

Degree Proposal for the Ph.D. in Geosciences (CIP 40.0699) at Florida Atlantic University

The Department of Geosciences at Florida Atlantic University proposes to offer advanced professionally oriented graduate training in an on-campus program leading to the degree of Doctor of Philosophy (Ph.D.) in Geosciences with an implementation date of the 2009-2010 academic year. The specific aim of the program is to produce professionals with the knowledge and skills necessary to contribute, directly or indirectly, to the conservation and prudent use of natural resources for the general benefit of Florida and its citizens, as this will foster independent scientific and technical research, not to mention comprehensive assessments on major environmental issues. Planning for the degree proposal has been done in close consultation with the geoscience professional community and has led to the formation of an advisory board which will continue to monitor the degree program once implemented. Below are some salient features of the degree proposal.

- The PhD program will provide ***advanced research and technical training*** to allow its graduates to find ***solutions*** to Florida's environmental problems.
- The program will be an innovative ***professionally oriented degree*** which answers the call from employers in the South Florida area and throughout the state, such as the Florida Department of Environmental Protection, the South Florida Water Management District, and the U.S. Geological Survey, that have a growing need for ***highly trained individuals*** in advanced technology and field applications in the geosciences.
- The doctorate will be an ***integrated professional*** program, whereas existing doctoral programs in the State of Florida related to this proposal are largely ***discrete*** (i.e. solely focused on either geography or geology) and are designed largely for the traditional academic career track. The lack of a combined geography/geology focus in other advanced degree programs in the State of Florida is of ***serious concern*** to the environmental professional community, as the letters of support included in the proposal strongly attest.
- The program will ***integrate technical and field aspects*** of geography and geology at the doctoral level with cognate areas such as field biology, anthropology, chemistry and urban planning to create true, well-rounded geoscientists who can look at complex environmental problems in a more holistic manner.
- While the main focus of the degree will be on ***traditional, full-time students***, the degree program will also ***welcome part-time students*** who wish to maintain their professional employment while earning their doctoral degree. Thus, the degree program also brings educational opportunities to professional geoscientists in the South Florida region who are interested in updating and advancing their skills as geoscientists, yet cannot abandon their current employment.
- The professional community in South Florida is ***very excited about this integration*** and has argued that the degree ***will appeal to a wide audience***. This is **NOT** yet another doctoral program in geography or geology being proposed in Florida, it is a *geosciences* doctoral program, which implies much more.

- Based on professional demand in Florida, students in the program will specialize in one of the following areas:

--Hydrology and Water Resources: Research/coursework in applied hydrology (quantity and quality) and water resources aimed at surface, sub-surface and coastal processes.

--Urban Development and Sustainability: Research/coursework in urban land use change, environmental systems and economic development focused on sustainable urban development and the local impact of globalization and global environmental change in South Florida communities.

--Cultural and Spatial Ecology Research: Research/coursework in biogeography of natural ecosystems and ethnobotanical studies - reconstructing past environments/analyzing present environments - for mapping and modeling vegetation, ecosystems and natural resources.

- There are no plans to abandon the current master's programs, but to *retool the master's* programs towards terminal degree programs geared towards developing *specific applied job skills* in geography and geology. Master's students would be trained for a very different kind of job, perhaps more as a geosciences technician as opposed to a holistic scientist.

Institutional and State University System Missions:

- The Ph.D. in Geosciences will *complement and support* the strategic goals of Florida Atlantic University (FAU) and the State University System (SUS). The four, broader goals set forth by the SUS include:

GOAL 1: Access to and production of degrees,

GOAL 2: Meeting statewide professional and workforce needs,

GOAL 3: Building world-class academic programs and research capacity, and

GOAL 4: Meeting community needs and fulfilling unique institutional responsibilities.

The 7 goals within the FAU Strategic Plan are:

GOAL 1: Providing increased access to higher education,

GOAL 2: Meeting statewide professional and workforce needs,

GOAL 3: Building world-class academic programs and research capacity,

GOAL 4: Meeting community needs and fulfilling unique institutional responsibilities,

GOAL 5: Building a state-of-the-art-information technology environment, and

GOAL 6: Enhancing the physical environment,

GOAL 7: Increasing the university's visibility.

- The proposed degree program will be a *professional degree* (SUS Goal 2, FAU Goal 2) which answers the call from state and federal employers in the area, other local agencies and environmental consulting firms for more highly trained individuals in advanced

technology and field applications in geosciences in order to study and solve various environmental problems in South Florida and beyond.

- The program will emphasize higher level **integration** of conventional disciplines such as geography, geology, and earth sciences with technical and field based sciences, and will thus provide access to a different type of doctoral degree program not currently available in the state of Florida (SUS Goal 1, FAU Goal 1).
- The program will welcome **part-time applicants** from the geoscience professional community in South Florida, making advanced educational and research opportunities available to a wider constituency in the FAU service region (SUS Goal 1, FAU Goal 1).
- The program will make an **important contribution** towards FAU's strategic goal of committing academic and fiscal resources to meeting Florida's need for trained professionals in areas that implement advanced technologies, and help prepare students for emerging trends in the labor force in Florida (SUS Goals 2 and 4, FAU Goals 2 and 4). In this way, the department is demonstrating its commitment to recruiting and preparing students for professions vital to the sustainability of Florida.
- The Department is at the **forefront of geoscience research and technologies** and encourages fieldwork and the attainment of skills in applied tools such as quantitative and theoretical techniques, geographic information systems, hydrologic modeling and remote sensing (FAU Goal 3).
- Students have the opportunity to be **trained in specialized research facilities**, such as the Geo-Information Science Center and the proposed Hydrology and Water Resources Center (SUS Goal 3). These centers provide services to a variety of clients, including the National Science Foundation, South Florida Water Management District, Florida Department of Environmental Protection, and various municipal agencies.
- Inclusion of a Ph.D. in Geosciences will allow the Department, College and University to **expand its graduate and overall research** presence in environmental conservation and sustainability, and in the work associated with one of the world's largest environmental restoration projects – the Comprehensive Everglades Restoration Plan (CERP), thus adding to the greater visibility of the university in the area of environmental research (FAU Goal 7).
- The program will **meet community needs** and fulfill unique institutional responsibilities in the seven-county service region (SUS Goal 4 and FAU Goal 4) by offering specialty programs to address **local environmental concerns** in areas of environmental analysis such as contamination and planning due to the relative scarcity of water resources and water contamination and the problem of unsustainable management of natural resources, which hampers human development and urbanization efforts.

Fiscal Implications

- The main cost of implementing the program is met through **reallocated dollars** from

current salary resources, therefore providing an important educational opportunity for FAU's service area at a very *minimal additional cost*.

- Recent faculty hires between 2005 and 2007 and faculty staffing in the Department is *adequate to initiate the program*.
- *No additional funding* beyond an increase in graduate stipends is necessary to start the program.
- *No additional space* is needed to start the program, although more space has been committed to the department as this program grows.
- *No special equipment or library resources* are needed to implement the program.

Florida Board of Governors

Request to Offer a New Degree Program

Florida Atlantic University
University Submitting Proposal

August 2008
Proposed Implementation Date

Charles E. Schmidt College of Science
Name of College or School

Geosciences
Name of Department(s)

Geography and Geology
Academic Specialty or Field

Ph.D. in Geosciences
Complete Name of Degree
CIP Code=45.0799

The submission of this proposal constitutes a commitment by the university that, if the proposal is approved, the necessary financial resources and the criteria for establishing new programs have been met prior to the initiation of the program.

March 19, 2008
Date Approved by the University Board of Trustees

Frank T. [Signature] 3/19/08
President Date

[Signature] 3/19/08
Signature of Chair, Board of Trustees Date

[Signature] 3/29/08
Vice President for Academic Affairs Date

Provide headcount (HC) and full-time equivalent (FTE) student estimates of majors for Years 1 through 5. HC and FTE estimates should be identical to those in Table 1. Indicate the program costs for the first and the fifth years of implementation as shown in the appropriate columns in Table 2. Calculate an Educational and General (E&G) cost per FTE for Years 1 and 5 (Total E&G divided by FTE). (**SEE NOTE ** BELOW**)

Implementation
Timeframe

Projected Student
Enrollment (From Table 1)

Projected Program Costs
(From Table 2)

	HC	FTE	Total E&G Funding	Contract & Grants Funding	E&G Cost per FTE
Year 1	16	9	292,602	18,000	32,511
Year 2	31	18			
Year 3	42	25			
Year 4	51	31.5			
Year 5	58	36.5	669,448	465,250	18,341

****NOTE: For Year 1, only \$40,000 of Total E&G costs (13.6%) is new E&G \$\$ needed specifically for the Ph.D. program.**

FLORIDA ATLANTIC UNIVERSITY

NEW DEGREE PROGRAM APPROVAL
ROUTING AND SIGNATURE

PROPOSED PROGRAM Ph.D. in Geosciences CIP 45,0799

DEPARTMENT Geoscience Russell Dy 10/24/07
(Name) (Chair) (Date)

COLLEGE Science G. W. Perry 10/25/07
(Name) (Dean) (Date)

PROVOST'S OFFICE Norman Kaufman 11/13/07
(Assoc. Provost - Academic Budgets) (Date)

M. R. Allen 11/13/07
(Assoc. Provost - Enrollment Management) (Date)

DEAN OF UNDERGRADUATE/GRADUATE STUDIES Bryant T. Ramm 11-16-07
(Circle One) (Date)

UTS E. H. New 12/7/07
(President) (Date)

PROVOST John F. Whitely 12/10/07
(Date)

INTRODUCTION

I. Program Description and Relationship to System-Level Goals

- A. Briefly describe within a few paragraphs the degree program under consideration, including (a) level; (b) emphases, including concentrations, tracks, or specializations; (c) total number of credit hours; and (d) overall purpose, including examples of employment or education opportunities that may be available to program graduates.**

The Department of Geosciences at Florida Atlantic University, housed in the Charles E. Schmidt College of Science on the Boca Raton campus, proposes to offer advanced graduate training in an on-campus program leading to the degree of Doctor of Philosophy (Ph.D.) in Geosciences. This professionally oriented program will combine department specialties in geography and geology with other cognate areas in the College and the University. The program will build upon successful undergraduate and master's degrees in geography and geology already offered through the department at FAU, and will provide advanced research and technical training to allow its graduates to find *solutions* to problems. The doctorate will be an *integrated* program, whereas existing doctoral programs in the State of Florida related to this proposal are largely *discrete* (i.e. solely focused on either geography or geology) and are designed largely for the traditional academic career track. The proposed degree program will be an innovative *professional degree* which answers the call from employers in the South Florida area and throughout the state, such as the Florida Department of Environmental Protection, the South Florida Water Management District, Broward County and Palm Beach County Planning Agencies, the Army Corp of Engineers, the U.S. Geological Survey, Coastal Planning and Engineering, Inc. and a variety of other local agencies and environmental consulting firms that have a growing need for highly trained individuals in advanced technology and field applications in the geosciences. While the main focus of the degree will be on traditional, full-time students, the degree program will also welcome part-time students who wish to maintain their professional employment while earning their doctoral degree. Thus, the degree program also brings educational opportunities to professional geoscientists in the South Florida region who are interested in combining geography, geology and cognate areas at an advanced graduate level and cannot abandon their current employment or move from the South Florida area to pursue doctoral programs in other parts of the state. With all the above in mind, this new Ph.D. program will thus meet all of the goals set forth in both the SUS and FAU strategic plans, namely:

1. Access to and production of degrees,
2. Meeting statewide professional and workforce needs,
3. Building world-class academic programs and research capacity,
4. Meeting community needs and fulfilling unique institutional responsibilities.

The geosciences examine the earth as a series of interrelated systems and processes thus, involving analysis of natural and human phenomena within the earth system at various spatial and temporal scales. Since 2004, the Department has gone through the process of tightly integrating the geosciences at FAU, successfully merging the teaching and research strengths of

the Department in geography and geology. Additionally, we are building teaching and research programs that complement and enhance the missions of FAU's Charles E. Schmidt College of Science, the Environmental Science program, the Center for Environmental Studies, Center for Urban and Environmental Solutions, Center for Urban Redevelopment and Education, and the Harbor Branch Oceanographic Institution. Continued strengthening of the Department's research Center in Geo-Information Science and the proposed creation of a Center for Hydrogeology and Water Resources are both an integral part of the Department mission. In response to local need, and as presented at the FAU Board of Trustees retreat on campus planning in 2006 (www.fau.edu/provost/files/06_bot_retreat-campusprogramplans.pdf), the Department will expand its course offerings, both undergraduate and graduate, and its research presence on the Davie campus of FAU in Broward County to create further synergism with the field/environmental biologists housed on that campus, and to be prepared to successfully interact with the US Geological Survey operations expected to take residence and grow in presence in Davie in the near future to expand research on the Comprehensive Everglades Restoration Project (CERP). The Department has also begun a dialogue with the University of Miami's Rosenstiel School of Marine and Atmospheric Science and will seek to foster research synergism, particularly in Everglades research, as our program grows and develops. Our relationship with all of the above-mentioned programs and centers will be key to the development of a well-rounded integrated doctoral program in the geosciences, tailored particularly to the South Florida region.

An advanced degree program combining facets of both geography and geology into a doctoral degree in Geosciences will be especially tailored to the changing needs of the university's service region through an innovative curriculum that includes cross-disciplinary course work in the geosciences as well as ecology and conservation biology, chemistry, anthropology and urban and regional planning. The Department of Geosciences is very well positioned to address and resolve a broad spectrum of spatial and environmental problems in both theoretical and applied contexts. Understanding human, environmental and surface and subsurface processes of the past and present, modeling to predict for the future, as well as having the skill to identify related problems and provide solutions, is essential for environmental and human sustainability. The existing strengths of the Department, the College, the University and the local community, as highlighted below, combine to provide a dynamic program covering both regional and global aspects of the geosciences.

- State-of-the-art geospatial equipment in GIS, Remote Sensing and Hydro-Modeling
- State-of-the-art field equipment including GPS units and surveying equipment
- Strong involvement of faculty and graduate students in local, national (i.e. NSF) and international grants addressing real-world problems
- Department-housed Center for Geo-Information Sciences
- Proposed Center for Hydrogeology and Water Resources
- Excellent working relationship with other FAU research units such as the Center for Environmental Studies, Center of Excellence in Biomedical and Marine Biotechnology, Harbor Branch Oceanographic Institution, Center for Urban and Environmental Solutions, Center for Urban Redevelopment and Education, Environmental Science program, Department of Biological Sciences, Department of Anthropology [and its proposed Public Archeology Center which will have a marine archeology component],

Department of Chemistry and Biochemistry, the College of Engineering and Computer Science, and the Department of Urban and Regional Planning

- Excellent working relationships with local governmental units and agencies such as the South Florida Water Management District, USGS, Florida Department of Environmental Protection, and the Broward and Palm Beach County Planning Offices
- Research strengths of the University of Miami's Rosenstiel School of Marine and Atmospheric Science as a partner for Everglades research
- Excellent working relationship with local environmental consulting and research agencies such as Coastal Planning and Engineering, CEPEMAR, and the Coastal Education and Research Foundation
- Major environmental conservation areas including the world's largest, 30-year multi-billion dollar environmental restoration project (CERP) in our neighborhood
- Rapidly escalating local job markets highly geared towards environmental analysis and planning in SE Florida.

The Department of Geosciences at Florida Atlantic University offers high-quality scientific education currently leading to undergraduate and master's degrees in geography and geology with emphasis in *Earth Systems Science*, *Human-Environmental Systems Science*, and *Geo-Information Science*. The Geosciences doctoral program at FAU will provide advanced research and technical training not currently possible within a Master's program and will be consistent with the recently revised mission of the Department of Geosciences, taking full advantage of the strengths mentioned above. The program will emphasize the higher level *integration* of conventional subfields within geography, geology, and earth science with technical and field based subfields in the geosciences such as geographic information systems, remote sensing, geovisualization, geomatics, marine geology, geophysics, and coastal and environmental engineering to analyze terrestrial and aquatic subtropical environments. The cognate programs at FAU mentioned above will contribute course work and faculty input that will enhance and broaden the educational experience of the students to create well rounded professionals in the geosciences.

The program will require students to complete 90 credit hours beyond the baccalaureate degree with a cumulative GPA of at least 3.0. The Department expects doctoral students in the program to specialize in one of the following areas:

--GIScience. Applied and theoretical research in spatial information technology, particularly reconstructing past environments and analyzing present environments utilizing satellite imagery, aerial photographs and archival research as well as extracting environmental information from advanced and specialized remote sensing imagery for mapping and modeling of vegetation, ecosystems and natural resources. This research area will combine coursework and faculty expertise in geography, geology, biology and urban and regional planning.

