THE GRADUATE SCHOOL - UNIVERSITY OF RHODE ISLAND
NEW PROGRAM REPORT FROM THE GRADUATE COUNCIL TO THE FACULTY SENATE
CURRICULAR REPORT 2012-13-2A; 19 November 2012

At Meeting No. 467 held on 19 November 2012, the Graduate Council approved the attached proposal that is now submitted to the Faculty Senate.

SECTION I
BACKGROUND INFORMATION

ABSTRACT
The Graduate Council approved a proposal from the College of the Environment and Life Sciences (CELS) for a ***Graduate Certificate in Geographic Information Systems and Remote Sensing (GIS/RS).*** The program is designed to provide students advanced training in using geospatial technologies to address analytical problems where location is an essential parameter. All environmental issues are place-based and require data on the location of features on the surface of the earth (e.g. wetlands, aquifers, land use, people, sources of pollution, coasts, etc.). Students completing the URI GIS/RS Certificate program will be competent in accessing geospatial data from many sources, creating a cartographically uniform database of geospatial information, performing spatial analysis, and tabulating results quantitatively and cartographically.

BACKGROUND
The US Department of Labor identified geotechnology, including Geographic Information Systems (GIS), remote sensing, and Global Position System (GPS), as one of the most important emerging and evolving fields, comparable to the fields of nanotechnology and biotechnology. Education in GIS and remote sensing is now a fundamental expectation required of the new generation of workforce in environmental science and natural resources management. GIS and Remote Sensing (GIS/RS) technologies are pervasive in the land management workplace and are critical support tools for resource conservation, and use planning, pollution abatement, water resources management, and environmental protection.

The Budget Office reviewed the proposal with the understanding that the new program will use existing departmental faculty and support staff. It is further expected that the Department will use its resources to sustain the program in the future.

SECTION II
RECOMMENDATION

The Graduate Council approved the proposal ***Graduate Certificate in Geographic Information Systems and Remote Sensing (GIS/RS***) at its Meeting No. 467 held on 19 November 2012, and forwards it to the Faculty Senate with a recommendation for approval.

A Proposal for a

A. PROGRAM INFORMATION

1. Name of institution

University of Rhode Island

2. Name of department, division, school or college

Department of Natural Resources Science, College of the Environment and Life Sciences

3. Title of proposed program and Classification of Instructional Programs (CIP) code

Graduate Certificate in GIS and Remote Sensing. CIP code = 45.0702

4. Intended initiation date of program change. Include anticipated date for granting first degrees or certificates, if appropriate.

Initiation date: September 2013
First degree date: May 2014

5. Intended location of the program

URI Main Campus, College of the Environment and Life Sciences

6. Description of institutional review and approval process

	Approval Date
Department	9/11/2012
College	10/5/2012
CAC/Graduate Council	11/19/2012
Faculty Senate	
President of the University	

7. Summary description of proposed program (not to exceed 2 pages)

The URI Graduate Certificate in Geographic Information Systems and Remote Sensing (GIS/RS) provides students advanced training in using geospatial technologies to address analytical problems where location is an essential parameter. All environmental issues are place-based and require data on the location of features on the surface of the earth (e.g. wetlands, aquifers, land use, people, sources of pollution, coasts, etc.). Students completing the URI GIS/RS Certificate program will be competent in accessing geospatial data from many sources, creating a cartographically uniform database of geospatial information, performing spatial analysis, and tabulating results quantitatively and

cartographically. All students will be able to create new geospatial databases in both raster and vector formats. Students will have the opportunity to use their newly acquired skills in class projects and specialty courses such as coastal applications of GIS/RS, landscape-scale applications, and statistical analysis of spatial data.

The URI GIS/RS Certificate program does not require any new classes or FTEs. It is based on a strong collection of existing classes offered across campus. The classes can accommodate new students pursuing the GIS/RS Certificate.

