demonstrating they have worked with ArcGIS 9.3 or higher on a range of projects over the course of a year. The GISc Committee, an interdisciplinary committee consisting of faculty who work with or are familiar with geospatial field, will evaluate the submitted documents to determine if the experience provides the students with sufficient knowledge in GIS to succeed in the program. To remain in the program students must retain an over-all GPA of 3.0, with no more than one grade lower than this benchmark per semester. Initially, no GRE requirement will be necessary for admission to the program.

Students who fail to attain a GPA of 3.0 or students who cannot complete the program can receive a master's certificate in GIS upon completing 18-credit hours, with a GPA of at least 2.7. The certificate course is an option only available to students enrolled in the master's program. The capstone credits are not eligible as part of the 18 credits required for the certificate

g. Accreditation

There is no accrediting body and no accreditation for geospatial analysis at this time.

II. Mission

a. Include complete institution mission statement

> "The University of Mary Washington is one of Virginia's outstanding public liberal arts universities, providing a superior education that inspires and enables our students to make positive changes in the world.
>
> The University is a place where faculty, students, and staff share in the creation and exploration of knowledge through freedom of inquiry, personal responsibility, and service. UMW regards the provision of high-quality instruction as its most important function. The University offers a wide range of undergraduate and graduate programs focusing on both disciplinary and interdisciplinary studies. These academic programs afford students opportunities to integrate and apply their knowledge within broad educational experiences, to develop their professional interests, and to practice the habits of mind necessary for life-long learning. Through a professionally engaged faculty, the University supports ongoing research appropriate to the development of student abilities and faculty interests. It especially encourages the participation of undergraduates in research.

UMW's size, dedicated faculty, and historical commitment to fine teaching create an institutional culture where both undergraduate and graduate students benefit from strong connections with their faculty and multiple opportunities for active learning.

Located in Fredericksburg, between our nation's capital and the capital of the Commonwealth of Virginia, the University of Mary Washington is a nexus for engagement among diverse communities and is dedicated to supporting professional advancement and economic development and to improving the regional quality of life.

We fulfill our mission by fostering students' intellectual and creative independence, facilitating their immersion in local, regional, national, and international communities, and by inculcating the values of honor and integrity. UMW graduates are models of adaptive learning, personal achievement, responsible leadership, service to others, and engaged citizenship in a global and diverse society."[1]

1-University of Mary Washington Strategic Plan 2009-201. http://president.umw.edu/wp-content/blogs.dir/181/files/2011/09/UMW-Strategic-Plan-2009-2014.pdf4

b. Explain how proposed program connects with institution's mission

The University of Mary Washington's strong commitment to academic excellence and its high academic standards for liberal arts learning are widely acknowledged, consistently winning Mary Washington recognition as one of the nation's best small masters-granting institutions. The University continually identifies the educational needs of area school districts, businesses, military and security agencies, professional organizations, and individual citizens, and works to meet those needs by delivering flexible and accessible programs. Such a need was identified by the Department of Labor in 2001, through the High Growth Job Training Initiative (HGJTI). The initiative identified 14 sectors that fit within the following criteria:

- They are projected to add substantial numbers of new jobs to the economy or affect the growth of other industries; or
- They are existing or emerging businesses being transformed by technology and innovation requiring new skills sets for workers.

Geospatial technology was one of 14 sectors identified. In November 2, 2005 the U.S. Department of Labor, Employment and Training Administration published the report "**Identifying and Addressing Workforce Challenges in America's Geospatial Technology Sector**"[2] which stated "The few graduate programs now in place cannot meet the needs of the marketplace and the global demand will likely continue to grow faster than the supply of qualified graduates". The GIS certificate currently prepares students to fill the 3,000 – 4,000 advanced level GIS positions identified in the report as unfilled due to a lack of qualified candidates. With the addition of a graduate program in Geospatial Analysis, we will address the need for graduate programs.