--Hydrology and Water Resources. Research in the areas of hydrology and water resources aimed at developing a more complete understanding of both surface and sub-surface processes and their practical applications, especially dealing with flow issues, supply issues and water quality. Studies also include coastal and wetland environments. This research area will combine coursework and faculty expertise in geology, geography, biology, civil and ocean engineering and chemistry.

--Urban Development and Sustainability. Research on urban land use change, urban environmental systems and urban economic development utilizing geographic information science and other spatial analysis tools to incorporate sustainable urban development in the subtropical environment of the everglades ecosystem. This research area will combine coursework and faculty expertise in geography, geology, biology and urban and regional planning.

--Cultural and Spatial Ecology. Research focused on the biogeography of natural ecosystems as well as ethnobotanical studies focused on the cultural variations in human uses and sustainability of plants. This research area will combine coursework and faculty expertise in geography, geology, anthropology and biology.

--Marine Paleontology. Research in marine paleontology, particularly molluscan paleoecology, leading to a better understanding of past oceanic environments and climates in both high and low latitude areas. This research area will combine coursework and faculty expertise in geology, geography, anthropology, and biology.

B. Describe how the proposed program is consistent with the current State University System (SUS) Strategic Planning Goals. Identify which goals the program will directly support and which goals the program will indirectly support. (See the SUS Strategic Plan at <http://www.flbog.org/StrategicResources/>)

The proposed Ph.D. in Geosciences has been formally presented to the FAU Board of Trustees by the Dean as an important special initiative of the Charles E. Schmidt College of Science -see the presentation summary at www.fau.edu/provost/files/06_bot_retreat-campusprogramplans.pdf, and has been submitted on the List of New Degree Programs under consideration at FAU by the Provost <http://www.fau.edu/provost/files/NewDegreeProgramsUnderConsideration.pdf> to the Chancellor/BOG staff. The Ph.D. in Geosciences will complement and support the strategic goals of Florida Atlantic University (FAU) and the State University System (SUS), and where appropriate, this section will identify the specific SUS Goal met by this degree proposal. The four, broader goals set forth by the SUS include:

1. Access to and production of degrees,
2. Meeting statewide professional and workforce needs,
3. Building world-class academic programs and research capacity, and
4. Meeting community needs and fulfilling unique institutional responsibilities.

As already discussed in the introduction section of this proposal, the Ph.D. in Geosciences will not find itself in direct competition with other more traditional geography and geology doctoral programs within the state which are focused largely on traditional academic career tracks. Indeed, the statement by the Assistant State Geologist, Jonathan Arthur, in his letter of support for this program (see appendix) clearly demonstrates the need for this program:

“The degree program...clearly fills a void in Florida’s academic environment at the Ph.D. level. Many existing geology/geoscience Ph.D. programs in Florida focus primarily on theoretical concepts, with study areas across the globe. While this aspect of academia is required to further the understanding of earth processes, there are elements of your proposal that I consider relatively unique and of equal importance. Principal among these is the recognition that applied geoscience research focusing on issues facing Florida needs to be addressed in the context of human interaction with the environment. There is no better way to address many of these spatial and temporal issues than through the application of remote sensing and geographic information systems. To my understanding, most existing geography degree programs do not facilitate the linkage to geologic and hydrologic processes. In all, I would characterize the proposal as highly relevant and distinctive.” Jonathan Arthur, Assistant State Geologist, State of Florida

The proposed degree program will be a targeted professional degree (SUS Goal 2) which answers the call from state and federal employers in the area, as well as other local agencies and environmental consulting firms for more highly trained individuals in the geosciences. This is clear from excerpts given below from some of the letters of support found in the Appendix of this proposal.

“Floridians expect and deserve a healthy environment, which includes the biodiversity for which Florida is so well renowned. Local institutions should develop graduate programs at the doctoral level to focus on issues that are unique to their region, which should include coastal, wetland and aquifer protection. The water management community thus requires the presence of a multifaceted university in order to attract highly qualified employees to staff their operations. FAU can be a fertile training ground for these prospective employees...The proposed Ph.D. program in Geosciences is timely and necessary.” Sharon Trost, Chief Information Officer, South Florida Water Management District

“The U.S. Geological Survey has a strong research program in South Florida and routinely is in need of scientists at the graduate level....If implemented as proposed, the Florida Atlantic University proposal should serve a growing need in industry and government in South Florida with students who have a highly sophisticated degree of technical knowledge and skills in applied geologic and geographic science.” Barry Rosen, Director, Florida Integrated Science Center, U.S. Geological Survey

“I think this program addresses some of the more specific local needs in our professional community. Today, it is practically impossible to obtain such a Ph.D. locally without having extensive adverse impacts both personally and professionally. This program will open doors and offer opportunities that will help meet local academic needs in the applied geosciences as required by my firm and my clients...” Marco Bell, Marco Water Engineering, Inc.

“As an engineer who has been deeply involved in the Comprehensive Everglades Restoration Plan (CERP) and Restoration of Lake Okeechobee, I can testify that there is a severe lack of personnel in practical applied Geosciences. Your commitment to develop scientists who are not focused on an academic career, but are interested in working with engineers in solving complex ecological problems is very much appreciated.” K. Dan Shalloway, SFRN, Inc.

“As Geographic Information Systems becomes more prolific within the County and is integrated within the business processes of the County, the demand for workers with advanced Geosciences skills is growing exponentially.” Victoria Morrow, GIS Manager, Broward County GIS Planning Services Division

“As a consulting environmental engineering firm, we have a need for highly skilled graduates in water resources that are locally-grown. Familiarity with the water resources problems of Florida, the issues, and agencies are very important. A particular need is for graduates that have

advanced training in water resources modeling....We do not see any end to the need for advanced modelers.” Patrick Gleason, Vice President, Camp Dresser & McKee Inc.

“My combined experience with these entities has given me a broad perspective on the research needs and employment market in Florida with respect to environmental sciences. There is a need for an expanded pool of highly educated geoscience professionals in Florida, not only in relation to the growth-management issues, but also geologic hazards and natural resource conservation/protection.” Jonathan Arthur, Assistant State Geologist, State of Florida

As illustrated above, these employers have a growing need for a workforce trained in advanced technology and field applications in geosciences in order to **conduct research and provide solutions to various environmental problems** in South Florida and beyond. The program will emphasize higher level integration of conventional subfields in geography, geology, and earth sciences with technical and field based sciences and other cognate areas, and will thus provide access to a new and different doctoral degree program not currently available in the state of Florida (SUS Goals 1 and 2). Additionally, the program will welcome part-time students who can enroll in doctoral work while maintaining their professional positions, thus opening graduate educational opportunities to a wider pool of geoscience professionals than other geography and geology doctoral programs in the state. This will be a highly attractive feature to Florida’s geoscience professional community.

Doctoral students from the program will specialize in hydrogeology/water resources, GIS/Remote Sensing technologies, or various areas within environmental analysis (such as paleoenvironments, coastal environments, biogeography, ethnobotany, and urban land-use change and sustainability). These areas emphasize skill sets that are required by local job markets, which address socio-economic concerns to scientific issues (e.g., weighing the costs and benefits of tourism development to environmental protection). Thus, the program will make an important contribution towards committing academic and fiscal resources to meeting Florida’s need for trained professionals in areas that implement advanced technologies, and help prepare students for emerging trends in the labor force in general (SUS Goal 2). In this way, the department is demonstrating its commitment to recruiting and preparing students for professions vital to the sustainability of Florida.

The Department is at the forefront of geoscience research and technologies and requires fieldwork and the attainment of skills in applied tools such as quantitative and theoretical techniques, geographic information systems, hydrologic modeling and remote sensing. Students are trained in specialized research facilities, such as the Geo-Information Science Center and the proposed Hydrology and Water Resources Center within the Department and other research centers in the College and elsewhere within the university (SUS Goal 3). These centers provide services to a variety of clients, including the National Science Foundation, South Florida Water Management District, Florida Department of Environmental Protection, and various municipal agencies.

The Ph.D. in Geosciences will allow the Department, the Charles E. Schmidt College of Science and University to expand its graduate and overall research presence in environmental conservation and sustainability, and in the work associated with one of the world’s largest environmental restoration projects (i.e., Comprehensive Everglades Restoration Plan - CERP), thus adding to the greater visibility of the university in the area of environmental research. In

doing so, the program will meet community needs and fulfill unique institutional responsibilities in the seven-county region serviced by FAU (SUS Goal 4) by offering specialty programs to address local geoscience issues, such as coastal processes and water resource planning and restoration, and applied modeling.

Local job markets are increasingly highly geared towards environmental analysis, planning due to the relative scarcity of water resources and water contamination; and the problem of unsustainable management of natural resources, which hinders human development and urbanization efforts. Pollution, the depletion of natural resources, and the disintegration of ecological functions are matters of local, national and global concern. Economic development and more rigorous environmental standards not only in South Florida, but the world over contribute to the urgency of offering this doctoral program. The aim of the program is to provide professionals with the knowledge and skills necessary to contribute, directly or indirectly, to the conservation and prudent use of natural resources for the benefit of society, as this will foster independent scientific and technical research, not to mention comprehensive assessments on major environmental issues. This aim seems highly embedded within the SUS goals, as is made clear in the following statement by Sharon Trost, Chief Information Officer, South Florida Water Management District:

“In my opinion, there will be a direct relationship between the economic development of a region and the quantity and quality of college degree offerings, especially advanced degrees. Over the next thirty years, the Comprehensive Everglades Restoration Project (CERP) will demand many highly trained professionals in order to fully address major water resources and biological issues such as the state of wetlands, invasive and indigenous species of flora and fauna and of course the quantity, quality, timing and distribution of the region’s available water.” Sharon Trost, Chief Information Officer, South Florida Water Management District

INSTITUTIONAL AND STATE LEVEL ACCOUNTABILITY

II. Need and Demand

- A. Need: Describe national, state, and/or local data that support the need for more people to be prepared in this program at this level. Reference national, state, and/or local plans or reports that support the need for this program and requests for the proposed program which have emanated from a perceived need by agencies or industries in your service area. Cite any specific need for research and service that the program would fulfill.**

Broad Overview of Need:

In recent years, research in the geosciences has experienced a tremendous explosion in both quantity and quality (e.g., *NSF Geosciences Beyond 2000: Understanding and Predicting Earth’s Environment and Habitability*, National Science Foundation, Washington, DC.). This growth reflects a realized need to integrate the atmospheric, earth, and ocean sciences in order to understand the complex processes that drive human-environmental interactions. It is this need for *integration* of the various specialized disciplines that focus on individual components of the Earth System that provides the rationale for a Ph.D. Program in Geosciences at Florida Atlantic University. While SUS institutions offer graduate degrees in the various component disciplines,

synthesis is lacking, and FAU proposes to provide that synthesis to address the complex needs of the scientific community.

In his 2006 Presidential Address to the American Association for the Advancement of Science, Dr. Gilbert S. Omenn outlined scientific *grand challenges* for the future compiled from a variety of sources such as the National Science Foundation and the National Academies of Sciences. These grand challenges include (*Science*, 314, p1696ff, 15 December, 2006):

- Biogeochemical cycles (nutrient elements C, O, H, N, S, P and regulators K, Ca, Mb, Fe, Zn) and their perturbations;
- Biological diversity and ecosystem functioning;
- Climate variability—local and regional;
- Hydrologic forecasting—floods, droughts, contamination;
- Environmental changes as selection agents on pathogen virulence and host susceptibility to infections;
- Markets, treaties, and rules to govern resource extraction and waste disposal
- Land use and land cover dynamics.

All of these challenges involve integration of various earth science disciplines and further interdisciplinary connections to other fields of study. Additionally, they all bear strongly on issues facing the state of Florida, and especially Florida's Gold and Treasure Coasts.

Rising to these challenges requires training a human resource base with education and skills in both the appropriate specialized disciplines and in their synthesis. It will be this integration of specialized knowledge that will lead to the fundamental solutions required. In this context, it is useful to note that Dr. Tim Killeen, president of the largest Earth Sciences professional society, the American Geophysical Union, and Director of the National Center for Atmospheric Research (which is the largest employer of geoscientists outside the federal government) has observed that

... U.S. universities are currently educating an insufficient number of geoscience graduates for the jobs that are projected to open up in the next decade, let alone for those new jobs that will undoubtedly be created as the story of the 21st century unfolds. It is time to think more broadly about how to build the base of expertise. ("Challenges for the Geosciences", EOS: Transactions of the AGU, 87, 549, 5 December 2006.)

The National Science Foundation (NSF), one of the main sources of funding of university-based basic research, has recognized the capital role of geo-scientific research. The Directorate for Geosciences (GEO) is one of six research arms within the National Science Foundation, with an annual budget of over \$700M, second only to the Directorate for Mathematical and Physical Sciences, which encompasses a broader scientific portfolio, in gross budget volume (see Figure 1). This level of funding is likely to continue, given the very close linkage of the geosciences with two of the areas of priority in NSF agency-wide funded research, Bio-complexity in the Environment and Polar Research.

The NSF divides the Geosciences program and funding opportunities into Atmospheric Sciences, Earth Sciences and Ocean Sciences. The Department at FAU, through faculty specializations and course offerings, covers many of the program and funding subdivisions within these areas,

such as paleoclimates and geospace environmental modeling within the Atmospheric Sciences division; earthscope, earth sciences instrumentation, geobiology, geomorphology and land use dynamics, geophysics and hydrologic sciences within the Earth Sciences division; and marine geology and geophysics, and biological, chemical and physical oceanography within the Ocean Sciences Division.

Funding category and agency	2004 actual	2005 preliminary	2006 proposed	2005–06 % change
	\$ millions			
Total	7,352	7,391	7,354	-0.5
National Science Foundation (NSF)	4,123	4,057	4,170	2.8
Mathematical and physical sciences	1,092	1,070	1,086	1.5
Geosciences	713	694	709	2.2
Computer and information science and engineering	605	614	621	1.1
Biological sciences	587	577	582	0.9
Engineering	566	561	581	3.5
U.S. polar research programs	342	344	387	12.4
Major research equipment	156	174	250	44.0
Social, behavioral, and economic sciences	184	197	199	1.0
Integrative activities	164	130	135	3.8
Education and human resources	152	140	115	-17.9
Budget authority adjustment ^a	-438	-443	-494	11.5
Department of Energy (DOE)	3,229	3,334	3,184	-4.5
Basic energy sciences	991	1,105	1,146	3.7
High energy physics	716	736	714	-3.1
Biological and environmental research	574	582	456	-21.7
Human genome	64	65	64	-0.5
All other research	510	517	391	-24.3
Nuclear physics	380	405	371	-8.4
Fusion energy sciences	256	274	291	6.1
Advanced scientific computing research	197	232	207	-10.9
Small business innovation research ^b	115	0	0	na

na = not applicable.

^a Budget authority adjustment subtracts costs for research facilities, major equipment support, and other non-R&D from total NSF budget authority.

^b DOE treats this activity as a budget execution program (i.e., funds are collected from existing appropriations and are not allocated until three quarters into the fiscal year).

NOTES: Detail may not add to total because of rounding. Percent change derived from unrounded data. Not all federally sponsored basic research is categorized in subfunction 251.

SOURCES: Agencies' submissions to Office of Management and Budget, MAX Schedule C; budget justification documents; and supplemental data obtained from agencies' budget offices.

Figure 1. Federal research and development and research and development plant budget authority for general science and basic research (Source: *Federal R&D by budget function: Fiscal Years 2004-2006*, NSF May 2006).

Research in the geosciences advances scientific knowledge leading to better management of the Earth's natural resources, such as water, energy, minerals, and biological diversity (NSF GEO <http://www.nsf.gov/geo/about.jsp>). This type of research is needed, for instance, in order to confront the increasingly severe water supply and quality problems faced by all parts of the country. Given the competition for water among farmers, communities, aquatic ecosystems and other users as well as emerging challenges, such as climate change and the threat of waterborne diseases, the National Academy of Science (NAS 2004, *Confronting the Nation's Water*

Problems) concludes that an additional \$70 million in federal funding should go annually to water research. Key research needs highlighted by NAS in the area of water resources include:

- 1) water demand and use
- 2) water supply augmentation
- 3) sustainable development
- 4) restoration of water quality at contaminated sites
- 5) salt water intrusion
- 6) radioactive waste disposal
- 7) interaction between water cycle and global energy and chemical cycles

In order to successfully address the above issues, which are of significant importance to the welfare of society, research must be conducted that integrates physical geology and geography, biology, chemistry, GIS science, and social science. The National Research Council's Committee on Beyond Mapping has characterized interdisciplinary integration as an urgent need both in the emerging geospatial technologies, where traditional academic programs have been described as inadequate (*Beyond Mapping: Meeting National Needs Through Enhanced Geographic Information Science*, 2006, pp. 100, National Research Council, Washington, DC), and in geological and geotechnical engineering (*Geological and Geotechnical Engineering in the New Millennium*, 2006, pp. 221, National Research Council, Washington, DC). Furthermore, the National Research Council described ad hoc academic arrangements as lacking an adequate reward structure that could facilitate such endeavors and provide them with temporal continuity.