8. **Signature of the President**

David M. Dooley

9. **Person to contact during the proposal review**
   Name: Peter August and Yeqiao Wang
   Address: Department of Natural Resources Science
   Phone: 4-4794, 4-4345
   Email: pete@edc.uri.edu, yqwang@uri.edu

10. **Signed agreements for any cooperative arrangements made with other institutions/agencies or private companies in support of the program.**

N/A

B. **RATIONALE: There should be a demonstrable need for the program.**

1. **Explain and quantify the needs addressed by this program, and present evidence that the program fulfills these needs.**

The US Department of Labor identified geotechnology, including Geographic Information Systems (GIS), remote sensing, and Global Position System (GPS), as one of the most important emerging and evolving fields, comparable to the fields of nanotechnology and biotechnology[1]. Education in GIS and remote sensing is now a fundamental expectation required of the new generation of workforce in environmental science and natural resources management. GIS and Remote Sensing (GIS/RS) technologies are pervasive in the land management workplace and are critical support tools for resource conservation, land use planning, pollution abatement, water resources management, and environmental protection. Furthermore, GIS/RS technologies are central to emergency response and public safety operations, business allocation modeling, and decision-support systems. In

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[1]   Gewin, V, 2004. Mapping Opportunities, *Nature*, Vol. 427, Jan. 2004.

recent years we have found a large number of working professionals are seeking a GIS/RS graduate certificate program to add these technical skills to their portfolio of existing skills in land management, civil engineering, geology, conservation biology, soils, hydrology, wetlands, forestry, municipal, planning, etc. Evidence for the widespread adoption of GIS/RS technologies in the work place is the simple fact that every public agency, most municipalities, every large engineering and planning firm, and most NGO's have invested in GIS/RS to manage their geospatial (map) data. There is a huge demand for trained personnel in this field and academic institutions have responded by offering graduate certificate programs to provide focused training in geospatial technology. For example, the US Department of Labor (http://tinyurl.com/GISCert-1) reports annual growth in Geospatial Technology to be expanding at a rate of 100%/year for commercial applications and 35% overall. In August 2012 there were 180 GIS/RS certificate programs at academic institutions in the US. Clark University, Boston University, U Mass Boston, and University of Connecticut are the closest competing certification programs in southern New England. This new certificate will be the first GIS/RS credentialing within Rhode Island and builds on URI's long-standing reputation as a national and international leader in this field. In 2010, Money Magazine rated "GIS Analyst" in the top 100 job categories in America based on wage potential and professional growth (http://tinyurl.com/GISCert-2). The URI GIS/RS Certificate program will provide working professionals and graduate students a solid foundation in geospatial technology and prepare them to use these tools to address the complex problems facing society.

C.   INSTITUTIONAL ROLE: The program should be clearly related to the published role and mission of the institution and be compatible with other programs and activities of the institution.

1. Explain how the program is consistent with the published role and mission of the institution and how it is related to the institution's academic planning.

Spatial data analysis has been a core component of the NRS pedagogy since 1987. The GIS/RS classes serve undergraduate and graduate majors from the CELS, the College of Engineering, and Oceanography, among others. It is a fundamental technology to address geospatial data that are location-based, as are nearly all environmental and social science data. Spatial data analyses are core components of the Sea Grant and Land Grant programs at URI and serve as major components of numerous external grants.

D.   INTERINSTITUTIONAL CONSIDERATIONS: The program should be consistent with all policies of the Board of Governors pertaining to the coordination and collaboration between public institutions of higher education. (Consult the Board of Governors' *Coordination Plan for Academic Programs in Rhode Island Public Institutions of Higher Education* [www.ribghe.org/publicreg.htm] for guidelines and

restrictions regarding the types and levels of programs the institutions are allowed to offer.)

URI coordinates GIS software site licensing purchasing through the Board of Governors for Higher Education. Professors August and Wang interact regularly with their colleagues at RIC. CCRI does not have a GIS curriculum at the present time. No new software licensing is required for this certificate.