As an inter-disciplinary subject, geospatial analysis fits well within the liberal arts tradition. The liberal arts heritage at UMW provides students with speaking, writing, and presentation skills that will complement their geospatial skills. As a result, our graduates can more effectively communicate their findings to managers and audiences in general. In recent years the university has also moved to embrace Science, Technology, and Math (STEM). Under the auspices of the **S**tem **T**alent **E**xpansion

through **R**esearch, **E**ngagement, **P**reparation and **S**cholarships (STEREPS) project, the University of Mary Washington is completing a series of initiatives to recruit and retain Science, Technology, and Math (STEM) majors, particularly students who are members of groups that are traditionally under-represented in the STEM disciplines. Geospatial analysis can and will play a role in STEREPS and furthermore embrace the Virginia Higher Education Opportunity Act of 2011 (TJ21) set forth by the governor.

A number of distinct needs have become increasingly evident. One is the need for geospatial analysts who are skilled in using the technology to more effectively conduct spatial analysis and take a leadership role in organizations that rely on geospatial technology. A second need is for accessible graduate MSGA programs for adult students with minimal commuting distance and time for area residents.

[2] U.S. Department of Labor, Employment and Training Administration. (2010). *Identifying and Addressing Workforce Challenges in America's Geospatial Technology Sector*. Washington, D.C.: Author. http://www.doleta.gov/brg/pdf/Geospatial%20Final%20Report_08212007.pdf

A third need is for a program that eases employer and student access to the program in order to facilitate an on-going relationship that ensures program relevance, provides graduates of the program with ready access to jobs and provides related opportunity for research and development through partnerships. The proposed MSGA directly address these needs.

The College of Arts and Sciences supports regional economic development, lifelong learning and professional advancement through quality full-time and part-time educational programs and appropriate ancillary services. The College offers undergraduate degree completion programs, post-baccalaureate and certificate programs, including programs developed through partnerships with other institutions and by cooperative agreement with Virginia's public research universities. The composition of the curricula and faculty remain flexible in order to respond to the changing needs of the students and businesses that the College serves. The MSGA represents a program that fits well with the College's mission.

This proposed degree program articulates well with Goal 1, Objective C "**Enhance and enrich the course of study in the liberal arts as a principal and defining character of the University and the foundation for the UMW undergraduate experience**"[3] and Goal 6 "**promote and enhance regional engagement, leadership, and service to the public**"[4] of UMW's Strategic Plan. A graduate program in geospatial analysis will advance UMW's community/social embeddedness and technology transfer, provide educational opportunities for local and regional residents, and create opportunities for partnerships and collaborative research with businesses. This degree program will service other significant UMW endeavors such as the Center for Spatial Analysis and Research (CeSAR), through student internships and research opportunities that will provide students with experiential learning opportunities that are seen by employers as highly desirable qualities in student resumes.

Compressing the time frame from the traditional two years to one year of graduate work will give UMW students a competitive edge in the field. These benefits address two recent concerns of Governor McDonnell; affordable education and greater innovation and competitiveness.

As the economy of the nation and the state becomes more dependent on technology, technology related jobs will increase concomitantly. This program will provide our students with the philosophical,

technical and communications skills that will inspire them and enable them to contribute to positive change through their professional careers in geospatial analysis.

The importance of our proximity to some of the nation's leading employers of geospatial analysis cannot be over-stated. The proximity of the university to the headquarters of the FBI and the National Marine Intelligence Center (NMIC), in Quantico, VA 20 miles to the north and the National Geospatial Intelligence Agency (NGA) in Fort Belvoir, VA, 20 miles further, enables employees at these agencies to enroll in a graduate program that is more convenient and accessible. Historically, through our cartography and GIS classes, we have graduated students who are now very successful in geospatial careers.

[3], [4] - University of Mary Washington Strategic Plan 2009-2014. http://president.umw.edu/wp-content/blogs.dir/181/files/2011/09/UMW-Strategic-Plan-2009-2014.pdf

The table below illustrates the range of agencies and businesses, as well as the positions of our alumni, currently working in geospatial positions.