Research in the geosciences also improves our ability to predict and respond to natural events of economic and social importance, such as drought, hurricanes, and changes in the aquatic and terrestrial environment. There is, particularly, a great need for basic research in the geosciences in coastal areas, such as Southeastern Florida, where population pressure and rapid development co-exist with mutable ecosystems of extraordinary value. This need was addressed in a 2006 report by the National Research Council, which reviewed the increasing role of geospatial technologies, research and tools in disaster management and urged for a greater investment in this field. (<http://www.nationalacademies.org/morenews/20061226.html>.)

The development of powerful new modeling techniques has contributed to an explosive increase in the volume and value of research in the geosciences. Computer numerical modeling and geospatial technologies such as geographic information systems and remote sensing have proven essential tools that improve our understanding of complex environmental processes, and have in turn attracted the attention of governmental agencies, research institutions and private companies (*Earth Science and Applications from Space: Urgent Needs and Opportunities to Serve the Nation*, 45pp, 2005, National Research Council, Washington, DC). The Department of Geosciences at Florida Atlantic University is at the forefront of such research and technologies. The Department has excelled in the application of modeling tools to predict and manage a broad range of human-environmental issues of interest in our service area, from groundwater flow to invasive species dispersal patterns (see faculty CVs in the Appendix of this document).

Applied geoscience research is complemented by a maintained strength in basic research in various fields, including climatology, stratigraphy, sedimentology, paleontology, and hydrogeology. These areas provide a fertile field of exciting opportunities for research, as global

change and increased societal demands call for better understanding of the earth's history and of the response of ecosystems to a changing physical environment. The proposed integrated Ph.D. program in Geosciences would be uniquely suited to conduct this type of research and provide the education necessary to prepare future scientists to continue this research in the future.

Growth of Geosciences and Employment Trends:

Scientific, human-resource capabilities are increasing, thus more people who are in the geosciences will need to be educated for these positions. In looking at the growth trends in employment, clearly those educated in different facets of the geosciences will be in demand. Employment projections for geography/geology professionals are growing faster than average, 12-35% and by 2014, the discipline will need 892,000 additional employees (Occupational Information Network, <http://online.onetcenter.org/find/quick?s=geography&g=Go>.) The same source identifies that in areas related to this proposal, for cartographers and photogrammatists there is 10-20% growth anticipated, for mapping technicians a 10-20% growth, and for hydrologists, the growth will be faster than average with a 21-35% growth rate. Also, for urban and environmental areas in the geosciences, there will be a 10-20% increase in available positions. Given the multidisciplinary nature of the degree and the increasing job market for those with specific geoscience computer and analytical skills, jobs are particularly available for those with higher level skills in mapping, remote sensing, hydro modeling, geophysics, petrology and engineering geology that require advanced graduate training.

The National Science Foundation (NSF) indicates that science and engineering jobs are expected to increase by about 47% or about 2.2 million jobs, driven mainly by the computer-related sciences. Additionally, environmental science employment will increase by 21,000 jobs over the next decade. These trends are particularly pertinent for the geosciences, as the discipline includes science, computers and the environment, all areas in which NSF predicts a high increase in employment opportunities as indicated in a recent NSF report by Thurgood, Golladay and Hill in 2006 (<http://www.nsf.gov/statistics/nsf06319/pdf/nsf06319.pdf>).

This report also sites a recent national survey in which 70% of graduating students (with undergraduate degrees in the geosciences) wanted to continue graduate work in the physical sciences/earth science arena (p, 60, <http://www.nsf.gov/statistics/nsf06319/pdf/nsf06319.pdf>). Also, geosciences are becoming increasingly prominent not only for graduate study, but grant and research activity as well, as is reflected in the grants solicited from organizations such as the NSF. The NSF is currently setting aside \$5,000,000 for funding in the geosciences, and granting a total of 45 awards in the geosciences and related areas as is indicated in a recent report (<http://www.grants.gov/search/search.do?oppId=1679&mode=VIEW>). The NSF is also funding the creation of new workshops such as "Bringing Research on Learning to the Geosciences" (http://serc.carleton.edu/research_on_learning/workshop02/), thus reflecting the interest and importance of this area.

Thus, at the national level a continued demand for people with both geographic, geologic and computer/analytical skills obtained through Geosciences can be expected for the next decade and beyond. In a 2000 survey of public interest by the NSF, the environment ranked as one of the highest categories, indicating that public support for these areas that support environmental research can be expected to remain high, which translates into growing available research dollars

and a growing number of higher- level environmental positions (<http://www.nsf.gov/statistics/nsf06319/pdf/nsf06319.pdf>). Under present conditions, the NSF claims the ceiling on research and development activities is fixed only by the availability of trained personnel, more so than the amounts of money available. Thus, the limiting resource for scientific, environmental research and development is currently an insufficient number of appropriately trained individuals.

Florida's Contribution to Advanced Geoscience Training:

The state of Florida's annual Ph.D. production from the three public institutions with Ph.D. programs in both geography and geology averaged just 3 (see Table 1 below) for the period from 1997-2005. There are currently no Ph.D. programs that integrate the geosciences, as is being proposed here, that are offered by the State's public or private institutions. Given the need as described in the previous paragraphs, it is safe to assume that while the demand for traditional, discrete degrees in geography or geology seems to be safely met in Florida, the need and demand for doctoral training in applied or integrated geosciences is not being fulfilled in Florida. This Ph.D. program will fulfill that need. [NOTE: We have chosen the CIP code 45.0799 for this proposal. This CIP code is classified as "Geography Other". USF uses this same CIP code for their Geography and Environmental Policy doctoral degree. Thus, we DO have the same CIP code, but it is not the same degree program—i.e. our "Geography Other" degree program is not the same as USF's "Geography Other".]

Table 1 Doctoral Degrees in Geosciences 1997-2005

Institution	PhD Awarded	2004-2005	2003-2004	2002-2003	2001-2002	2000-2001	1999-2000	1998-1999	1997-1998	Total	Avg/Year
University of Florida	Geography	3	3	2	3	4	3	11	4	33	3.67
	Geology	5	1	1	2	1	2	0	2	14	1.56
	Total	8	4	3	5	5	5	11	6	47	5.20
Florida State University	Geography	3	2	4	1	0	1	0	0	11	1.22
	Geology	1	3	2	3	1	2	6	0	18	2.00
	Total	4	5	6	4	1	3	6	0	29	3.22
University of South Florida	Geography*	0	0	0	0	0	0	N/A	N/A	0	0.00
	Geology	1	0	2	0	0	0	N/A	N/A	3	0.50
	Total	1	0	2	0	0	0	N/A	N/A	3	0.50

*Geography and Environmental Policy

According to the Bureau of Economic and Business Research (BEBR), the population of Florida increased to 15,982,378 in the year 2000 (<http://www.bibr.ufl.edu>). This figure represents growth of over 3 million people from the previous decennial census in 1990; a growth rate that lags behind only California and Texas. It is anticipated that this growth rate will continue apace throughout the rest of this decade, with Florida's population expected to expand by a further 3.6 million. Projections from the BEBR show Florida becoming the nation's third largest state (surpassing New York) by 2010. In the service area for FAU and in adjacent communities, Broward, Miami-Dade, and Palm Beach counties rank among the highest in population. Furthermore, these 3 counties account for slightly less than one third of the State's total growth. These three counties are also ranked among the highest nationally in both population number and rate of growth. However, collectively these counties do not host a single professionally oriented

geoscience Ph.D. granting institution. Only FIU has a Ph.D. in traditional geology and the University of Miami with a geology-related Ph.D. But again, neither of these programs are similar to what is being proposed here.

According to a late 1990s comprehensive review of the situation in FAU's service area undertaken by the Business Development Board of Palm Beach County, in terms of higher education, the county ranks at the bottom in the number of graduate students enrolled among the eight metropolitan areas included in the bench marking exercise (www.bdb.org). This reflects the small number of research universities located in the county; only three universities offer post-graduate studies. It puts Palm Beach at a significant disadvantage in meeting the recruiting needs of high-tech sectors, which often require a rich talent pool of research scientists, engineers, and specialists in other disciplines. This creates an employment problem in our service area which means that need in the area cannot be met by professionals trained in South Florida schools; this program will help meet that need.

Impact of Florida's Rapid Population Growth and the Need for Geoscience Research:

The rapid population growth in the South Florida region has created a need to better understand the influence of human activities on environmental processes. According to the U.S. Environmental Protection Agency (South Florida Geographic Initiative in EPA 841-S-95-001 Jan 1995), major environmental problems exist in the region, such as the following.

- Mercury contamination of Everglades fish and other biota
- Ecological degradation of Florida Bay and the Florida Keys National Marine Sanctuary
- Water supply conflicts among agricultural interests, natural resources, and an expanding urban population
- Nutrient enrichment of the Everglades by agricultural or urban drainage water
- Loss of historic hydropatterns, water gradients, and discharge
- Rapid regional population growth
- Spread of exotic plants and animals
- Loss of native populations and species of flora and fauna
- Extensive conversion of remaining wetlands and natural lands to other land uses

The Comprehensive Everglades Restoration Plan is "part of a larger effort to restore the ecosystem and provide for a sustainable south Florida." Efforts that require expertise in the Geosciences and related fields is planned to be taking place at least through the year 2014. Addressing such complex environmental issues will require involvement of appropriately trained scientists, many of whom should also be graduates of a PhD program in Geosciences at FAU.

Doctoral Geoscientists will be able to add to the CERP project in ways that complement the work of other scientists. Geoscience PhD's will have the environmental research training, coupled with the ability to understand and work with local human populations, to precisely map areas as they change through restoration with the aid of Differential GPS, model hydrologic flow with the aid of Geographic Information Systems (GIS), analyze remote sensing images to understand what is happening on a large scale, that cannot be similarly determined from the ground, analyze the potential impact of mining activities, and to also be able to ground truth that

which they have seen from an aerial view, to add in detail and look into causation. The letters of support for this program (see Appendix) point out the strong local need and professional enthusiasm for this program.

B. Demand: Describe data that support the assumption that students will enroll in the proposed program. Include descriptions of surveys or other communications with prospective students.

Since late 2004, the Department Chair has received inquiries from graduates of our geography and geology programs and from working professionals in the area about the likelihood of FAU offering a doctoral degree in the field of geosciences, especially as related to water supply and quality, environmental analysis and urban sustainability. As Dr. Leonard Berry, Director of the Center for Environmental Studies at FAU writes (see letter in Appendix)

“In our work on the practical issues of environmental management here in South Florida and elsewhere around the globe I get regular inquiries about the availability of such a degree and expression of the need for advanced work in this field.” Leonard Berry, Center for Environmental Studies, FAU

This apparent demand was one of the main reasons the geoscience faculty began discussing the possibility of a Geosciences doctorate. Over the course of the compilation of this proposal, the Department Chair has been in contact with many professionals working in the field of geosciences who have been very supportive of the proposal and who have indicated that some of their current employees will be initial applicants into the program. Their letters of support appear in the Appendix.

Additionally, the Department conducted surveys with detailed information about the proposed program. These surveys were distributed to current students in geography and geology programs at FAU, as well as a sampling of recent alumni of the Department. The surveys were distributed via e-mail in June 2007 and again in August 2007 to recent graduates whose e-mail addresses were still known to be current through their continued contact with various faculty members of the Department. It should be noted that the alumni surveys were biased towards recent M.A./M.S. graduates since it is these students who keep in contact with the Department most regularly.

E-mail surveys were distributed to all current geography and geology majors at both the undergraduate and graduate level and a total of 64 recent graduates of our programs. Of the currently-enrolled students surveyed, 32 responded (approximately 1/3), with 15 of those (~47% of the respondents) expressing interest in applying, or at least expressing a strong desire to learn more about the program. The remainder was largely unclear of their future plans. Of the alumni, 29 surveys were returned (~45% of those surveyed), with 12 responding that they would be interested in applying to the program (~41% of the respondents). Four additional respondents wrote that they were ‘undecided’ depending on the flexibility of the program (ie. class schedules fitting around their work schedules) and the flexibility and support of their current employers. Thirteen responded that they would not be interested in the program, however, most of these were not for reasons that necessarily have a negative reflection on the degree proposal. Three are currently in Ph.D. programs at other institutions, 7 mentioned that they had left South Florida (or are planning to leave) and would not be interested in returning to

the area to pursue the degree, 2 wrote that their current lifecycle/family situation would make it too problematic, and 1 indicated that he was not currently working in an area related to the geosciences.

It is notable that two of the ‘yes’ responses in the alumni group were from students who have left the area (St. Louis, MO and Brazil), but are excited enough about the program to return to FAU/South Florida to enroll. This speaks very positively about the program proposed here since both of these individuals are currently employed in responsible, professional geoscience positions, but see important value to returning to FAU for this proposed degree. The following are comments from one graduate (MA in Geography) of our department who currently works in Brazil.

“Thank you for sending this email. I got so excited with the program, you have no idea....my head is still spinning with the possibilities.

A program like this would be my dream come true. After trying 3 different majors I really found myself in what we did over there at the department. I know we cannot change the world quickly, but with our research and work I am sure we can be part of the change.

I would be very interested in applying to the program. Since I finished the Master’s program, I have been interested in applying to a Ph.D. program. After reading the background and the different specializations, the interest only increased. The world today has an urgent need for professionals who can relate more than one discipline related to Earth Sciences and this program is able to do exactly that. Water availability, air and soil pollution are only some of the huge problems we face and have to find a solution for our own future and the future of the next generation. We need to address it now. Prepared professionals with a global view are more than necessary for this important task. I believe more than South Florida will benefit from professionals coming out of this program. “ Lorena Gouvea, M.A. Geography , 2003

Arguably, the numbers of positive responses from our alumni survey are not horribly high, however, the number of alumni that we were able to reach (number surveyed) was relatively low as well. It is important to point out, that alumni from FAU’s geography and geology programs are absolutely NOT the only source of potential students from FAU for this program. As there is currently no doctoral program for certain specialties of the field biologists at FAU, nor a higher level graduate degree for those earning the M.S. in Environmental Science, this degree will be the **ONLY** environmental doctorate at FAU. Even some FAU departments outside of the College of Science at FAU have indicated that we should expect a flow of some of their master’s students into our doctoral program, particularly those with environmental interests, such as Master’s in Urban and Regional Planning students with an interest in environmental planning. The Chair of Geosciences has already been visited by about half a dozen MURP students who have heard about the proposed program and are excited!

- C. If similar programs (either private or public) exist in the state, identify the institution(s) and geographic location(s). Summarize the outcome(s) of any communication with such programs with regard to the potential impact on their enrollment and opportunities for possible collaboration (instruction and research). Provide data that support the need for an additional program.**

Because no schools in Florida offer a degree similar to the proposed degree (see support letter from Dr. Jonathan Arthur, Assistant State Geologist and Florida Department of Environmental Protection), the Department of Geosciences at FAU sought support from the two largest institutions in the state that offer advanced graduate training in geography and geology, the University of Florida and Florida State University. The Geography and Geology Departments at both institutions were phoned and emailed about the proposal and were asked to review the proposal for any potential negative impacts or conflicts with their own doctoral programs. The departments from FSU have not yet responded to my requests for a formal letter, however, both the Geography and Geology Departments at the University of Florida wrote letters of support for the proposed program at FAU. Their letters are found in the Appendix of this document. As is indicated in these letters, the impact on the UF programs is expected to be negligible if any impact at all. As the program at FAU grows, there may be opportunity to expand the specialty base of our degree by including faculty from UF, FSU and possibly other SUS institutions in the program.

- D. Use Table 1 (A for undergraduate and B for graduate) to categorize projected student headcount (HC) and Full Time Equivalents (FTE) according to primary sources. Generally undergraduate FTE will be calculated as 40 credit hours per year and graduate FTE will be calculated as 32 credit hours per year. Describe the rationale underlying enrollment projections. If, initially, students within the institution are expected to change majors to enroll in the proposed program, describe the shifts from disciplines that will likely occur.**

We expect that all full-time students in the doctoral program in Geosciences will have teaching or research assistantships, and will therefore be enrolled for 24 credit hours per year; 9 credit hours in each of the Fall and Spring semesters and 6 credit hours over the summer. Thus, assuming graduate FTE is calculated as 32 credit hours per year, then the FTE in Table 1B is calculated as 0.75 (24/32) of the headcount for full-time students, and for part-time students, the FTE is calculated as 0.5 of the headcount.