1. **Estimate the projected impact of program on other public higher education institutions in Rhode Island (e.g. loss of students or revenues), provide a rationale for the assumptions made in the projections, and indicate the manner in which the other public institutions were consulted in developing the projections.**

   RIC offers an introductory GIS class taught by an adjunct faculty member in their geography program within the Political Science Department. Neither RIC nor CCRI teach any classes in remote sensing. The proposed certificate program will complement and strengthen higher education throughout the state of Rhode Island.

2. **Using the format prescribed by RIOHE, describe provisions for transfer students (into or out of the program) at other Rhode Island public institutions of higher education. Describe any transfer agreements with independent institutions. The institution must also either submit a Joint Admissions Agreement transition plan or the reason(s) the new program is not transferable. (See *Procedure for Strengthening the Articulation/Transfer Component of the Review Process for New Programs* which can be found at *www.ribghe.org/publicreg.htm*.)**

   GEOG306 (3 cr) at RIC would be equivalent to NRS409 (3 cr)

3. **Describe any cooperative arrangements with institutions offering similar programs. (Signed copies of any agreements pertaining to use of faculty, library, equipment, and facilities should be attached.)**

   No cooperative arrangements are required for this certificate program.

4. **If external affiliations are required, identify providing agencies. (Indicate the status of any arrangements made and append letters of agreement, if appropriate.)**

   N/A

5. **Indicate whether the program will be available to students under the New England Board of Higher Education's (NEBHE) Regional Student Program (RSP).**

We are not requesting this certificate program to be included under the NEBHE RSP. We note that GIS/Remote Sensing training is available at both UCONN and UMASS.

E. **PROGRAM: The program should meet a recognized educational need and be delivered in an appropriate mode.**

1. **Prepare a typical curriculum display for one program cycle for each sub-major, specialty or option, including the following information:**

   a. **Name of courses, departments, and catalog numbers and brief descriptions for new courses, preferably as these will appear in the catalog. In keeping with each institution's timetable for completion of student outcomes assessment, each institution should provide an assessment plan detailing what a student should know and be able to do at of the program and how the skills and knowledge will be assessed. For example, if a department brings forth a new program proposal but that department is not slated to have its student outcomes assessment completed until 2008, the program could be approved but with the provision that the department return no later than 2008 and present to the Academic and Student Affairs Committee its student outcomes for that particular program.**

   Through the stated goals and learning outcomes of this certificate program (see section L), graduates will be competent in accessing geospatial data from many sources, creating a cartographically uniform database of geospatial information, performing spatial analysis, and tabulating results quantitatively and cartographically. All students will be able to create new geospatial databases in both raster and vector formats. Students will have the opportunity to use their newly acquired skills in class projects and specialty courses such as coastal applications of GIS/RS, landscape-scale applications, and statistical analysis of geospatial data.

   Overall assessment plans for NRS programs/courses are currently under development or review by the URI Office of Assessment. Assessment rubrics for evaluation of this certificate program are provided in section L.1. of this proposal. Assessment of this program will take place annually and in accordance with the assessment planning and reporting schedule for certificates required by the University.

   The GIS/RS Certificate will be based on existing classes. <u>No new courses are required for this certificate</u>. A typical curriculum might look like:

   Semester 1:
   NRS410**.** Fundamentals of GIS (3 cr).
   NRS509. Concepts of GIS and Remote Sensing in Environmental Science (3 cr)
   NRS516. Remote Sensing in Natural Resources Mapping (3 cr)

Semester 2:
NRS522. Advanced GIS Analysis of Environmental Data (3 cr)
NRS524. Application of Advanced Spatial Analysis (1 cr)

NRS533. Landscape Pattern and Change (3 cr**), or**
MAF465. GIS Applications in Coastal and Marine Management (3 cr)

b. **Required courses in area of specialization and options, if any.**

   Required Courses:

   NRS410**.** Fundamentals of GIS (3 cr).
   NRS509. Concepts of GIS and Remote Sensing in Environmental Science (3 cr)
   NRS522. Advanced GIS Analysis of Environmental Data (3 cr)

   NRS516. Remote Sensing in Natural Resources Mapping (3 cr) <u>**or**</u> NRS415. Remote Sensing of the Environment (3 cr)

   3 Credits From the Following Concentration Courses:

   NRS524. Application of Advanced Spatial Analysis (1 cr)
   NRS533. Landscape Pattern and Change (3 cr**)**
   MAF465. GIS Applications in Coastal and Marine Management (3 cr)
   STA515. Spatial Data Analysis (3 cr)
   OCG555. Modern Oceanographic Imaging and Mapping Techniques (3 cr)
   OCG665. Marine Bio-Optics and Remote Sensing (3 cr)

c. **Course distribution requirements, if any, within program, and general education requirements.**

   N/A

d. **Total number of free electives available after specialization and general education requirements are satisfied.**

   In addition to 12 credits of the four required courses, 3 credits are to be chosen from a specific list of concentration classes. There are no free electives.

e. **Total number of credits required for completion of program or for graduation. Present evidence that the program is of appropriate length as illustrated by conformity with appropriate accrediting agency standards, applicable industry**

standards, or other credible measure, and comparability of lengths with similar programs in the state or region.

Total Credits Required to Complete Certificate = 15 cr (5 courses).

Credit/course requirements for comparable programs:

> U Mass Boston GIS Certificate, 4 courses
> University of Connecticut GIS Certificate, 4 courses
> University of New Haven GIS Certificate, 4 courses
> University of Wisconsin, 5 courses and internship
> U Maryland Baltimore County GIS Certificate, 5 courses

f. **Identify any courses that will be delivered or received by way of distance learning. (Refer to *www.ribghe.org/publicreg.htm* for the *Standards for Distance Learning in the Rhode Island System of Public Higher Education*.)**

All classes will meet in person. None are delivered by distance learning at this time.

g. **Describe the admission requirements for students in the program.**

Applicants for the Graduate Certificate in GIS and Remote Sensing must meet the following requirements:

1. A Bachelor's degree in natural or social sciences, business, finance, geography, surveying, policy, economics, communications, engineering, or other disciplines that require place-based analysis.
2. Coursework or work experience in performing basic quantitative analysis or graphic design using contemporary software programs.

Applicants will provide college transcripts, a personal statement of their interest in pursuing the GIS/RS Certificate, and two letters of recommendation. GRE scores are not required. Applications will be submitted through the normal URI Graduate School system (Apply Yourself) and be evaluated by Drs. Wang and August. Students may begin the program in the Fall or Spring semesters.

2. **Describe certification/licensing requirements, if any, for program graduates and the degree to which completion of the required course work meets said requirements. Indicate the agencies and timetables for graduates to meet those requirements.**

The professional certification for GIS – called a GISP – administered by the GIS Certificate Institute, requires 400 hours of instruction for certificate holders. Our lecture and lab course will exceed this GISP requirement.

3. **Include the learning goals (what students are expected to gain, achieve, know, or demonstrate by completion of the program) and requirements for each program.**

The learning goals for the GIS/RS Graduate Certificate program are:

Goal I. Produce graduates with advanced-level technical skills in GIS and remote sensing along with analytical and cartographic abilities to successfully conduct geospatial analyses that support state, national and international industries, agencies and institutions that address the location-based challenges facing society.

Goal II. Prepare graduates with the ability to perform geospatial data processing appropriate for research, scholarly, applied problem-solving, and/or creative endeavors.

Goal III. Prepare graduates to be interested, motivated and capable of pursuing continued life-long learning in geospatial data processing in order to keep abreast of advances in GIS/RS hardware, software, and data.

4. **Demonstrate that student learning is assessed based on clear statements of learning outcomes and expectations.**

Learning outcomes for each learning goal for this certificate are:

Goal I Above
Outcome – Graduates will know how to search for and download geospatial data from the Internet and convert the data into a file format, coordinate system, and datum suitable for spatial data analysis designed to achieve the results sought for the application at hand.