Name	Position	Agency
John Goolgasian	Director, Foundation GEOINT	NGA
Tim Gill	Senior Case Officer	FBI
Heather Casey	GIS Coordinator	U.S Army
John Barretta	Case Officer	NGA TradeCraft
Jacqueline Nolan	Cartographer/GIS lead	Library of Congress
Christopher Belios	Director, Global analysis program	BAE Systems
Adam Owings	Director, GIS projects	Next Tier Concepts

The region we serve supports numerous consulting companies that regularly work with geospatial data. Our graduates will provide needed manpower and strengthen the region's growing geospatial job market. As with our undergraduate GIS certificate, our masters students will have the opportunity to complete the program through an internship to fulfill the requirements of the final projects while facilitating their immersion in local and regional companies thus strengthening the bond between the university and the community.

III. Curriculum Description

a. Total credit hours:30

Based on information gathered from other programs and our contacts in the region we foresee a program consisting of 24-credit hours of coursework followed by a capstone course, a six-credit independent project. Students entering the program will either have professional experience working with GIS or undergraduate coursework in GIS.

The 30-credit hour non-thesis master's degree program is in general similar to those for a traditional master's degree except that it emphasizes instruction in theory and practice and serves as preparation for careers in a profession. The program of study is a coherent program designed to assure the mastery of specific knowledge and skills. The overall form and content of the student's program of study is highly structured. The program will allow students to enroll as full-time students or part time students. Part time students can elect to take one or two courses per semester. When launched, all courses will

be mandatory unless a student has already demonstrated expertise in the field. For instance, a student who has been working as an image analyst at NGA who demonstrates superior subject matter knowledge would be better served by substituting the remote sensing course of an independent study where a more in depth investigation would be more beneficial. In such cases, if approved by a faculty member, an independent study may be substituted for a course.

The curriculum comprises six four-credit graduate courses followed by a six-credit capstone project. To meet the needs of part-time students and to ensure there will be laboratory and classroom space available, classes will be held in evening hours during fall and spring semesters. The capstone project will be undertaken immediately following the spring semester over a ten week period. The six-credit capstone is an independent study that provides both the faculty and the student with a measure of the GIS skills acquired from the program. The process is driven by the student, who, under the guidance of an instructor/mentor, formulates a research question to address. This is an opportunity for students to pursue original research. The capstone will demonstrate the student's ability to work independently and to write, present and discuss problems effectively. More importantly the project can serve as a marketing tool, providing students with a working example of their abilities.

Table 1 provides a description of the various course schedules that will be available to students.

b. List of all courses (all new)

Fall Semester:

GISC 510 - Spatial thinking (4 credits)

GISC 540 - Modeling and Spatial Statistics (4 credits)

GISC 570 – Geospatial Intelligence (4 credits)

Spring Semester:

GISC 520 –GeoDesign and Geovisualization (4 credits)

GISC 550 – Remote Sensing and Digital Imagery (4 credits)

GISC 580 – Geospatial Data and Services on the Web (4 credits)

Final Semester:

GISC 591 - Capstone project (6 Credits)

Potential Independent Study (GISC 585) topics (based on current faculty expertise):

1. GIS for the urban environment
2. GIS for underdeveloped countries
3. GIS and spatial analytics

c. Outline of concentrations or tracks, if any

There are no tracks. All students will be required to complete all courses (GISC 510, 520, 540, 550, 570 and 580). Students may apply to substitute an independent study (GISC 585) for GISC 550 or 580. Such an application must be approved by one faculty member and the director of GIS programs.

d. Requirements of special projects, theses, etc.

Following completion of all course work, students must complete the MSGA capstone course - GISC 591 with a minimum grade of B. The course must be completed over the course of a 10-week full summer session. Students will be assigned or request to work with a course instructor. Students will be required to submit a research proposal that outlines the nature of the investigation, a rationale for the investigation and a project timeline with milestone dates. This is an independent research project and as such the work must be the product of the student with guidance limited to discussions, directions and comments. The project will be evaluated on the flowing:

- Strength and readability of the proposal
- Adherence to timeline
- Final Report
- Final presentation
- Structure of the database
- Thoroughness

IV. Faculty

a. Dr. Brian Rizzo (Geography)