In the first three years, a majority of the students will likely be past graduates of our own programs in the Department of Geosciences and currently employed within our service area, or other geosciences professionals working in South Florida desiring to acquire additional advanced training. The number of full-time students enrolling in the program is expected to increase as statewide, national and international recruiting efforts prove to be effective. Additionally, it is anticipated that some shift may occur from students in master's programs in related areas at FAU, such as Environmental Science, Civil Engineering and Urban and Regional Planning (as happens periodically with our current graduate programs), but these numbers should be small and taper off rather quickly. The Ph.D. in Geosciences will, however, become an alternative for students in these fields who, upon completion of their master's degrees, desire to seek advanced graduate training.

Based on preliminary discussions within the local professional community, we expect a sizeable influx of part-time students, particularly in the beginning years; professionals who wish to acquire additional advanced training without abandoning their full-time employment positions. We expect the part-time applicants to remain significant throughout year 5 and beyond, as the nature of the degree being proposed is ideal for those already holding important professional

positions in the geosciences within the service area of FAU. Therefore, Table 1B reflects a gradual shift from a highly local to an increasingly wider geographic base, and from a predominantly part-time base to a greater representation of full-time students in the program. It should also be noted that it is expected that most of the initial students in the program will likely come into the program already having earned a Master's degree, and will therefore require less coursework in the program (as discussed later in this proposal), and will complete the program in less than 5 years if they are enrolled as full-time students.

The headcounts in Table 1B are fully justified based on the demand feedback discussed in section B above. It is important to reiterate that even though the degree program will be mainly designed for full-time students, our program will welcome part-time students who naturally take longer to finish the degree, and will show up in the program numbers for a longer period of time. In discussion with department Chairs at UF and FSU in geography and geology, part-time students are not widely admitted for a variety of reasons, in fact sometimes part-timers are often discouraged from applying. Therefore, our degree program will open up to a market that is often discouraged from entering doctoral programs in geography and geology at UF and FSU. Notice that Table 1-B shows a steady and consistent flow of part-timers from Year 1-Year 5. Our Year 5 enrollment estimate is almost half part-time students.

Also, the lack of a combined geography/geology focus in other advanced degree programs in the State of Florida should not be underestimated—as the letters from the professional community strongly attest. What makes this integration even stronger is the combination of geography and geology with other specialties such as field biology, anthropology and urban and regional planning, thus creating true, well-rounded geoscientists. The professional community in South Florida is very excited about this integration and has argued that the degree will appeal to a wide audience. This is **NOT** yet another doctoral program in geography or geology being proposed in Florida, it is a *geosciences* doctoral program, which implies much more.

Another important point that makes a comparison of enrollment and degrees granted statistics in geography and geology at other SUS institutions questionable is our intended focus on the applied aspects of the geosciences to serve the needs of the professional community. This is absolutely not the focus at the other departments, particularly UF and FSU, where a stronger emphasis is placed on traditional academic, theoretical training usually for a university career, and therefore the market is generally not the same. We intend to train applied *geoscientists* to contribute to finding scientific solutions to environmental problems, and evidence from the professional community suggests that the demand is high. It is worth noting that one geography department in Texas, (Texas State University—formerly SW Texas State University), recently set up an applied doctoral degree in geography, and currently boasts 70 doctoral students (*Guide to Geography Programs in the Americas, 2006-2007*, Association American Geographers).

The final total headcount of 58 by the fifth year (28 part-time and 30 full-time) is more than reasonable considering (1) the perceived demand, (2) the total number of participating faculty members, and (3) the number of available teaching and research assistantships. The projected student to faculty ratio compares favorably with programs in Geography or Geology around the country. It is also worth noting, however, that actual demand for the most recent doctoral programs in the Charles E. Schmidt College of Science, specifically Integrative Biology and Chemistry, have exceeded the demand estimates generated during the proposal preparation. It is

probable that the same underestimate will happen with the Geosciences doctoral program.

- E. Indicate what steps will be taken to achieve a diverse student body in this program, and identify any minority groups that will be favorably or unfavorably impacted. The university's Equal Opportunity Officer should read this section and then sign and date in the area below.**

The diversity of the local community was projected to achieve levels that will make it the first region in the U.S. that does not have an ethnic or racial majority by the year 2005. The FAU student body in general is expected to continue to reflect the diversity of the region. The diversity of the graduate student body in Geosciences at FAU reflects that seen in the nation at large. The Geosciences program will target groups that are under-represented in the sciences so that its student body will more closely reflect that seen in the local region. The competition among graduate programs in the sciences for recruitment of qualified under-represented minority candidates is very keen. The proposed degree program in Geosciences will make recruitment of such students a high priority in its recruitment plan for new PhD students. In particular, universities and colleges in the State of Florida will be targeted for student recruitment through brochures, contacts with specific departments in universities in the region, and visits by FAU/Geoscience recruitment teams. Such efforts can be made by faculty attending professional conferences as well. Additionally, faculty recruitment in the various units participating in this program will emphasize identification of qualified minority candidates. This effort is expected, in turn, to attract minority students through identification with faculty members as potential role models and mentors.

Read and Approved:

Hard Copy Document signed by Paula Behul

Paula Behul, Director
Equal Opportunity Programs

Date

III. Budget

- A. Use Table 2 to display projected costs and associated funding sources for Year 1 and Year 5 of program operation. Use Table 3 to show how existing Education & General funds will be shifted to support the new program in Year 1. In narrative form, summarize the contents of both tables, identifying the source of both current and new resources to be devoted to the proposed program. (Data for Year 1 and Year 5 reflect snapshots in time rather than cumulative costs.)**

With the recent faculty hires in biogeography and geophysics for the 2007-2008 academic year, faculty staffing in the Department is adequate to initiate the program. The expansion of the geosciences programs on the Davie campus, as already planned for by the Dean of the College (www.fau.edu/provost/files/06_bot_retreat-campusprogramplans.pdf), will add three new geosciences faculty, and should adequately accommodate much of the growth of the program in

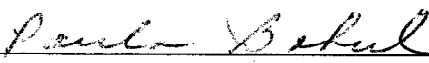
Geography Programs in the Americas, 2006-2007, Association American Geographers).

The final total headcount of 58 by the fifth year (28 part-time and 30 full-time) is more than reasonable considering (1) the perceived demand, (2) the total number of participating faculty members, and (3) the number of available teaching and research assistantships. The projected student to faculty ratio compares favorably with programs in Geography or Geology around the country. It is also worth noting, however, that actual demand for the most recent doctoral programs in the Charles E. Schmidt College of Science, specifically Integrative Biology and Chemistry, have exceeded the demand estimates generated during the proposal preparation. It is probable that the same underestimate will happen with the Geosciences doctoral program.

E. Indicate what steps will be taken to achieve a diverse student body in this program, and identify any minority groups that will be favorably or unfavorably impacted. The university's Equal Opportunity Officer should read this section and then sign and date in the area below.

The diversity of the local community was projected to achieve levels that will make it the first region in the U.S. that does not have an ethnic or racial majority by the year 2005. The FAU student body in general is expected to continue to reflect the diversity of the region. The diversity of the graduate student body in Geosciences at FAU reflects that seen in the nation at large. The Geosciences program will target groups that are under-represented in the sciences so that its student body will more closely reflect that seen in the local region. The competition among graduate programs in the sciences for recruitment of qualified under-represented minority candidates is very keen. The proposed degree program in Geosciences will make recruitment of such students a high priority in its recruitment plan for new PhD students. In particular, universities and colleges in the State of Florida will be targeted for student recruitment through brochures, contacts with specific departments in universities in the region, and visits by FAU/Geoscience recruitment teams. Such efforts can be made by faculty attending professional conferences as well. Additionally, faculty recruitment in the various units participating in this program will emphasize identification of qualified minority candidates. This effort is expected, in turn, to attract minority students through identification with faculty members as potential role models and mentors.

Read and Approved:

 11-13-07
Paula Behul, Director Date
Equal Opportunity Programs

III. Budget

A. Use Table 2 to display projected costs and associated funding sources for Year 1 and Year 5 of program operation. Use Table 3 to show how existing Education & General funds will be

the early years. As part of Campus Academic Planning, the Dean has requested for the new faculty to be in place on the Davie campus in 2012.

Thus, for year 1, the faculty salaries and benefits needed to support the doctoral program will come entirely from reallocated base E&G funds. This will include \$123, 717 reallocated from Geosciences faculty (one of those faculty members is paid from Research Office budget and one from the Center for Environmental Studies), and \$77, 345 from the home departments and Colleges of the cognate faculty. See Table 4 for a complete listing of faculty involved with the program.

These reallocated salaries and benefits extend into year 5 with an increase in % effort, and therefore amount reallocated, for some of the junior faculty who are less involved in the doctoral program in year 1 and for some more senior faculty as well (see Table 4). This differential is found in the “New Enrollment Growth E&G” column for year 5. Also, in year 5, the new Davie faculty will be added, as discussed above (see Table 4). The reallocated base for the percentage effort associated with the new Davie faculty is shown in the “Other E&G” category for year 5. Again, these new faculty have been planned for outside of the approval of the Ph.D. in Geosciences.

AMP (formerly known as A&P) staff in year 1 will include 2 part-time employees. Our department’s budget coordinator currently is a (0.75) FTE position, and a computer support person is a (0.50) FTE position (a full-time employee currently shared with the Dean’s office). In year 1, we would not expect this arrangement to change, but moving both of these AMP support positions to full-time positions (1.0 FTE) would need to occur by year 5 to support the growth of the program. 10% of their effort for year 1 would be reallocated in support of the doctoral program, with that effort continuing at 10% through year 5 as both positions move to full-time. The differential in cost in moving these positions to full time (taking the % effort into account) is found in the “New Enrollment Growth E&G” column for year 5. Additionally, the department currently has 1 USPS employee (senior secretary). This would be enough to implement the program and sustain the program through year 5. 10% of the USPS employee’s effort would be reallocated to support the doctoral program in year 1 through year 5. Additionally, a full-time lab support person (AMP) would need to be added on the Davie campus to support the growth in Geosciences in Broward County in year 5, with 5% of that position’s effort devoted to the doctoral program in that year. The cost associated with this addition that would be devoted to the doctoral program is found in the “Other E&G” category for year 5.

In order to staff undergraduate courses normally taught by regular faculty now engaged more in the PhD program, we estimate that 2 additional adjuncts (OPS) beyond our current usage (generally about 2 per semester totaling \$18,000 for the academic year from our E&G funding) would be needed to initiate the program. However, we fully expect that these 2 additional adjunct positions per semester (\$18,000 for the academic year) to be funded from grants and contracts obtained by program faculty that provide release time. The Department currently receives 16 graduate teaching assistantships to support our master’s programs in geography and geology, each assistantship averaging about a \$10,000 stipend. As shown in Table 1B, 4 full time students are predicted for year 1, therefore the additional need for year 1 would be the funds necessary to move 4 of our current 16 GTA positions (reallocated to the Ph.D. program) from master’s level funding (\$10,000 each) to doctoral level funding (\$20,000 each). Part-time

students would not be eligible for assistantships.

By year 5, we anticipate that the full-time enrollment in the doctoral program will be 30 (see Table 1B). To accommodate support for these doctoral students, the \$160,000 currently allotted to graduate teaching assistantships in the Geosciences Department would be reallocated to the doctoral program, and the main need would be the extra \$160,000 to convert these salaries from current Master's level (\$10,000 each) to doctoral level (\$20,000 each). The remaining 14 full-time students in the program would be supported by research grants. Our department has a history of supporting 4-5 research assistantships, and we expect the quantity and consistency of funds for this to grow quickly as the program and the research activity of the recent hires develops. Also, the cognate faculty in the program will begin to recruit and support students of their own. By year 5, we would expect the adjunct need of the Department to grow, funded from faculty buyouts from grant and contract activity.

Ample library resources are available to meet the initial needs of the proposed program, particularly since during the initial years students will be enrolled in coursework leading to their advanced research. As many of these courses are currently offered at FAU, and current library resources adequately support those courses, initial additional resources are not necessary.

After a few years into the program, however, an additional investment in geoscience-related materials for the library will be necessary to support advanced research. The amount needed for the Library to increase the geoscience-related holdings by year 5 is estimated by the Wimberly Library staff to be \$20,000, as discussed more fully later in this document. This would add important research resources such as *Global Biogeochemical Cycles*, *Ethnobotany Research and Applications*, *Journal of Ethnobiology*, and the *Geoscience World Database* package, which includes several specialized geology research publications.

In the expense category on Table 2, we do not expect special needs for implementation of the program, however, by year 5 we estimate a need for computing, display and field technology equipment as described in section 10, part F of this document. This expense for year 5 would be approximately \$175, 000 with approximately 3/4 of that total being funded from grants and contracts. No other special or capital outlay costs would be incurred for implementing and maintaining the program through year 5.

- B. If other programs will be impacted by a reallocation of resources for the proposed program, identify the program and provide a justification for reallocating resources. Specifically address the potential negative impacts that implementation of the proposed program will have on related undergraduate programs (i.e., shift in faculty effort, reallocation of instructional resources, reduced enrollment rates, greater use of adjunct faculty and teaching assistants). Explain what steps will be taken to mitigate any such impacts. Also, discuss the potential positive impacts that the proposed program might have on related undergraduate programs (i.e., increased undergraduate research opportunities, improved quality of instruction associated with cutting-edge research, improved labs and library resources).**

The Department's graduate program will change in emphasis from the master's programs to the doctoral program as being the primary research degree in Geosciences. This is consistent with

the College's outlined objectives in support of FAU's Strategic Plan and Goals, that is "*The Charles E. Schmidt College of Science will orient its graduate programs primarily to doctoral degrees.*"

There are no plans to abandon the master's programs, but to retool the master's programs towards professional or terminal degree programs geared towards developing specific job skills in geography and geology. We will encourage non-thesis work at the master's level and will combine doctoral and master's students in many graduate courses. Thus the major adjustment for the master's programs will be largely additional students (FTE) in graduate classes, and perhaps less opportunity for all but the highest caliber of master's students to do thesis work. Provision of assistantships will shift to doctoral students, but we anticipate that due to the increased research activity in the Department that the doctoral program will bring, there will be increased funded research opportunities for master's students as well as doctoral students.

At the undergraduate level, as a result of redefining the department mission recently, we have already streamlined course offerings in order to free up faculty time so that a higher level of participation can be devoted to the doctoral program. Thus, we expect no negative impact on the undergraduate programs in the Department beyond a slightly higher rate of teaching by instructors as faculty use grants to buyout of some teaching. We will use the Master Teacher program of the Charles E. Schmidt College of Science diligently to maintain quality teaching among all faculty, including instructors. The undergraduate student experience will be enhanced by more experienced teaching assistants in the classroom as we shift preference from masters to doctoral students, greater library and lab resources, improved faculty teaching from cutting edge research and greater opportunity to be involved in faculty research.

C. Describe other potential impacts on related programs or departments (e.g., increased need for general education or common prerequisite courses, or increased need for required or elective courses outside of the proposed major).

There are no required courses to be taken in other departments, but the interdisciplinary nature of the proposed program will allow students to take courses from an approved cognate list in other departments appropriate to the student's research focus within the degree program. The departments in question, anthropology, biology, and urban and regional planning, (and to a lesser degree, chemistry and mathematics), have all been informed and have written letters of support for the Ph.D. in Geosciences and support their involvement in the proposed program in general. The Department will also seek to expand its relationship with the Departments of Civil and Ocean Engineering and expects to incorporate coursework and faculty from those fields as the doctoral program in Geosciences grows. It is not expected that student enrollment in any individual cognate course listed in the proposed program will strain the resources of the department in question, but will merely add to the graduate FTE production of the department by strengthening the enrollment of the courses.

Additionally, certain faculty within some of the departments above will be listed as cognate faculty for this degree program as they may be called upon to serve on dissertation committees appropriate to their expertise. These faculty members have expressed their strong interest in being involved in the program, and are listed below. Their vitas are found in the Appendix of

this document.