Goal II Above
Outcome – Graduates will have acquired advanced level skills in raster and vector spatial data analysis including the ability to quantitatively analyze spectral variables to extract land cover classes from airborne and satellite imagery.

Goal III Above
Outcome – Graduates will be skilled in using professional associations and web, blog, wiki, social networks, and other electronic means to participate in the community of practitioners to stay abreast of advancements in GIS and remote sensing science.

F. **FACULTY AND STAFF: The faculty and support staff for the program should be sufficient in number and demonstrate the knowledge, skills, and other attributes necessary to the success of the program.**

    1. **Describe the faculty who will be assigned to the program. Indicate total full-time equivalent (FTE) positions required for the program, the proportion of program faculty who will be in tenure-track positions, and whether faculty positions will be new positions or reassignment of existing positions.**

        Peter August, Professor, Natural Resources Science, existing position
        Yeqiao Wang, Professor, Natural Resources Science, existing position
        Robert Thompson, Professor, Marine Affairs, existing position
        Liliana Gonzalez, Professor, Statistics, existing position
        Gavino Puggioni, Assistant Professor, Statistics, existing position
        Peter Cornillon, Professor, Oceanography, existing position
        Christopher Roman, Associate Professor, Oceanography, existing position

        These faculty have been provided a copy of this GIS/RS Certificate proposal to review and all of the feedback we have received has been positive and supportive.

        No new FTE's are required for the certificate.

G. **STUDENTS: The program should be designed to provide students with a course of study that will contribute to their intellectual, social and economic well-being. Students selected should have the necessary potential and commitment to complete the program successfully.**

    1. **Describe the potential students for the program and the primary source of students. Indicate the extent to which the program will attract new students or will draw students from existing programs and provide a specific rationale for these assumptions. For graduate programs, indicate which undergraduate programs would be a potential source of students.**

        We anticipate three types of students working toward this certificate. (1) Students enrolled in existing graduate programs (e.g., Biological and Environmental Science, Marine Affairs, Oceanography, Civil Engineering, MESM) will enter this certificate program to obtain this credential in addition to their graduate degree. (2) We expect to attract students who possess a Bachelor's degree and want to improve their GIS/RS skills to enhance their employability. These students would complete the program in two semesters. (3) Finally, we expect to attract working professionals who require advanced training in GIS/RS and will complete the requirements for the certificate in 3-4 semesters

as part-time students. Inasmuch as there is no similar certificate program at URI, we will not be redirecting students from another program to ours.

The GIS/RS Graduate Certificate will be granted in three different ways:

1. As a stand-alone certificate to students meeting the course requirements.
2. As a precursor to a M.S. degree. Students who come to URI for the certificate might choose to expand their studies and enter a Master's Degree program (such as MESM or BES in CELS). In cases such as this, credits taken to satisfy the certificate requirement would count toward the M.S. degree.
3. Concurrent with a graduate degree. A matriculating graduate student who can satisfy the GIS/RS Graduate Certificate requirements in conjunction with the courses identified in their M.S. or Ph.D. Program of Study would be eligible to receive the GIS/RS Certificate.

L.   EVALUATION: Appropriate criteria for evaluating the success of a program should be development and used.

1. List the performance measures by which the institution plans to evaluate the program. Indicate the frequency of measurement and the personnel responsible for performance measurements. Describe provisions made for external evaluation, as appropriate.

August and Wang will measure the success of the overall program (annually) using this rubric. Threshold values for each cell are based on our initial expectations for the certificate program.