Dr. Brian Rizzo has over 35 years of experience working geospatial systems. As a research scientist with Environment Canada from 1983 -1996, he worked as a programmer on the Canadian Geographic Information System, the first operational GIS in the world. He received his doctorate from the University of Virginia in Environment Sciences using geospatial analysis and statistics to model ecological change as a result of climate change. In 1999 he co-founded Isosceles Information Solutions, a company focused on the development and deployment of web based geospatial applications. Following the sale of the company in 2005, he joined the Infinity Systems group where he built a geospatial applications division. In 2007, he joined the University of Mary Washington to develop the GIS program.

As the founder and Director of the Center for Spatial Analysis and Research (CeSAR), Dr. Rizzo has secured two grants in the first year of operation. The first was a mapping project requiring 6 sets of 11 maps to be production ready. The second was a grant from the National Park Service to complete a wetland remediation. In 2011, Dr. Rizzo led two research grants from the Department of Mines Minerals and Energy, Virginia. The first was "Spatial characterization of karst features in Virginia" and the second was "High-resolution Terrain Modeling for Landslide Risk Assessment." Dr. Rizzo's research is focused on the spatial aspects of problems both physical and social. Current research includes an examination of shoreline change in the Virginia Barrier islands and the ecological implications of climate change in North America. Dr. Rizzo incorporates multivariate statistics into much of his work. He has also led many workshops and taught short courses in ESRI's ArcGIS.

b. Dr. Stephen Hanna (Geography)

Dr. Stephen Hanna's expertise in the geospatial realm centers on cartographic design and map production for a variety of media. Since arriving at the University of Mary Washington in 1997, Dr. Hanna has developed and taught cartography and GIS courses at both the introductory and advanced level. During that time he has also provided multiple opportunities for students to design and produce maps for external clients. These have appeared online as well as in books and museum exhibits.

Dr. Hanna's research centers on the social and political uses and meanings of maps and mapping practices. His articles on this topic have appeared in *ACME: An Online Journal of Critical Geography*, *Progress in Human Geography*, and *Cartographica.* In addition, his co-edited book, *Mapping Tourism*, was published by the University of Minnesota Press. Finally, over 40 maps of his design have appeared in exhibitions, journal articles, and books

c. Dr. Jacqueline Gallagher (Geography- contributing faculty to GISC 580)

Dr. Gallagher has been teaching geographic information science, with an emphasis on field applications through mobile GIS and the global positioning system, for over ten years. She is a geomorphologist with considerable experience in teaching and research outside the classroom, which she has been able to relay to the laboratory through mobile GIS. She joined the geography department at the University of Mary Washington in 2006.

Dr. Gallagher's research interests range from fluvial geomorphology & wetland studies to vegetation & land use changes over time. Most data are collected in the field, often as attributes that are stored in mobile GIS files. Data are examined through a variety of methods, including the spatial analysis tools within GIS. Dr. Gallagher is also working on a manuscript relating mobile GIS and GPS to field studies; it includes an up-to-date explanation of the global positioning system and how accuracy may be assessed and improved, as well different methods by which field data may be collected into GIS layers, written so as to be intelligible to those without higher level math and physics backgrounds.

d. New faculty

Delivery of the program will require the addition of new faculty with specialties that fall along the lines of the curriculum. The administration is committed to filling these lines as needed.

While all tracks will operate concurrently and will share core classes, it will be necessary to add full-time faculty to ensure that the necessary core courses are taught by faculty with the appropriate qualifications and to prevent the program from detracting from the already successful undergraduate Geography major and GIS certificate program.

V. Assessment

a. Student assessment

i. Learning outcomes

Each instructor in his/her course will assess student performance and attainment of learning goals via projects, assignments, exams, presentations, papers, etc., as relevant to the specific course.

- Annual analysis of student academic performance and constituent satisfaction
- Biennial analysis of student academic performance; implementation of curriculum review; focus group study and examination.