John Baldwin, Biological Sciences, Charles E. Schmidt College of Science
Douglas Broadfield, Anthropology, Dorothy F. Schmidt College of Arts and Letters
Clifford Brown, Anthropology, Dorothy F. Schmidt College of Arts and Letters
Mary Cameron, Anthropology, Dorothy F. Schmidt College of Arts and Letters
Nathan Dorn, Biological Sciences, Charles E. Schmidt College of Science
Ann-Margaret Esnard, Urban and Regional Planning, CAUPA
Dale Gawlik, Biological Sciences, Charles E. Schmidt College of Science
Michael Harris, Anthropology, Dorothy F. Schmidt College of Arts and Letters
Michelle Ivey, Chemistry, Honors College
Marguerite Koch-Rose, Biological Sciences, Charles E. Schmidt College of Science
William Louda, Chemistry, Charles E. Schmidt College of Science
Jon Moore, Biological Sciences, Honors College
William O'Brien, Environmental Studies, Honors College
Edward Orlando, Biology, Harbor Branch
C. Edward Proffitt, Biological Sciences, Charles E. Schmidt College of Science
David Prosperi, Urban and Regional Planning, CAUPA
Jaap Voss, Urban and Regional Planning, CAUPA
Xing-Hai Zhang, Biological Sciences, Charles E. Schmidt College of Science

Additional faculty will be added from Civil Engineering and Ocean Engineering as the program grows and evolves. A letter of support from the Dean's office of the College of Engineering and Computer Science can be found in the Appendix of this proposal. Additionally, as FAU's more tightly integrated relationship with the Harbor Branch Oceanographic Institution evolves, it is expected that faculty formally housed there will become part of the cognate faculty of the Ph.D. in Geosciences. The Department of Geosciences has already had a minor relationship with HBOI in the past, and we fully expect that relationship to grow and flourish, particularly with the Aquaculture and Marine Science Divisions of Harbor Branch. Thus, our Department and the proposed program can be an important part of the continued integration of Harbor Branch with FAU.

D. Describe what steps have been taken to obtain information regarding resources (financial and in-kind) available outside the institution (businesses, industrial organizations, governmental entities, etc.). Describe the external resources that appear to be available to support the proposed program.

The Department Chair and some of the Geosciences faculty have had numerous meetings with representatives from a variety of agencies and consulting firms that work in the geosciences, such as the U.S. Geological Survey, the South Florida Water Management District, Coastal Planning and Engineering, Inc., and CEPEMAR. There has been strong support throughout the professional community for the degree proposal as was indicated earlier in this proposal. The agencies above, in particular, have indicated a willingness to allow faculty and students to use their specialized equipment and research/lab space (specialized space and equipment that is not available at FAU) when needed. This should save the department a great deal in resources and allow us to serve students with highly specialized interests related to our areas of focus in the

degree program, making our program even more attractive.

Our strong relationship with Coastal Planning and Engineering, Incorporated (CPE), a multidisciplinary coastal service firm, has yielded equipment-sharing, lab space-sharing, scholarships, student internships and joint grant opportunities with faculty and graduate students, and we expect that relationship to grow further with the addition of the doctoral program. CPE has been an important employer of recent graduates of our Department as the training and skills we provide fit nicely with the projects and overall goals of the firm. As described on their webpage (www.coastalplanning.net) and in the promotional literature of CPE

“Our firm specializes in comprehensive coastal management using a regional perspective to design sustainable and economically feasible projects. ... CPE is a company of professionals dedicated to delivering best-value services and coastal solutions based on innovated applications of cutting-edge science and technology.”

The continued support of our program by CPE, along with their vast resources and expertise, have been and continue to be invaluable to the Department of Geosciences, and again, this relationship will only grow stronger with the addition of the Ph.D. program.

Additionally, some agencies and private firms have expressed an interest in becoming directly involved in the graduate education of the program. This time and expertise is another invaluable resource for the doctoral students in Geosciences at FAU. As Barry Rosen states:

“The U.S. Geological Survey is looking forward to having new opportunities to work with Florida Atlantic University graduate students, collaborating both on a formal and informal basis, through classroom instruction, internships, and as representatives on dissertation committees... Cooperation with academia and other scientific organizations is an integral part of the U.S. Geological Survey’s mission plan. The development of an integrated geosciences program at Florida Atlantic University will greatly facilitate this objective and allow the U.S. Geological Survey to continue its contribution to the Nation’s science.” Barry Rosen, Director, Florida Integrated Science Center, U.S. Geological Survey

Our burgeoning relationship with USGS, will bring not only the opportunity to share equipment and educational expertise, but also the opportunity to expand our research expertise. This should make the grant success rate even higher, particularly with federal funding agencies such as the National Science Foundation, a major funding source of geoscience-related research.

“The U.S. Geological Survey has a strong research program in South Florida and routinely is in need of scientists at the graduate level. We look forward to working with well trained University graduate students and exploring external funding opportunities with University faculty. Research proposals that combine academic and government scientists generally receive favorable treatment by funding agencies, such as the National Science Foundation among others.” Barry Rosen, Director, Florida Integrated Science Center, U.S. Geological Survey

The National Science Foundation (NSF), one of the main sources of funding of university-based basic research, has recognized the capital role of geo-scientific research, and will indeed be a main target for funding opportunities in the Department. The Directorate for Geosciences (GEO) is one of six research arms within the National Science Foundation, with an annual budget of over \$700M, second only to the Directorate for Mathematical and Physical Sciences, which

spans a broader scientific portfolio, in gross budget volume as presented in section IIA of this proposal. This level of funding is likely to continue, given the very close linkage of the geosciences with two of the areas of priority in NSF agency-wide funded research, Bio-complexity in the Environment and Polar Research.

The NSF divides the Geosciences program and funding opportunities into Atmospheric Sciences, Earth Sciences and Ocean Sciences. The Department at FAU, through faculty specializations and course offerings, covers many of the program and funding subdivisions within these areas, such as paleoclimates and geospace environmental modeling within the Atmospheric Sciences division; earthscope, earth sciences instrumentation, geobiology, geomorphology and land use dynamics, geophysics and hydrologic sciences within the Earth Sciences division; and marine geology and geophysics, and biological, chemical and physical oceanography within the Ocean Sciences Division.

Additional funding sources include the Florida Department of Environmental Protection, the South Florida Water Management District and the various county and municipal planning agencies. The Department has a strong track record in securing such funding and expects the volume of funding to grow significantly as our new faculty will become more and more research active.

IV. Projected Benefit of the Program to the University, Local Community, and State

Use information from Table 1, Table 2, and the supporting narrative for “Need and Demand” to prepare a concise statement that describes the projected benefit to the university, local community, and the state if the program is implemented. The projected benefits can be both quantitative and qualitative in nature, but there needs to be a clear distinction made between the two in the narrative.

The proposed degree program will be an *innovative professional degree* which answers the call from employers in the South Florida area and throughout the state, such as the Army Corp of Engineers, the U.S. Geological Survey, the Florida Department of Environmental Protection, the South Florida Water Management District, Broward County and Palm Beach County Planning Agencies, Coastal Planning and Engineering, Inc. and a variety of other local agencies and environmental consulting firms that have expressed a growing need for highly trained individuals in advanced technology and field applications in the geosciences in order to study and solve various environmental problems in South Florida and beyond. This need is demonstrated in Table 1B, which is based on surveys and other feedback among current students of the Department, alumni of our programs and working geoscience professionals in South Florida as well as in the letters of support found in the Appendix of this document. While the degree program is focused on full-time students, the program will also welcome part-time students who can enroll in doctoral work while maintaining their professional positions, thus opening graduate educational opportunities to a wider pool of geoscience professionals than other geography and geology doctoral programs in the state.

The Ph.D. in Geosciences will make an important contribution towards committing academic and fiscal resources to meeting Florida’s need for trained professionals in areas that implement

advanced technologies, and will help prepare students for emerging trends in the labor force in general, demonstrating the Department's commitment to recruiting and preparing students for professions vital to the sustainability of Florida. Research in the geosciences improves our ability to predict and respond to natural events of economic and social importance, such as drought, hurricanes, and changes in the aquatic and terrestrial environment. There is, particularly, a great need for basic research in the geosciences in coastal areas, such as Southeastern Florida, where population pressure and rapid development co-exist with mutable ecosystems of extraordinary value. This need was addressed in a 2006 report by the National Research Council, which reviewed the increasing role of geospatial technologies, research and tools in disaster management (<http://www.nationalacademies.org/morenews/20061226.html>.) It is important to note that most of the cost of implementing the program is merely reallocated dollars from current resources, therefore providing an important educational opportunity for FAU's service area at a very minimal additional cost (Table 2).

Inclusion of a Ph.D. in Geosciences will also allow the Department, the Charles E. Schmidt College of Science and University to expand its graduate and overall research presence in environmental conservation and sustainability, and in the work associated with one of the world's largest environmental restoration projects (i.e., Comprehensive Everglades Restoration Plan - CERP), thus adding to the greater visibility of the university in the area of environmental research. In doing so, the program will meet community needs and fulfill unique institutional responsibilities in the seven-county service region by offering specialty programs to address local geoscience issues, such as coastal processes and water resource planning and restoration, and applied modeling.

V. Access and Articulation – Bachelor's Degrees Only

- A. If the total number of credit hours to earn a degree exceeds 120, provide a justification for an exception to the policy of a 120 maximum and submit a request to the BOG for an exception along with notification of the program's approval. (See criteria in BOG Regulation 6C-8.014)**

This section does not apply to this degree proposal.

- B. List program prerequisites and provide assurance that they are the same as the approved common prerequisites for other such degree programs within the SUS (see Common Prerequisite Manual <http://www.facts.org>). The courses in the Common Prerequisite Counseling Manual are intended to be those that are required of both native and transfer students prior to entrance to the major program, not simply lower-level courses that are required prior to graduation. The common prerequisites and substitute courses are mandatory for all institution programs listed, and must be approved by the Articulation Coordinating Committee (ACC). This requirement includes those programs designated as "limited access."**

If the proposed prerequisites are not listed in the Manual, provide a rationale for a request for exception to the policy of common prerequisites. NOTE: Typically, all lower-division courses required for admission into the major will be considered prerequisites. The curriculum can require lower-division courses that are not prerequisites for admission into

the major, as long as those courses are built into the curriculum for the upper-level 60 credit hours. If there are already common prerequisites for other degree programs with the same proposed CIP, every effort must be made to utilize the previously approved prerequisites instead of recommending an additional “track” of prerequisites for that CIP. Additional tracks may not be approved by the ACC, thereby holding up the full approval of the degree program. Programs will not be entered into the State University System Inventory until any exceptions to the approved common prerequisites are approved by the ACC.

This section does not apply to this degree proposal.

- C. If the university intends to seek formal Limited Access status for the proposed program, provide a rationale that includes an analysis of diversity issues with respect to such a designation. Explain how the university will ensure that community college transfer students are not disadvantaged by the Limited Access status. NOTE: The policy and criteria for Limited Access are identified in BOG Regulation 6C-8.013. Submit the Limited Access Program Request form along with this document.**

This section does not apply to this degree proposal.

- D. If the proposed program is an AS-to-BS capstone, ensure that it adheres to the guidelines approved by the Articulation Coordinating Committee for such programs, as set forth in Rule 6A-10.024 (see Statewide Articulation Manual <http://www.facts.org>). List the prerequisites, if any, including the specific AS degrees which may transfer into the program.**

This section does not apply to this degree proposal.

INSTITUTIONAL READINESS

VI. Related Institutional Mission and Strength

- A. Describe how the goals of the proposed program relate to the institutional mission statement as contained in the SUS Strategic Plan and the University Strategic Plan.**

The proposed Ph.D. in Geosciences fits with the goals and mission statements of both the SUS (<http://www.flbog.org/StrategicResources/>) and Florida Atlantic University (<http://www.fau.edu/strategicplan/mission.php>; <http://www.fau.edu/strategicplan/goals.php>).

The proposed offering of the degree has been formally presented to the FAU Board of Trustees by the Dean's office as an important special initiative of the Charles E. Schmidt College of Science. Additionally, the College has formally announced an initiative to re-establish geosciences faculty and research on the Davie campus in Broward County with an environmental and geotechnical emphasis to complement an overall environmental program on that campus (www.fau.edu/provost/files/06_bot_retreat-campusprogramplans.pdf). While much of the course offerings at Davie will initially be at the undergraduate level, the presence of Geosciences

faculty in Davie will offer research synergism with the field biologists and USGS research staff on that campus that will benefit the doctoral program.

The Ph.D. in Geosciences will complement and support the strategic goals of Florida Atlantic University (FAU) and the State University System (SUS), and where appropriate, this document will identify the specific SUS Goal and the corresponding FAU Goal met by this degree proposal. The four, broader goals set forth by the SUS include:

- GOAL 1: Access to and production of degrees,
- GOAL 2: Meeting statewide professional and workforce needs,
- GOAL 3: Building world-class academic programs and research capacity, and
- GOAL 4: Meeting community needs and fulfilling unique institutional responsibilities.

The 7 goals within the FAU Strategic Plan are

- GOAL 1: Providing increased access to higher education,
- GOAL 2: Meeting statewide professional and workforce needs,
- GOAL 3: Building world-class academic programs and research capacity,
- GOAL 4: Meeting community needs and fulfilling unique institutional responsibilities,
- GOAL 5: Building a state-of-the-art-information technology environment, and
- GOAL 6: Enhancing the physical environment,
- GOAL 7: Increasing the university's visibility.

As already discussed in the introduction section of this proposal, the Ph.D. in Geosciences will not find itself in direct competition with other more traditional geography and geology doctorate programs in the state which are focused largely on traditional academic career tracks. The proposed degree program will be a professional degree (SUS Goal 2, FAU Goal 2) which answers the call from state and federal employers in the area, other local agencies and environmental consulting firms for more highly trained individuals in the geosciences. These entities have a growing need for a workforce trained in advanced technology and field applications in geosciences in order to study and solve various environmental problems in South Florida and beyond. The program will emphasize higher level **integration** of conventional disciplines such as geography, geology, and earth sciences with technical and field based sciences, and will thus provide access to a different type of doctoral degree program not currently available in the state of Florida (SUS Goal 1, FAU Goal 1). The program will welcome part-time applicants from the geoscience professional community in South Florida, making advanced educational and research opportunities available to a wider constituency in the FAU service region (SUS Goal 1, FAU Goal 1).

Doctoral students from the program will specialize in hydrogeology/water resources, GIS/Remote Sensing technologies, or various areas within environmental analysis (such as paleoenvironments, coastal environments, biogeography, ethnobotany, and urban land-use change and sustainability). These areas emphasize skill sets that are required by local job markets, which address socio-economic concerns to scientific issues (e.g., weighing the costs and benefits of tourism to environmental protection). Thus, the program will make an important contribution towards FAU's strategic goal of committing academic and fiscal resources to meeting Florida's need for trained professionals in areas that implement advanced technologies,

and help prepare students for emerging trends in the labor force in general (SUS Goals 2 and 4, FAU Goals 2 and 4). In this way, the department is demonstrating its commitment to recruiting and preparing students for professions vital to the sustainability of Florida. (Please refer to letters of support from private industry and public agencies that appear in the Appendix section of this proposal).

The Department is at the forefront of geoscience research and technologies and encourages fieldwork and the attainment of skills in applied tools such as quantitative and theoretical techniques, geographic information systems, hydrologic modeling and remote sensing (FAU Goal 3). Students have the opportunity to be trained in specialized research facilities, such as the Geo-Information Science Center and the proposed Hydrology and Water Resources Center (SUS Goal 3). These centers provide services to a variety of clients, including the National Science Foundation, South Florida Water Management District, Florida Department of Environmental Protection, and various municipal agencies.

Inclusion of a Ph.D. in Geosciences will allow the Department, College and University to expand its graduate and overall research presence in environmental conservation and sustainability, and in the work associated with one of the world's largest environmental restoration projects (i.e., Comprehensive Everglades Restoration Plan - CERP), thus adding to the greater visibility of the university in the area of environmental research (FAU Goal 7). The program will meet community needs and fulfill unique institutional responsibilities in the seven-county service region (SUS Goal 4 and FAU Goal 4) by offering specialty programs to address local geoscience issues, such as coastal processes and water resource planning and restoration, and applied modeling. Local job markets are highly geared towards environmental analysis, contamination and planning due to the relative scarcity of water resources and water contamination; and the problem of unsustainable management of natural resources, which hampers human development and urbanization efforts. Pollution, the depletion of natural resources, and the disintegration of ecological functions are matters of local, regional and global concern. Economic development and more rigorous environmental standards not only in South Florida, but the world over contribute to the urgency of the offering of this doctoral program. The aim of the program is to provide professionals with the knowledge and skills necessary to contribute, directly or indirectly, to the conservation and prudent use of natural resources for the general benefit of society, as this will foster independent scientific and technical research, not to mention comprehensive assessments on major environmental issues.

B. Describe how the proposed program specifically relates to existing institutional strengths, such as programs of emphasis, other academic programs, and/or institutes and centers.