Metric	Successful Beyond Expectations	As Expected	Does Not Meet Expectation
Number of applicants per year. The larger this number, the more successful the program. If we get no applicants in the first three years, we will assume we misjudged the marketplace. Since all the classes used to meet the requirements for the certificate are already being taught, there will be no impact if the program is poorly subscribed.	Over 15	1-15	0
Number of matriculating students. We will monitor the number of students actively pursuing a GIS/RS certificate. Because we might be hosting part-time students who need extra time to complete the	Over 10	1-10	0

requirements for the certificate, the number of matriculating students will give us a good indication of program vitality.			
Number of certificates granted per year. A student should be able to complete the certificate in two semesters if they take three classes per semester. Part-time students should be able to complete the program in four semesters. If students fail to complete the requirements in these time windows, we will have to determine what the obstacles are.	Over 10	1-10	0
Student diversity. We will advertise the GIS/RS certificate to reach students representing a diversity of cultures, genders, ages, and stage of career.	Equitable distribution of students across all diversity categories	Some representation of diversity categories but not spread evenly	No students from underrepresented diversity categories

August and Wang will measure the attainment of learning outcomes for students using the following rubric:

Outcome – Graduates will know how to search for and download geospatial data from the Internet and convert the data into a file format, coordinate system, and datum suitable for spatial data analysis designed to achieve the results sought for the application at hand.			
Element/Evaluation Event	**Accomplished**	**Proficient**	**Novice**
Data Search and Database Creation

1. Evaluated in Project # 1 in NRS 522.
2. Evaluated in Project 2 in NRS 410 | Able to find accurate and current geospatial data at an appropriate scale and standardize the database to a common geography to support analysis and mapping. | Able to create a database in support of a GIS/RS application but some requisite data are missing, at an inappropriate scale, or in incompatible digital formats. | Unable to locate readily available geospatial data, not able to standardize to a common geography and data format system. |
Outcome – Graduates will have acquired advanced level skills in raster and vector spatial data analysis and the ability to quantitatively analyze spectral variables to extract land cover classes from airborne and satellite imagery.			
Element/Evaluation Point	**Accomplished**	**Proficient**	**Novice**
Modeling and Analysis	Capable of developing models and workflows that	Able to develop models or workflows that	Unable to develop a model or a workflow to

1. Evaluated in Project # 2 in NRS 522. 2. Evaluated in Final Project NRS 516	include performing preprocessing, geometric rectification, image classification, change analyses, terrain assessment, overlay functions, and neighborhood analysis.	include some geospatial data analysis functions but not the full suite of advanced procedures.	perform complex geospatial analysis.

Outcome – Graduates will be skilled in using professional associations and web, blog, wiki, social networks, and other electronic means to participate in the community of practitioners to stay abreast of advancements in GIS and remote sensing science.

Element/Evaluation Point	Accomplished	Proficient	Novice
Community of Practice 1. Evaluated in Class Project in NRS 509	Member of a number of GIS/RS LISTSERVS, regularly follows online bulletin boards and blogs, is a member in professional organizations, attends regional and national conferences, and participates in training webinars.	Occasionally participates in GIS/RS-relevant LISTSERVS and electronic forums, periodically attends conferences and workshops, rarely follows blogs, wikis, or online training.	Does not interact with peer individuals or organizations.

Evaluation Roadmap. Student Evaluation of learning outcomes will occur at the following required courses within in the GIS/RS Certificate program.

Learning Outcome	Required Course				
	NRS 410	NRS 415	NRS 509	NRS 516	NRS 522
Outcome 1 – Graduates will know how to search for and download geospatial data from the Internet and convert the data into a file format, coordinate system, and datum suitable for spatial data analysis designed to achieve the results sought for the application at hand.	✕	✕	✕		✕
Outcome 2 - Graduates will have acquired advanced level skills in raster and vector spatial data analysis and the ability to quantitatively analyze spectral variables to extract land cover classes from airborne and satellite				✕	✕

imagery.					
<u>Outcome</u> 3 – Graduates will be skilled in using professional associations and web, blog, wiki, social networks, and other electronic means to participate in the community of practitioners to stay abreast of advancements in GIS and remote sensing science.			✗	✗	✗