Upon completion of the program, students are expected to demonstrate knowledge and skills that include:

- Understanding the role of geospatial technologies (GIS, RS, GPS,) as part of a broader science-technical and social systems within organizations
- Functions and methods of geospatial systems analysis and design from a theoretical, practical and managerial perspective
- Proficiency in advanced geospatial techniques including, geovisualization, map serving, spatial statistics, computer programming as applied to geospatial problems, database management, and spatial analysis
- Proficiency in the design, development and maintenance of a web based geospatial application
- Being well grounded in spatial thinking, theories and philosophies
- An understanding of current and future GIS and related technological developments.
- Communication techniques appropriate to GIS and technical environments, especially report writing, effective production and use of maps and other graphics, presentation skills, and interpersonal communication

ii. Methods for assessing

Attainment of expected learning outcomes will be measured in several ways. At each orientation session for students entering the program, a variety of assessment instruments will be administered to establish a baseline database of students' understanding and knowledge of program learning goals, their current understanding of geographic information systems along with related technologies such as remote sensing, global positioning systems, and internet mapping.

A second survey will be administered upon completion of the program to assess attainment of core program learning objectives, overall satisfaction with the program, changes in baselines established at their orientation sessions, and suggestions for improvement of the program.

Successful completion of all required course work, course projects, papers, exams, and other specific course assignments will also measure attainment of program learning objectives. In addition, electronic portfolios will be required throughout the program, providing each student the opportunity to build a compilation of knowledge and skills for internal and external review. Portfolio elements from all students will add to assessment data collected for the MSGA program. Further, student, alumni, and employer surveys will be conducted, and information related to career prospects for graduates will be obtained. The overall program content, structure, specific courses, and program administration will be modified based on the results of the above assessments and surveys.

The plans for assessing this program match the institution's overall program review, analysis, and enhancement. Specifically, the College of Arts and Sciences has developed assessment plans that range from semester evaluations to program reviews, and include such actions as analyzing course evaluation results, obtaining student academic performance data and constituent satisfaction information, conducting comprehensive curricula reviews, and determining the extent to which program benchmarks have been achieved. The Dean, Program Director and the GISc Committee will use this collection of data to improve the scope and quality of program and support services offered at the College.

iii. Workplace competency\skills fostered by program

Workplace competencies and skills will be imparted throughout the curriculum through a range of proven techniques and mechanisms. Case studies will be employed to demonstrate solution sets for geospatial problems as well as failed approaches that should be avoided. Laboratory exercises will be based on real world problem sets and lecture material will be geared towards new theory and approaches that have proven to be effective and transferrable to the workplace. The capstone course will prepare students to work through all phases of a project life-cycle.

Our graduates will have the ability to:

- Make informed procurement decisions on issues related to geospatial concerns
- Implement long term maintenance and development plans
- Develop project budgets and timelines
- Implement a life-cycle plan
- Conduct vector and raster based analysis
- Transform and convert data from myriad forms to a required form
- Setup, implement and maintain a GIS server
- Develop scripts and web based custom applications using FLEX or Silverlight extensions
- Articulate and communicate effectively to other geospatial professionals and non-professionals
- Develop field plans and conduct a research project

b. Program assessment

The Master's degree in GA will prepare students for careers in a wide range of fields which can benefit from analyzing, mapping, disseminating and manipulating and integrating spatial data. The program is designed to provide the theoretical, technical, and managerial knowledge and skills required by GA professionals. Graduates will be prepared to operate successfully in careers associated with the analysis of human and physical systems, biological and environmental planning, analysis and science, urban planning, design, development, analysis and management. In addition, geospatial intelligence, crime analysis, and security related fields will also provide opportunities for employment. The program accommodates students with undergraduate degrees in a variety of areas who have a background in GA.

i. Timeline for conducting program assessments

Each graduating class will also be required to complete an exit survey. The exit surveys will provide, among other information, the place of employment and the salary of the graduating student if a job has been secured. This information will used to follow the individuals career for a minimum of five years. Bi-annual phone surveys will track the progress of the student, noting the shifts in responsibilities, duties and technological applications. Students who have not secured a job in the field within 2 month of graduation will be surveyed in an attempt to understand why placement was not successful.