The Department of Geosciences already has a good relationship in terms of grant proposals and contracts with the Center for Environmental Studies at FAU, research and contract work with the Center for Urban and Environmental Solutions, and the beginnings of such a relationship with the Harbor Branch Oceanographic Institution (HBOI). Additionally, the Department has begun a dialogue with the Center for Urban Redevelopment and Education in the College of Architecture, Urban and Public Affairs at FAU. The mission statements, as obtained from their respective web pages and promotional material, of some of the partners in this program are consistent with the goals of FAU and the proposed program:

“The Florida Center for Environmental Studies represents the [ten state universities and four major private universities](#). The center acts as a facilitator and co-ordinator of research and training related to the environment and as a locus for environmental information. Grounding its activities in the Florida sub-tropical environment, its mandate encompasses global tropical and sub-tropical environments especially the issues and problems of water dominated ecosystems.”
<http://www.ces.fau.edu/>

“Harbor Branch Oceanographic Institution (HBOI) is dedicated to exploring the world’s oceans, integrating the science and technology of the sea with the needs of humankind. Our staff of over 250 includes scientists, engineers, mariners and support personnel. We are involved in research and education in the marine sciences; biological, chemical, and environmental sciences; marine biomedical sciences; marine mammal conservation; aquaculture; and ocean engineering.”
www.hboi.edu

The Center for Urban and Environmental Solutions (CUES) “facilitates dialogue and fosters solutions to urban and environmental issues through research, education, training and partnerships.” Through the Center’s leading role in the Florida Ocean Alliance and CUES’ various research agendas over the years, such as sustainability in South Florida, Land Use and Hazard Vulnerability, Growth Management and Resource Protection, and Economics of Beach Restoration, a key partnership will be forged to merge the research activity of the doctoral program with CUES where appropriate. Both the Department of Geosciences and CUES should benefit greatly from this relationship.
<http://www.cuesfau.org>

The Center for Urban Redevelopment and Education “is an applied research and community outreach center established to support and strengthen government and community-based organizations and to empower individuals within the University’s service area.”
www.cure.fau.edu

Additionally, the Department has research and field teaching relationships with the Departments of Anthropology, Biological Sciences and Chemistry and teaching relationships with Environmental Sciences, Civil Engineering, and Urban and Regional Planning. The addition of the Ph.D. in Geosciences will give the Department the opportunity to expand those relationships with cooperation in doctoral training, grant proposals and educational program enhancements. The degree program will be based in the geosciences, but will truly be cross-discipline and cross-college at FAU.

- C. Provide a narrative of the planning process leading up to submission of this proposal. Include a chronology (table) of activities, listing both university personnel directly involved and external individuals who participated in planning. Provide a timetable of events necessary for the implementation of the proposed program.**

2004-2005 AY

-Department Subcommittee formed to create new mission statement for the Department. This committee (Ivy, Oleinik, Restrepo and Tran) was charged by Nathan Dean, Dean of the Charles E. Schmidt College of Science, to more tightly integrate Geography and Geology within the Department through the mission statement. 9/04

-Department approves new mission statement on 11/04/04.

Mission Statement

The Mission of the Department is to provide students with a high-quality scientific education and expose them to professional research focused on the Geosciences through excellence in teaching, research and creative activities. Additionally, we will provide service to the university and local and regional communities by regularly offering courses that address a broad education in the Geosciences. Moreover, the department will strive for continued growth in our service mission through expansion in the distance-learning environment, through the continued offering of certificate programs in Geo-Information Science, and through the training of students to solve problems in their communities.

-Department votes to change its name from Department from 'Geography and Geology' to 'Geosciences' to reflect the new, integrated mission. 11/04/04

-Faculty Assembly of the Charles E. Schmidt College of Science approves name change from Department of 'Geography and Geology' to the Department to 'Geosciences' on 12/02/04.

-University Provost, John Pritchett, approves the name change from Department of 'Geography and Geology' to the Department of 'Geosciences' on 12/07/04.

-Dr. Russell Ivy is appointed Interim Chair by Dean Nathan Dean to begin making the necessary changes in the Department to move towards implementing the ideas presented in the mission statement. 12/04

-Interim Chair forms curriculum committees to begin looking at the undergraduate degree programs, degree requirements and course offerings in light of the new mission of the Department. Curriculum committees are formed in the areas of *Earth Systems Science*, *Human-Environmental Systems Science* and *Geo-Information Science*. Baccalaureate degree tracks were revised to fit the new mission and foci of the department. Several courses were eliminated from the course offerings that did not fit with the new foci and a few core courses were created to fill holes or strengthen offerings in the new areas of emphasis.

-Department identified basic hiring needs of tenure-track professors to implement the mission, and foci of the 'new' Department. These are not listed in any specific rank order

- 1) Coastal Geologist-Environmental Geophysics and/or Shallow Seismic Geophysics;
- 2) Hydrogeologist/Hydrogeochemist;
- 3) GIS/Remote Sensing Technical-Spatial/Quantitative Analysis;

4) Human-Environmental Geographer-Hazards, Vulnerability, Biogeography, or Landscape Ecology.

-Department hires Dr. Maria Fadiman as a Human-Environmental Geographer to begin as a tenure-track Assistant Professor in Fall 2005.

-Research faculty status granted to Dr. Charles Finkl from the Coastal Education and Research Foundation and Coastal Planning and Engineering

2005-2006 AY

-Department approves a formal set of Goals and Objectives that stem from the Mission Statement. 9/05

-Department curriculum committees [*Earth Systems Science*, *Human-Environmental Systems Science* and *Geo-Information Science*] complete their assessment of the undergraduate degree programs and course offerings and finalize paperwork for changes. The committees then move to examine the Masters' degree programs, requirements and course offerings in the same fashion. Again, requirements are slightly changed, courses are deleted and some new courses are added to reflect the new mission/foci of the Department.

-A Ph.D. Planning Committee is formed in the Department that meets weekly (Ivy, Oleinik, Restrepo, Tran). Goal of the committee is a white paper that describes the intended focus of the Ph.D. proposal.

-Commitment for 2 annual research scholarships for graduate students—Coastal Planning and Engineering and the Coastal Education and Research Foundation

-Dr. Russell Ivy is appointed Chair of Geosciences by Dean Nathan Dean and is charged to move ahead with a formal full-scale proposal for the Ph.D. degree based in the Department. 12/05.

-Research faculty status granted to Dr. Roger Charlier

-Department hires Dr. Tara Root as hydrogeologist/hydrogeochemist to begin tenure-track Assistant Professor position during the 2006-2007 AY.

-Department hires Dr. Maria Jose Garcia-Quijano as GIS/Remote/Quantitative geographer to begin tenure-track Assistant Professor position during the 2006-2007 AY.

-Department hires an instructor James Gammack-Clark to replace Gallagher. The instructor will free up availability of some of the technical faculty for graduate course offerings by teaching some of the lower-level GIS courses.

-Department hires a Visiting Assistant Professor in Geophysics, Dr. Corey Moss, for the 2006-2007 AY. This Geophysics position will eventually turn into a tenure-track position with a national search.

2006-2007 AY

-Department is visited by the new Dean of the Charles E. Schmidt College of Science, Dr. Gary Perry, who charges the Department to move forward with the planning of the Ph.D. degree in Geosciences. 9/06

-Ph.D. Planning Committee resumes weekly meetings. Tran, who departed FAU during the Summer of 2006 for a position with the EPA, is replaced by Charles Roberts. Goal of Committee is to have the Ph.D. proposal draft ready by the end of the Spring 2007 term. Department sets up subcommittees to help with the various pieces of the proposal. All faculty are involved at this point either on the main committee or a subcommittee. Committee explores the official name for the degree—Ph.D. in Geosciences, Ph.D. in Applied Geosciences and Ph.D. in Integrative Geosciences—Ph.D. in Applied Geosciences becomes the working title for the proposal.

-Dr. Ivy begins meeting with leaders from the geosciences and environmental professional community to gain interest in and support for the proposal as well as input for the shaping of the curriculum and other facets of the proposal. The end goal is a tight proposal that reflects the geoscience needs of the professional community, to gather letters of support for the proposal, and to select some of these professionals to serve on an advisory board to critique the final document, but also to monitor the degree program, if approved, in the future.

-Team visit from USGS to the Department of Geosciences (12/06)

-Department hires Dr. Scott Markwith as tenure-track assistant professor in the human/environmental interactions area. His specific area of expertise is Biogeography. This hire is a replacement for Dr. Tran who departed in Summer 2006, and therefore this was not on the hiring list identified in the 2004-2005 AY. Dr. Markwith will begin in the 2007-2008 AY.

-Department hires Dr. Xavier Comas as a tenure-track assistant professor in the geophysics area. He will begin in the 2007-2008 AY.

-Appointment of Professional Advisory Board by Dean Gary Perry, new Dean of the Charles E. Schmidt College of Science.

-Faculty of Geosciences approve the curriculum, admissions requirements and degree requirements of the program (March 2007)

-Ph.D. Planning committee reviews and selects criteria for Doctoral Faculty status

-Ph.D. Planning Committee reviews faculty from other Departments for Cognate Faculty list

-Ivy works with Dean Perry over the summer of 2007 to tighten the proposal

2007-2008 AY

-Department approves proposal document and finalizes name for degree --Ph.D. in Geosciences

as being a more flexible than other working titles during the planning process [Ph.D. in Applied Geosciences was the working title]

-Requests outside review from the Chair and Associate Chair of the Department of Geography and Earth Sciences at the University of North Carolina-Charlotte.

-Seek approval for Ph.D. in Geosciences from College, University, BOT, BOG

2008-2009 AY

-Implementation of Ph.D. in Geosciences

VII. Program Quality Indicators - Reviews and Accreditation

Identify program reviews, accreditation visits, or internal reviews for any university degree programs related to the proposed program, especially any within the same academic unit. List all recommendations and summarize the institution's progress in implementing the recommendations.

The last program review was completed in 2001, and indicated that the Department was doing well in teaching, research and service, given its size. This review was of the former Department of Geography and Geology. Since the end of 2004, the Department has made major changes in its mission, goals and curriculum to streamline the program to be consistent with local, state and national needs, and to prepare for the implementation of the Ph.D. in Geosciences. The changes made since 2004 have created a tighter focus for the Department that should make our program more competitive in attracting students, and our faculty more competitive in grant and other research arenas.

The Department sought an independent outside review of the proposal during September/October of 2007. The outside reviewers are Dr. Jerry Ingalls and Dr. John Binder (Chair and Associate Chair) from the Department of Geography and Earth Sciences at the University of North Carolina-Charlotte (<http://www.geoearth.uncc.edu/>). This is a Department that we have often used as a peer department to make comparisons for planning, and even though their doctoral program has taken a different direction from what we are proposing, the staffing in the department (geographers and geologists) and main focus areas in the department, that certainly form the basis of their undergraduate and master's programs, mirror ours very well. Their independent review is included in the Appendix.

VIII. Curriculum

A. Describe the specific expected student learning outcomes associated with the proposed program. If a bachelor's degree program, include a web link to the Academic Learning Compact or include the document itself as an appendix.

The Ph.D. in Geosciences will have the following outcomes, modified from the outcomes for the

M.A./M.S. programs in the Department to reflect advanced doctoral training:

- 1) Students will be well prepared for professional positions in the geosciences workforce. The criterion for success will be that at least 80% of the graduates of the doctoral program will obtain and maintain a position in their chosen field of interest related to their degree. The Department will constantly update the curriculum of the program in consultation with the Geosciences Professional Advisory Board to ensure that our students are prepared for such employment. The Department will maintain a database to monitor the success of this outcome.
- 2) Students will demonstrate the development of an advanced set of skills associated with their area of specialization. This outcome will be measured by successful public presentation of one or more major research projects. In addition to the doctoral defense at the end of the program, students will be required to give at least one department colloquium in GEO 6920 demonstrating advanced research proficiency. Both of these forums will be open to the public and a faculty committee (the student's doctoral committee for the defense, and the department's assessment committee for the colloquium) that will provide feedback to the student to monitor the success of this outcome.
- 3) Students will become engaged in appropriate professional activities in their area of specialization. This outcome will be measured by attendance and participation in the conferences, workshops and other meetings of professional societies. The student's doctoral committee will advise and monitor the candidate's success in this area. All student's will be required to give at least 2 professional conference or workshop presentations during their tenure in the doctoral program. Normally, this will be done as part of the enrollment in GEO 7978 Advanced Research.

B. Describe the admission standards and graduation requirements for the program.

Admission Requirements:

Individuals to be admitted to the doctoral program in Geosciences at Florida Atlantic University will submit applications to the Graduate Admissions Committee of the Department (as defined below in the section describing the administration of the program). The Committee will admit students based on the following admission requirements.

1. Minimum of a Bachelor's degree in a field of geosciences or related area. Students who have already earned a Master's Degree or equivalent in geography, geology or related field can be admitted to the doctoral program and will be given 30 credits toward the Ph.D. in Geosciences.
2. International students whose native language is not English must score at least 550 on the paper-based TOEFL or at least 213 on the computer-based test.
3. A combined score of 1000 or above in the Quantitative-Verbal sections (minimum of 500 on each section) on the GRE and a cumulative GPA of at least 3.0 in the last degree program of the applicant.
4. Three satisfactory professional and/or academic letters of reference.

5. A written letter of support from a Geosciences faculty member with doctoral faculty status at FAU, or an approved, affiliated faculty member with doctoral faculty status at FAU, indicating a willingness to supervise doctoral research of the applicant.

Administration of the Program:

The proposed Ph.D. program will be administered by a director (who will be the Geosciences Department Chair in the initial years of the program) and the doctoral faculty of the Geosciences Department and appointed doctoral faculty of cognate departments, as well as an advisory board appointed from the local professional community by the Dean of the Charles E. Schmidt College of Science. This group will be collectively known as the Geosciences Graduate Program Committee, and will be responsible for establishing and reviewing academic policy pertaining to the program, curriculum development and oversight, and overall program administration. The committee will also review faculty, both in Geosciences and other appropriate cognate FAU units, to determine status as doctoral faculty or graduate faculty, and therefore the role of the faculty member in the program. This includes approving all dissertation committees of individual students in the program. Dissertation committees will include a minimum of four faculty members of which a majority must have doctoral faculty status.

Graduate faculty status will be determined using the general criteria, policies and procedures outlined for the university-wide graduate faculty at FAU. Those with graduate faculty status may teach courses in the program and may serve on dissertation committees, however, the faculty member may not be the direct supervisor of a dissertation until he/she has reached doctoral faculty status. As is the policy of the Charles E. Schmidt College of Science, specific graduate faculties for each doctoral program housed in the College are appointed by the Dean of the College based on criteria approved by the Department and the College Graduate Program Committee.

The criteria for doctoral faculty status for the proposed degree program is

- 1) the faculty member shall hold a regular tenured, tenure-track or term appointed faculty position at FAU;
- 2) the candidate must present a record of a minimum of three refereed journal publications or one major book during the last five year period; and
- 3) the faculty member must have evidence of submitting at least one grant application for external funding during the same five year period.

Both doctoral and graduate faculty will be reviewed every five years by the Geosciences Graduate Program Committee to verify maintained graduate or doctoral faculty status. A faculty member may ask to be reviewed for change from graduate faculty status to doctoral faculty status at any time. Faculty members who meet the criteria for doctoral faculty status are referred to the Chair of Geosciences for recommendation of appointment by the Dean of the College. Research professors and outside professionals, such as employees of USGS, etc, with appropriate

graduate credentials may serve on a dissertation committee at the discretion of the Geosciences Graduate Program Committee, and may serve as the Chair of a doctoral committee in Geosciences provided a regular faculty member serves as Co-Chair of the committee.

The Geosciences Graduate Program Committee will also be responsible for admitting students into the program. The program committee will elect a four member subcommittee from its membership to serve as the Graduate Admissions Committee for the doctoral program. The Chair of this subcommittee must be a regular faculty member in the Department of Geosciences, and will also serve as the Graduate Program Director for the Department.

Degree Requirements:

A total of 90 credits beyond the Bachelor's degree or 60 credits beyond an earned Master's Degree in a related field, admission to candidacy, and successful defense of a research dissertation in an approved area within the Geosciences will earn students the Ph.D in Geosciences. Students must earn a grade of 'B' or higher in any course that is applied to the credit hours presented for the degree. The degree program should normally be completed within 4-5 years. As per university policy, the degree should be completed within 7 years of maintained continuous enrollment. Part-time students may need to petition to go beyond the 7 year rule. Petitions of part-time students in good standing with respect to a cumulative GPA in the program of 3.0 or higher, and regular matriculation will be supported by the Department. The specific degree requirements are discussed in detail below.

1. A minimum of 66 credits beyond the bachelor's degree or 36 credits of coursework beyond the Master's degree with a cumulative grade point average of 3.0 or higher and a minimum of grade 'B' in any course applied to the degree program with the following requirements:

(a) 9 credits will be in coursework designated as the *geosciences core*

GEO 6118	Research in the Geosciences	3
GLY 6931	Thesis/Dissertation Seminar	3
GEO 6920	Geosciences Colloquium Series	3*

[*This is a one-credit course. The content of the course varies from semester to semester as it is based on guest speakers discussing their research in the geosciences and related areas. Students will be asked to take the course for credit 3 semesters during their residency in the program to expose them to a wide variety of research in the geosciences and related areas.]

(b) The remaining 57 credits for students entering directly from their bachelor's degree program or remaining 27 credits for students entering with a master's degree in geography, geology or a related field will be made up of coursework in geography, geology and interdisciplinary cognates from the approved list as appropriate to the student's research plan. No more than 3 credit hours of GEO 6908 or GLY 6908 may be used to meet this requirement. All courses will be at the 5000 level or above, however, no more than 9 credits of 5000 level work may be applied to the degree. The student's major advisor and committee must approve all coursework in the student's program, and

any exceptions to the approved cognate list must be made by the Geosciences Graduate Program Committee.

(c) Courses designated as undergraduate proficiency courses, generally for students coming into the program with a non-related undergraduate degree, may not be used to satisfy course requirements for the degree. Undergraduate proficiency courses will be outlined in the admissions notification.

2. Admission to Candidacy as outlined below:

- (a) Formation of a dissertation committee. This committee includes the advisor plus three other members. A majority of the members must have doctoral faculty status in the doctoral program. Two of the members may be from another department or program at FAU or may be a professional in the local community with expertise pertinent to the research program designed.
- (b) Satisfactory completion of an examination covering graduate-level material in the field of geosciences. The material for the exam will be determined by the student's committee as appropriate to the research plan of the student. The exam must be taken during the academic term immediately following the completion of the coursework outlined in section 1 of the degree requirements. Two attempts at the examination are permitted. A second failure on the qualifying exam will result in dismissal from the program.
- (c) Submission and presentation of an original research proposal. The proposal will be publicly presented in the GEO 6920 Geosciences Colloquium Series. The student must receive written notification from the doctoral supervisor of satisfactory performance to meet this requirement.

3. Dissertation research under the direction of a faculty member in the Department or other Department-affiliated units and any other graduate level coursework desired by the dissertation committee (24 credit hours). Within the 24 credits, a minimum of 12 credits of GEO 7978 Advanced Research and 6 credits of GEO 7980 Dissertation must be included.

4. Written submission, public presentation and defense of a satisfactory research dissertation. The defense will include an oral examination of the research presented.

C. Describe the curricular framework for the proposed program, including number of credit hours and composition of required core courses, restricted electives, unrestricted electives, thesis requirements, and dissertation requirements. Identify the total numbers of semester credit hours for the degree.

The entire program requires 90 credit hours beyond the bachelor's degree including 9 credits of required core courses, as highlighted below.

GEO 6118	Research in the Geosciences	3
GLY 6931	Thesis/Dissertation Seminar	3
GEO 6920	Geosciences Colloquium Series	3*

[*This is a one-credit course. The content of the course varies from semester to semester as it is based on guest speakers discussing their research in the geosciences and related areas. Students will be asked to take the course for credit 3 semesters during their residency in the program to expose them to a wide variety of research in the geosciences and related areas.]

Additionally, a minimum of 12 credits of GEO 7978 Advanced Research and 6 credits of GEO 7980 Dissertation will be required. The remaining credits are made up of coursework and research credits as selected by the student in consultation with the doctoral advisor as appropriate to the student's research interests. *See section 'B' above for more detailed information on the program requirements.*

D. Provide a sequenced course of study for all majors, concentrations, or areas of emphasis within the proposed program.

The course of study provided is for full-time students coming into the Ph.D. in Geosciences program directly from an undergraduate degree, entering in the Fall semester of the academic year.

YEAR 1

Fall Semester

GEO 6118	Research in the Geosciences	3
GLY 6931	Thesis/Dissertation Seminar	3
GEO 6920	Geosciences Colloquium Series	1
Coursework chosen in consultation with doctoral committee		<u>2</u>
TOTAL Hours		9

Spring Semester

GEO 6920	Geosciences Colloquium Series	1
Coursework chosen in consultation with doctoral committee		<u>8</u>
TOTAL Hours		9

Summer Session

Coursework chosen in consultation with doctoral committee		<u>6</u>
TOTAL Hours		6

YEAR 2

Fall Semester

GEO 6920 Geosciences Colloquium Series	<u>1</u>
Coursework chosen in consultation with doctoral committee	<u>8</u>
TOTAL Hours	9

Spring Semester

Coursework chosen in consultation with doctoral committee	<u>9</u>
TOTAL Hours	9

Summer Session

Coursework chosen in consultation with doctoral committee	<u>6</u>
TOTAL Hours	6

YEAR 3

Fall Semester

Coursework chosen in consultation with doctoral committee	<u>9</u>
TOTAL Hours	9

Spring Semester

Coursework chosen in consultation with doctoral committee	<u>9</u>
TOTAL Hours	9*

*Students will also take their candidacy exam and prepare a research proposal for public defense near the end of this term.

Summer Session

Research/Dissertation Credits	<u>6</u>
TOTAL Hours	6

YEAR 4

Fall Semester

Research/Dissertation Credits	<u>9</u>
TOTAL Hours	9

Spring Semester

Research/Dissertation Credits	<u>9</u>
TOTAL Hours	9

*Students will also defend Dissertation during this semester.

E. Provide a one- or two-sentence description of each required or elective course.

Curriculum for Ph.D. in Geosciences

Geoscience Graduate-Level Courses

- GEA 6277 Human-Environmental Interactions (3 credits)
Methods and approaches to explore diverse aspects of human-environmental interactions.
- GEO 5435C Geographic Analysis of Population (3 credits)
Theory and methods in geographic analysis of population and demography.
- GEO 6117 Seminar in Geographic Methodology Techniques (3 credits)
Basic methodologies and techniques in geographic analysis.
- GEO 6118 Research in the Geosciences (3 credits)
An introduction to the research in Geosciences that form the main foci in the Department.
- GEO 6318 Plants and People (3 credits)
Cross-cultural examination of people's use of plants.
- GEO 6337 Culture, Conservation and Land Use (3 credits)
The course looks at how people utilize resources with emphasis on conservation and cultural influences on land use practices.
- GEO 6608 Seminar in Urban Area Analysis (3 credits)
Analysis of land-use, economic development and sustainability of the urban environment and its infrastructure.
- EVR 6364 Restoration Geoscience (3 credits)
Advanced topics and research in biogeography.
NOTE: This will be a new course proposal presented by Dr. Scott Markwith during the 2007-2008 school year. It is still going through the curriculum approval process.
- GEO 6908 Directed Independent Study (1-3 credits)
Independent study in topic areas outside the regular department offerings.
- GEO 6918 Graduate Research in Geosciences (1-9)
Independent research prior to Master's candidacy.
- GEO 6920 Geosciences Colloquium Series (1 credit)
Course for incoming graduate students to develop an awareness of various research perspectives in geosciences through a series of invited speakers.
- GEO 6938 Seminar in Special Topics in Regional/Systematic Geography (3 credits)
Analysis and synthesis of special topics in geography.
- GEO 6971 Master's Thesis (1-6 credits)
- GEO 7978 Advanced Research in Geosciences (1-9 credits)
Independent research prior to admission to doctoral candidacy.
- GEO 7980 Dissertation (1-12 credits)
- GIS 5033C Digital Image Analysis (3 credits)
Introductory course for graduate students covering the analysis of digital satellite imagery of the earth.
- GIS 5038C Remote Sensing of the Environment (3 credits)
Introductory course for graduate students covering principles of photographic and

- electromagnetic remote sensing systems.
- GIS 5051C Principles of Geographic Information Systems (3 credits)
Introductory course for graduate students covering the basic concepts of geographic information systems.
- GIS 5100C Applications in Geographic Information Systems (3 credits)
Project-oriented implementation and application issues in geographic information systems.
- GIS 5103C Programming in Geographic Information Systems (3 credits)
Introductory course for graduate students covering basic programming concepts and methodologies in geographic information systems.
- GIS 6039 Advanced Remote Sensing (3 credits)
Advanced study of remote sensing applications, project design, implementation and evaluation.
- GIS 6127 Hyperspectral Remote Sensing (3 credits)
Processing and interpretation of hyper- and ultra-spectral data with a focus on thematic information extraction from airborne and satellite-based sensors.
- GIS 6114 Internet GIS (3 credits)
Concepts and hands on techniques of how geographical information can be disseminated and processed in an Internet environment.
- GIS 6120 Topics in Geographic Information Science (3 credits)
Technical, operational and management issues in geographic information systems.
- GLY 5243 Advanced Environmental Geochemistry (3 credits)
A study of the hydrologic cycle and natural and man-made pollutants in the environment.
- GLY 5575C Shore Erosion and Protection (3 credits)
Study of the geomorphology and usage of coasts including such topic as sediment budgets and dune-beach interaction.
- GLY 5736C Marine Geology (3 credits)
Theoretical and applied earth science in the marine environment looking at the history of marine geology, structure and evolution of continental margins and the world's basins.
- GLY 5934 Advanced Topics in Applied, Coastal and Hydrogeology (3 credits)
Advanced work in specialized topics in engineering geology, coastal geology and hydrogeology not covered in other regular course offerings in the department.
- GLY 6619C Paleomalacology (3 credits)
Review of the systematics, evolution, and ecological interactions of the fossil mollusks.
- GLY 6661C Paleoecology (3 credits)
Overview of the principles of ecology as applicable in the fossil record and implications in evolutionary theory.
- GLY 6707 Regolith Geology (3 credits)
Surveys the occurrence and distribution of surficial materials.
- GLY 6737 Coastal Environments (3 credits)
Examination of the biophysical framework and biogeography of coastal environments.
- GLY 6745 Ancient Marine Environments (3 credits)

- Focuses on methods used to recognize ancient marine environments from the stratigraphic record and investigates changes in deep-sea sedimentation and sedimentary overlap sequences on continental margins.
- GLY 6746 Global Environmental Change (3 credits)
Study of the causes and impacts of global climatic change through time.
- GLY 6826 Optimization Applications in Groundwater (3 credits)
Develops and applies groundwater optimization models for the control of groundwater flow and water quality.
- GLY 6827C Advanced Hydrogeology (3 credits)
Advanced groundwater flow modeling.
- GLY 6828 Groundwater Solute Transport Modeling (3 credits)
Studies the mechanisms that govern the movement of water and pollutants in aquifers.
- GLY 6836 Modeling Groundwater Movement (3 credits)
Focuses on groundwater flow space and time scale, and surface groundwater interaction.
- GLY 6888 Coastal Hazards (3 credits)
A global review of natural and human-induced hazards as they affect coastal zones.
- GLY 6889 Environmental Geophysics (3 credits)
Lab-based course introducing students to the latest technologies in ground penetrating radar and other geophysics research techniques.
NOTE: This will be a new course proposal presented by Dr. Xavier Comas during the 2007-2008 school year. It is still going through the curriculum approval process.
- GLY 6908 Directed Independent Study (1-3 credits)
Independent study in topic areas outside the regular department offerings.
- GLY 6931 Thesis Seminar (3 credits)
Methods, procedures and policies for preparing, presenting, defending, and completion of a thesis or dissertation.
- GLY 6934 Special Topics in Applied Geology (3 credits)
Analysis and synthesis of special topics in geography.
- GLY 6971 Master's Thesis (1-6 credits)

Interdisciplinary Cognate Courses

(all cleared with each Department offering the course in question)

- ANG 6115 Seminar in Archeology (3 credits)
Archaeological method and theory as well as reconstruction and description of cultures.
- ANG 6490 Seminar in Cultural Anthropology I (3 credits)
Cultural Theory in historical perspective.
- ANG 6499 Seminar in Cultural Anthropology II (4 credits)
Cultural Theory in historical perspective.
- ANG 6587 Seminar in Biological Anthropology I (3 credits)
Biology and environment in human existence: theoretical considerations.
- BOT 6606/6606L Coastal Plant Ecology/Lab (4 credits)

CHS 6611	An in-depth analysis of current topics of coastal plant ecology. Chemical Analysis for Environmental Sciences (3 credits) Survey of basic chemical principles, atmospheric, aquatic and geologic chemistries with emphasis on the interfaces of each with the others.
ENC 6258	Scientific Communication (2 credits) Introduces students to grant writing and the publication process necessary for scientists.
ENV 6668	Environmental Systems and Processes (3 credits) Physical, chemical and biological processes in the environment.
EVR 6070	Ecological Modeling (3 credits) Modeling and simulation techniques used in environmental sciences.
PCB 6307/6307L	Freshwater Ecology/Lab (5 credits) A study of limnological processes with an emphasis on subtropical freshwater habitats.
PCB 6317/6317L	Marine Ecology/Lab (5 credits) A study of the principles, concepts, and techniques of marine and estuary ecology.
STA 6206	Statistical Methods for Environmental Sciences (3 credits) Review of statistical methods used in scientific research.
URP 6101	Planning Process and Skills (3 credits) Introduction to Urban Planning.
URP 6270	Introduction to GIS in Planning (3 credits) Overview of planning information systems.
URP 6272	Managing GIS Projects (3 credits) Organizational and management issues involved in implementing geographic information systems.
URP 6277	GIS Applications in Planning (3 credits) GIS applications in environmental planning, community and economic development planning, urban design and land use planning.
URP 6425	Environmental Analysis in Planning (3 credits) Analysis of natural and urban environments and the application of planning systems.

Additional courses will be added from Civil Engineering and Ocean Engineering as the program grows and evolves. A letter of support from the Dean's office of the College of Engineering and Computer Science can be found in the Appendix of this proposal.

F. For degree programs in the science and technology disciplines, discuss how industry-driven competencies were identified and incorporated into the curriculum and identify if any industry advisory council exists to provide input for curriculum development and student assessment.

Industry-driven competencies were gleaned by numerous discussions by the Chair of Geosciences with geoscience professionals in the South Florida area over the 2006-2007 planning year. This led to the creation of the Geosciences Professional Advisory Board which

further fine-tuned the curriculum and the degree program in general. The initial advisory board comprised of three highly accomplished geoscientists was appointed by the Dean of the Charles E. Schmidt College of Science to help oversee the planning of the program, and this group will make up the first professional members of the Geosciences Graduate Program Committee discussed above, once the degree is formally approved. The group below was recommended by the Chair of Geosciences and was appointed by the Dean during the Spring of 2007. Their CVs appear in the appendix of this document.

Z. (Ken) Chen, Ph.D.
Sr. Supervising Professional (Remote Sensing/GIS Specialist)
Environmental Resource Assessment Department
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406

Patrick J. Gleason, Ph.D. P.G.
Vice President
Camp Dresser & McKee Inc.
1601 Belvedere Road, Suite 211 South
West Palm Beach, FL 33406

Robert A. Renken
U.S. Geological Survey
FISC-Center for Water and Restoration Studies
3110 SW 9th Avenue
Ft. Lauderdale, FL 33315

Additional members may be added as the program grows and develops.

G. For all programs, list the specialized accreditation agencies and learned societies that would be concerned with the proposed program. Will the university seek accreditation for the program if it is available? If not, why? Provide a brief timeline for seeking accreditation, if appropriate.

As geography and geology are the main components of the proposed degree program, the learned societies that would be most concerned with this degree would be the major academic societies of these disciplines; the Association of American Geographers and the Geological Society of America. Other specialized associations, such as the American Water Resources Association, the American Society for Photogrammetry & Remote Sensing, and the International Association for Environmental Hydrology, among many others, would also have interest in the program. There are currently no formal accreditation boards for degree programs in geography and geology.

H. For doctoral programs, list the accreditation agencies and learned societies that would be concerned with corresponding bachelor's or master's programs associated with the proposed program. Are the programs accredited? If not, why?

See section G above.