At the end of each year, job placement data will be analyzed. Placements will be categorized by job title and associated job requirements. Shifts in requirements from year to year will be noted with particular attention focused on changing job requirements and description of competencies.

In addition, employers of the most recent graduates will be surveyed within six months from the time a student begins working.

ii. Methodology for program assessment

Survey data will be analyzed and assessed. The focus of the inquiry will be the relevance of the program to workplace needs and requirements. Shifts in job requirements, skill sets and other competencies will be noted. Changes to the curriculum will be required to address evolving workplace needs in order to remain ahead of the job needs, thus ensuring our students are employable and the degree is relevant and productive for the student.

iii. Program benchmarks

Benchmarks for the program will include the following: enrollment; job placement and advancement; satisfaction of graduates; employer satisfaction; and completion rates.
In order to determine whether or not these benchmarks have been met, the Program will compare each of these areas using projected data vs. actual data. Specifically, the following indicators will be used to determine the success of the program:

- Job placement
- Placement in graduate programs
- Level of initial employment
    - Mid-level
    - Upper Level
- Full-time vs. contract employment
- Job advancement
- Program Enrollment

Enrollments
The three program tracks combined are expected to fill the enrollment cap each semester. New applicants seeking to complete the program in one year have precedence over those seeking the prolonged two-year track.

Job Placement/Advancement
A relevant benchmark indicating successful job placement/advancement, as an outcome of the program would be if:
• 85% of the students report success in securing a higher level job in the field 2/3 years after graduation.

Satisfaction of Graduates
A survey will be sent to all graduates 12 months after graduation. A positive outcome will result if results of the survey show 75% of the graduates indicate satisfaction with:

- the overall quality of the instruction
- the content of the program
- how the program has assisted them in retaining or advancing their careers

Employer Satisfaction
75% of employers surveyed will indicate satisfaction with graduates of the program.

Completion Rates
75% of students pursuing the degree will graduate within a two-year period.

If the above benchmarks have not been met, the Program will, as appropriate and necessary:

- modify courses and/or curriculum
- adjust goals and objectives of the program
- adjust faculty teaching and advising assignments

VI. Expansion of current program, spin off, collaborative (indicate if any of these apply)

The current Certificate in Geographic Information Science has established a foundation upon which our master's program can be successfully developed. The certificate is relevant to students from a wide range of discipline's seeking jobs within their fields of study and to those students who move on to Graduate school to continue their study. Students awarded the certificate are successful in obtaining jobs. Anecdotal evidence suggestions that students awarded the certificate who apply to non-geospatial graduate school are more favorably looked upon for their geospatial skills. The annual graduation class is now nearing capacity (18), with the numbers increasing each year. Since the start of the program total enrollments in all GIS course have increased from 36 prior to 2007-08 to 197 in 2011-12.

In addition to the certificate, the department of Computer Science offers a concentration in GIS in the computer science major. The GIS concentration combines the foundations of computer science with GIS. The program is designed to address the growing demand for GIS-trained personnel with advanced computing skills to address the need for customized desktop and web based applications related to business, geo-spatial intelligence, education, health care, and numerous other employment fields.

Students who complete this concentration may choose to complete the GIS Certificate by completing one additional course. They will also be well poised to pursue an advanced degree in geospatial analysis.

Faculty members from two departments currently teach at least one GIS class within their discipline. In addition, the departments of Historic Preservation, Computer Science, Biology, Earth and Environmental Sciences, and Business have actively endorsed the program to their students, recognizing that their students can benefit from more GIS instruction. Technology classrooms for GIS courses are excellent on the Stafford campus and improving on the CAS campus. No improvement is required at this time.

VII. Justification

a. Current need for the program

There is a growing regional, national and global need for geospatial graduates. Over the past two decades geospatial analysis has become an important tool for a host of civil applications: locating new headquarters or retail outlets (business); tracking and organizing road and sewer repair (municipal); identifying and analyzing environmental damage (environment); identifying crime patterns (crime/emergency services support); and cataloging the locations of utility features (government

support). These applications are now embedded as fundamental information technology components in a host of industries. In fact, geospatial expertise, linked with management skills, is now an acceptable portal to management: the Chief Information Officer of a corporation.

In addition, the military and security agencies in this region have imbedded the technology into their operations. In the fall of 2011, with the opening of the National Geospatial Intelligence Agency's new headquarters in Fort Belvoir VA, 40 miles to our north along I-95, this region clearly supports the highest density of geospatial professionals in the country. Aside from meeting their own needs in geospatial and image analysis, NGA analysts are responsible for providing geospatial support services to all federal agencies. This includes the CIA, FBI, USSS, DHS, the National Ground Intelligent Center (NGIC), the Marine Corp Intelligence Service (MCIS) and the DOD. All of these agencies are with a 30 to 90 minute driving range and the majority of employees live in or around the Fredericksburg area.

As the need for geospatial analysts increases, agencies are looking to fill positions with new, highly qualified personnel and looking for opportunities to provide post graduate degrees for existing personnel. Our program will provide these opportunities in Fredericksburg where the majority of employees live and work. An evening program provides working professionals with the opportunity to participate as well.

A focus group sponsored by the GISc committee was attended by 15 invited regional senior geospatial managers. Representatives from NGA, CIA, FBI, DHS, NGIC, MCIS, and representatives from the state, regional agencies and businesses involved with geospatial analysis attended. At the conclusion of the meeting participants unanimously supported our efforts in developing a geospatial program citing a need for geospatial analysts with solid communication and analytical skills, and pledged their continued support offering to serve as an external advisory board to the program if requested to do so by the administration.

The success of the GIS certificate program has led to a growing number of recent graduates inquiring about post graduate opportunities in geospatial analysis. As awareness of the program grows, inquiries from geospatial professional looking to further their career through education continues to grow. This program clearly has a base of students from which to build a successful program.

b. Employment demand in Virginia (must include Bureau of Labor Statistics and Virginia Workforce Connection statistics for the year and for the next 10 years as projected)

c. National demand
d. Student demand
e. Alumni demand

VIII. Duplication

a. List other similar program in the Commonwealth

George Mason offers two Master of Science degrees, one in Geographic and Cartographic Sciences and another in Geoinformatics and Geospatial Intelligence. In addition, the engineering school at

Virginia Tech offers a Geospatial Engineering option within their Master of Science degree in Civil and Environmental Engineering.

b. Compare programs to show unique features of this proposal

The Virginia Tech program focusses on how geospatial technology can be applied to engineering problems as a tool and a technology. The emphasis of this MS degree is clearly Civil and Environmental Engineering. Students in the program are introduced to GIS to enable them to better recognize applications where GIS can be used and to provide enough familiarity with GIS to allow them to better work alongside GIS managers. Students are exposed to geospatial technologies but they are not immersed in their use, nor are they expected to become experts in its application. The program requires students to obtain only 9-credit hours of GIS instruction, with no prerequisites. This latter point suggests that students will not be learning at a graduate level when compared to our proposed program which requires extensive knowledge of geospatial technologies as a requirement for admission.

The MS in Geographic and Cartographic Sciences offered by George Mason requires four core GIS courses and provides multiple three-credit elective courses to students. The MS in Geoinformatics and Geospatial Intelligence requires seven core courses (each at three credits) and provides options for an additional nine electives. Both programs offer two tracks; a thesis option or comprehensive exam option. Classes are offered primarily during the day, with a few evening options. Both are two year programs.

Our program does not offer a thesis option and initially has fixed the courses to six, four-credit core courses plus a six-credit capstone course. The UMW program will focus more on the web services and programming aspects of geospatial technology. Offering 3, four-credit courses per semester allows us to provide more focused material in a 15 week period which we feel will ensure our students master the specific subject matter. Conceptually our program is more holistic, embracing the tenets of the Liberal Arts and Sciences. The Liberal Arts and Sciences tradition here at the University of Mary Washington seeks to ensure students build competence and confidence in writing, comprehension, analytics, synthesis and the expression of ideas. These are foundational traits that differentiate our program. These traits in combination with geospatial skills are tied directly to both program and learning outcomes to ensure our students can effectively transition into the workplace. All classes will all be offered during the evening to better serve adult and professional student population.

c. Enrollment and graduation numbers for five most recent years of other programs

IX. Student enrollment projections for proposed program (complete required SCHEV form for headcount enrollment and projected graduates)

X. Program Resource Needs – include completed SCHEV "Projected Resource Needs" form

XI. Provost Signature Page

XII. Appendices

a. Sample student curriculum plans – full time and part time

Option one: Full-Time - one year- 3 courses per semester.

First Year		
Fall	Spring	Summer
GISC 510	GISC 520	**GISC 591**
GISC 540	GISC 550	
GISC 570	GISC 580	

Option Two: Part-Time 2 Courses per semester first year, one course each semester second year

First Year			**Second Year**		
Fall	**Spring**		**Fall**	**Spring**	**Summer**
GISC 510	GISC 520		GISC 570	GISC 590	**GISC 591**
GISC 540	GISC 550				

Option three: Part-Time 1 Course per semester

First Year			**Second Year**			**Third Year**		
Fall	**Spring**		**Fall**	**Spring**		**Fall**	**Spring**	**Summer**
GISC 510	GISC 520		GISC 540	GISC 550		GISC 570	GISC 590	**GISC 591**

Note: Circumstances may allow for GISC 591 to be completed any semester upon completion of all core courses.

b. Course descriptions (mark new courses)

New course: GISC 510 - Spatial thinking: Students will learn to identify, explain, and find meaning in spatial patterns and relationships, such as site conditions, how places are similar and different, the influence of a land feature on its neighbors, the nature of transitions between places, how places are linked at local, regional, and/or global scales. Through readings, discussions, and laboratory assignments, students will learn how to frame research questions and engage with relevant literatures to create research designs appropriate for GIS (4 credits).

New course: GISC 540 - Modeling and Spatial Statistics: This course focuses on the application of statistics and spatial models in GIS. It will cover concepts of quantitative methods, the use of statistical procedure in problem solving, and applications of quantitative methods and spatial analysis throughout a series of geographic problems. Topics include: point pattern analysis, areal

data analysis, MAUP, gravity models, spatial autocorrelation, geostatistics (i.e., variograms and kriging) and network analysis (4 credits).

New course: GISC 570 – Geospatial Intelligence: The course will focus on the acquisition, methodologies, analysis, presentation and reporting of imagery and mapping data referencing activities on the earth with a focus on intelligence. Due to data availability and breadth of subject, non-military applications of the geospatial intelligence approach will be stressed. Topics may include food security, environmental and health risks, urban planning, and crime (including terrorism) analysis (4 credits).

Spring Semester:
New course: GISC 520 –GeoDesign and Geovisualization: This course will require students to integrate a variety of theories concerning the nature and uses of maps and geographic information with technical practice in cartographic design and geovisualization (4 credits).

New course: GISC 550 – Remote Sensing and Digital Imagery: This course is focused on the analysis of remotely sensed images with an emphasis on the use of satellite imagery and digital processing techniques in geographical research. This course is designed for early graduate students or advanced undergraduates who are interested in pursuing careers or scientific work in the remote sensing and geospatial technology fields (4 credits).

New course: GISC 580 – Geospatial Data and Services on the Web. In this course, students will acquire the knowledge needed to share GIS content on the Web or across the enterprise. The course will focus on workflows to publish maps, imagery, geoprocessing models, and feature templates for use in Web applications that support visualization, analysis, and editing of GIS resources (4 credits).

Final Semester (Summer):
New course: GISC 591 - Capstone project. An intensive independent research project that must be undertaken by each student at the end of the 2nd semester. A report and final presentation are required (6 Credits).

c. Abbreviated faculty CVs

d. Letters of support from potential employers (on company letter head)

e. Complete employment announcements (recent, within 6 months, and showing that the degree is required at the level proposed)

f. Student survey and results (and emails from students if provided as support)

g. Alumni survey and results