- I. Briefly describe the anticipated delivery system for the proposed program (e.g., traditional delivery on main campus; traditional delivery at branch campuses or centers; or nontraditional delivery such as distance or distributed learning, self-paced instruction, or external degree programs). If the proposed delivery system will require specialized services or greater than normal financial support, include projected costs in Table 2. Provide a narrative describing the feasibility of delivering the proposed program through collaboration with other universities, both public and private. Cite specific queries made of other institutions with respect to shared courses, distance/distributed learning technologies, and joint-use facilities for research or internships.**

Most of the coursework for the proposed program will be traditional delivery courses on the Boca Raton campus. With the expansion of geosciences faculty on the Davie campus by 2012, as has been proposed by the Dean as part of the formal growth plan for the Charles E. Schmidt College of Science, some graduate coursework will eventually be offered at that location to take full advantage of specialties of the new Davie geosciences faculty. Students taking courses from the approved cognate list within the Urban and Regional Planning Department will take some traditional delivery courses at the Tower campus, where that program is housed. As the program grows, distance learning options shared with other FAU campuses, centers, and other private and public universities in Florida and beyond will be explored, including distance learning technologies shared with the Los Alamos National Lab in New Mexico as one of the special initiatives of the Charles E. Schmidt College of Science. The Department has already begun to foster the Los Alamos relationship. Also, our relationship with USGS is expected to grow along with the program, offering research and internship opportunities for both graduate and undergraduate students, as well as expanded teaching opportunities with USGS faculty as adjuncts or research faculty. As mentioned earlier, the Department fully expects our relationship with the Harbor Branch Oceanographic Institute to grow and flourish and can certainly envision HBOI faculty participating in distance learning education in the program and dissertation committee work as the proposed degree program grows.

IX. Faculty Participation

- A. Use Table 4 to identify existing and anticipated ranked (not visiting or adjunct) faculty who will participate in the proposed program through Year 5. Include (a) faculty code associated with the source of funding for the position; (b) name; (c) highest degree held; (d) academic discipline or specialization; (e) contract status (tenure, tenure-earning, or multi-year annual [MYA]); (f) contract length in months; and (g) percent of annual effort that will be directed toward the proposed program (instruction, advising, supervising internships and practica, and supervising thesis or dissertation hours).**

As identified in Table 4, most of the faculty needed to sustain the program through year 5 is already in place at FAU. This list includes 16 within the Geosciences Department at FAU and 18 cognate faculty from Anthropology, Biological Sciences and Urban and Regional Planning with teaching and research specialties closely related to the focus areas of the proposed degree program. Three additional geosciences faculty will be added by year 5 of the program. This addition is already in the projected growth plan for the Charles E. Schmidt College of Science presented by the Dean to the Provost and the Board of Trustees. This faculty addition is not necessary for the implementation of the program, but the need is anticipated as the program

grows in enrollment.

Two important notes on Table 4: 1) An instructor with only an M.A. is included in the Geosciences faculty list. The role of this person will be merely the offering of a 5000-level course in Geographic Information Systems for students admitted to the program with minimal skills in that area. This instructor will not serve on dissertation committees, nor will he supervise graduate level DIS research. 2) Four Research Professors in Geosciences are not included in the list of faculty in Table 4. Dr. Charles Finkl, Dr. Lakhdar Boukerrou (affiliated with the Center for Environmental Studies at FAU), Dr. Myroslaw George Harasewych (affiliated with the Smithsonian Museum and Harbor Branch) and Dr. Roger Charlier are all appointed to such positions and actively contribute to graduate education in the department in terms of serving on thesis committees, offering research colloquiums and occasionally offering graduate level, adjunct courses in the Department. These services come at no salary and benefits cost to the university, except adjunct pay when they assume a teaching role. It should be noted that both Finkl and Charlier have research and teaching specialties in the coastal and marine science aspects of the geosciences, a popular area within geosciences, and therefore help to reduce upfront costs needed to implement and sustain that part of the program.

B. Use Table 2 to display the costs and associated funding resources for existing and anticipated ranked faculty (as identified in Table 2). Costs for visiting and adjunct faculty should be included in the category of Other Personnel Services (OPS). Provide a narrative summarizing projected costs and funding sources.

As discussed in Section III A, for year 1, the faculty salaries and benefits needed to support the doctoral program will come entirely from reallocated base E&G funds. This will include \$123, 717 reallocated directly from Geosciences faculty (one of those faculty members paid from Research Office budget and one from the Center for Environmental Studies), and \$77, 345 from the home departments of the cognate faculty. See Table 4 for a complete listing of faculty involved with the program.

These reallocated salaries and benefits extend into year 5 with an increase in % effort, and therefore amount reallocated, for some of the junior faculty who are less involved in the doctoral program in year 1 and for some more senior faculty as well (see Table 4). This differential is found in the “New Enrollment Growth E&G” column for year 5. Also, in year 5, the new Davie faculty will be added, as discussed above (see Table 4). The reallocated base for the percentage effort associated with the new Davie faculty is shown in the “Other E&G” category for year 5. Again, these new faculty have been planned for outside of the approval of the Ph.D. in Geosciences.

Two additional adjuncts (OPS) beyond our current usage (generally about 2 per semester) would be needed to initiate the program. These will be funded (\$18,000) from grants and contracts in the Department. We would expect that growth and development in the doctoral program would impact the adjunct (OPS) needs of the Department by year 5 with more courses needed both in Boca and on the Davie campus, and more teaching buyouts from faculty grant activity. Thus, the OPS funding for adjuncts in the Department should increase from the current funding level of \$18,000 to \$72,000. The funding for these new OPS positions would come from grant and contract money.

C. Provide the number of master's theses and/or doctoral dissertations directed, and the number and type of professional publications for each existing faculty member (do not include information for visiting or adjunct faculty).

Faculty Name	Theses	Dissertations	Professional Publications
Baldwin, John	5	0	13
Berry, Leonard	100	30	221
Broadfield, Doug	10	0	17
Brown, Clifford	1	0	40
Cameron, Mary	1	0	16
Comas, Xavier	0	0	8
Dorn, Nathan	0	0	13
Esnard, Ann-Margaret	20	3	22
Fadiman, Maria	1	0	6
Finkl, Charles	13	0	146
Garcia-Quijano, Maria	0	0	10
Gawlik, Dale	1	0	47
Hanson, Howard	0	0	60
Harris, Michael	9	0	35
Ivey, Michelle	0	0	10
Ivy, Russell	16	1	32
Koch-Rose, Marguerite	10	0	25
Louda, William	7	1	27
Markwith, Scott	0	0	6
Moore, Jon	0	0	42
O'brien, William	0	0	20
Oleinik, Anton	2	0	22
Orlando, Edward	0	0	38
Petuch, Edward	0	0	67
Proffitt, Edward	5	0	41
Prosperi, David	16	2	46
Restrepo, Jorge	7	0	33
Roberts, Charles	15	0	10
Root, Tara	1	0	4
Vos, Jaap	0	0	9
Warburton, David	1	0	5
Xie, Zhixiao	1	0	23
Zhang, Xing-Hai	5	1	33

NOTE: The table above only includes thesis and dissertation **supervision** as indicated in the directions. Also, the professional publications do NOT include published abstracts as not all faculty include these on their vitae. The professional publications include refereed journal articles, conference proceedings, technical reports and books and book chapters.

Since 2000, Geosciences faculty have published over 130 refereed publications and 45 funded research grants in addition to involvement in several grants through the Center for Environmental Studies under the direction of Dr. Leonard Berry. As can be seen from the data

above, the cognate faculty for the proposed program, have been highly productive as well.

D. Provide evidence that the academic unit(s) associated with this new degree have been productive in teaching, research, and service. Such evidence may include trends over time for average course load, FTE productivity, student HC in major or service courses, degrees granted, external funding attracted, as well as qualitative indicators of excellence.

The Office of Institutional Effectiveness at FAU collects productivity on all academic units at the university. Below is a summary of information about the Department of Geosciences over the past 3 academic years. The entire document can be found on the Institutional Effectiveness pages of the FAU website at http://iea.fau.edu/review/2007/PR2006-2007_Geosciences.rtf. The first table found below (Table B3 from the link above) shows the teaching productivity of the Department since the 2003-2004 academic year. This is followed by two tables illustrating the number of degrees awarded in geography and geology (Tables C3—one chart for each CIP code—from the link above), and a research summary table for the Department.

B 3 Average Course Section Size and Percent of Sections Taught By Faculty Geosciences

				Geosciences			College Total	University Total
				2003-2004	2004-2005	2005-2006	2005-2006	2005-2006
Course Level	Type							
Undergraduate	Lecture/Seminar	Sections Offered	#	58	62	58	602	5,076
			# Enrolled	2,337	2,731	3,073	32,266	155,969
			Avg Section Enrollment	40.2	44.0	52.9	53.5	30.7
		Sections Faculty-Taught	#	48	56	51	434	3,068
			%	82.8	90.3	87.9	72.1	60.4
	Lab	Sections Offered	#	25	23	23	646	865
			# Enrolled	400	463	435	11,439	14,637
			Avg Section Enrollment	16.0	20.1	18.9	17.7	16.9
		Sections Faculty-Taught	#	2	1	1	274	396
			%	8.0	4.3	4.3	42.4	45.8
	Discussion	Sections Offered	#	46	56	65	93	164
			# Enrolled	777	1,108	1,210	1,722	3,751
			Avg Section Enrollment	16.8	19.7	18.6	18.5	22.8
		Sections Faculty-Taught	#					1
			%					0.6
	Other Course Types	Sections Offered	#	19	20	22	353	1,413
			# Enrolled	29	50	49	665	8,640
			Avg Section Enrollment	1.5	2.5	2.2	1.8	6.1
		Sections Faculty-Taught	#	19	20	22	345	1,112
			%	100.0	100.0	100.0	97.7	78.7

				Geosciences			College Total	University Total
				2003-2004	2004-2005	2005-2006	2005-2006	2005-2006
Graduate	Lecture/Seminar	Sections Offered	#	11	15	16	195	1,623
			# Enrolled	100	143	103	1,444	19,368
			Avg Section Enrollment	9.0	9.5	6.4	7.4	11.9
		Sections Faculty-Taught	#	11	13	15	182	1,329
			%	100.0	86.7	93.8	93.3	81.9
	Lab	Sections Offered	#				2	8
			# Enrolled				15	55
			Avg Section Enrollment				7.5	6.8
		Sections Faculty-Taught	#					4
			%					50.0
	Other Course Types	Sections Offered	#	28	51	51	591	1,885
			# Enrolled	51	58	60	910	3,985
			Avg Section Enrollment	1.8	1.1	1.1	1.5	2.1
		Sections Faculty-Taught	#	27	51	51	556	1,761
			%	96.4	100.0	100.0	94.1	93.4

Source: Instruction and Research File and Student Data Course File

'Other Course Types' includes DIS, Thesis/Dissertation Research, Individual Performance Instruction, Internships, etc. Sections taught by tenured, tenure-earning and non-tenure-earning faculty are counted as 'faculty-taught'

C 3 Degrees Awarded Geography (Program CIP: 450701)

		Geography			College Total	University Total
		2003-2004	2004-2005	2005-2006	2005-2006	2005-2006
Associates	Degrees awarded with a:					
	Single major					169.0
	All					169.0
Bachelors	Degrees awarded with a:					
	Single major	11.0	6.0	11.0	539.0	3,880.0
	Double or triple major				3.5	337.0
	All	11.0	6.0	11.0	542.5	4,217.0
Masters	Degrees awarded with a:					
	Single major	11.0	8.0	7.0	76.0	1,018.0
	Double or triple major					2.0
	All	11.0	8.0	7.0	76.0	1,020.0
Specialist	Degrees awarded with a:					
	Single major					20.0
	All					20.0
Doctorate	Degrees awarded with a:					
	Single major				21.0	68.0
	All				21.0	68.0
Total	Degrees awarded with a:					
	Single major	22.0	14.0	18.0	636.0	5,155.0
	Double or triple major				3.5	339.0
	All	22.0	14.0	18.0	639.5	5,494.0

Source: Student Data Course File

Note: Degrees awarded with multiple majors may result in fractional degree totals for some groups.

A degree awarded with a single major contributes 1 degree, a double major contributes 1/2 degree in each major, and a triple major contributes 1/3 degree in each major to the degree totals.

C 3 Degrees Awarded
Geology (Program CIP: 400601)

		Geology			College Total	University Total
		2003-2004	2004-2005	2005-2006	2005-2006	2005-2006
Associates	Degrees awarded with a:					
	Single major					169.0
	All					169.0
Bachelors	Degrees awarded with a:					
	Single major	11.0	4.0	9.0	539.0	3,880.0
	Double or triple major				3.5	337.0
	All	11.0	4.0	9.0	542.5	4,217.0
Masters	Degrees awarded with a:					
	Single major	4.0	7.0	7.0	76.0	1,018.0
	Double or triple major					2.0
	All	4.0	7.0	7.0	76.0	1,020.0
Specialist	Degrees awarded with a:					
	Single major					20.0
	All					20.0
Doctorate	Degrees awarded with a:					
	Single major				21.0	68.0
	All				21.0	68.0
Total	Degrees awarded with a:					
	Single major	15.0	11.0	16.0	636.0	5,155.0
	Double or triple major				3.5	339.0
	All	15.0	11.0	16.0	639.5	5,494.0

Source: Student Data Course File

Note: Degrees awarded with multiple majors may result in fractional degree totals for some groups.

A degree awarded with a single major contributes 1 degree, a double major contributes 1/2 degree in each major, and a triple major contributes 1/3 degree in each major to the degree totals.

Research, Creative & Scholarly Activities
A Assessment Goals and Outcomes for Research (reported separately)
B 1 Faculty Person Years and FTE Devoted to Research
Geosciences

				Geosciences			College Total	University Total
				2003-2004	2004-2005	2005-2006	2005-2006	2005-2006
Departmental Research	Tenured & tenure-earning faculty	Professor, Assoc Professor, Asst Professor	Person-Years	1.7	1.6	1.4	19.5	95.9
			FTE	2.3	2.2	1.9	26.0	127.8
	Non-tenure-earning faculty	Instructors, Lecturers, Visiting Faculty	Person-Years	0.5	0.3	0.2	1.2	5.4
			FTE	0.6	0.4	0.2	1.6	7.2
	Other personnel paid on faculty pay plan		Person-Years				0.2	0.2
			FTE				0.3	0.3
	Total		Person-Years	2.2	1.9	1.6	20.9	101.4
			FTE	3.0	2.6	2.2	27.9	135.3

				Geosciences			College Total	University Total
				2003-2004	2004-2005	2005-2006	2005-2006	2005-2006
Sponsored Research	Tenured & tenure-earning faculty	Professor, Assoc Professor, Asst Professor	Person-Years	0.6	0.4	0.7	10.8	36.3
			FTE	0.8	0.6	0.9	14.5	48.4
	Non-tenure-earning faculty	Instructors, Lecturers, Visiting Faculty	Person-Years				1.4	7.5
			FTE				1.9	10.1
	Other personnel paid on faculty pay plan		Person-Years				11.6	53.6
			FTE				15.4	71.5
	Total		Person-Years	0.6	0.4	0.7	23.8	97.5
			FTE	0.8	0.6	0.9	31.7	130.0

Source: Instruction and Research File

'Other personnel paid on faculty pay plan' includes Scholar/Scientist/Engineer (all ranks), Research Assoc, Assoc In, Asst In, Postdoctoral Assoc

Includes summer, fall and spring semester data

Person-year= 1 person working full time for one year

1.00 FTE = .75 person-years

A site visit from Dr. Jonathan Arthur in the 2006-2007 academic year, prompted the following comment (pertinent to this section of the proposal) about the Department and its faculty.

"Based on my interaction with the faculty and students of the department, there exists a camaraderie, enthusiasm and sense of community that would foster the proposed program. It has also recently been my pleasure to serve on a National Academy of Sciences committee with one of your faculty members. Academic credentials of faculty are self-evident, as is the strong student enrollment. It is my pleasure to strongly recommend approval of the proposed innovative degree program, which recognizes and fills the "academic gap" with regard to integrated geoscience, social science and computer technology. Not only does this gap exist in South Florida, but throughout Florida, and it needs to be filled." Jonathan Arthur, Assistant State Geologist

X. Non-Faculty Resources

- A. Describe library resources currently available to implement and/or sustain the proposed program through Year 5. Provide the total number of volumes and serials available in this discipline and related fields. List major journals that are available to the university's students. Include a signed statement from the Library Director that this subsection and subsection B have been reviewed and approved for all doctoral level proposals.**

Library holdings for titles in the Geosciences at FAU number 14,079 volumes. Serial holdings at FAU in geoscience and related fields include 92 print journals, and 260 electronic journals in fields ranging from geosphere to atmosphere to hydrosphere. Additionally, 37 electronic databases in geosciences and related scientific disciplines are available at FAU. These include noncommercial databases such as Florida Environments Online (FEOL), and Florida Geological Survey Publications (FGS), and commercial databases such as GEOREF, GEOBASE, Web of Science and Compendex. Leading journals available through the FAU library in diverse geoscience disciplines include Nature, Science, AAPG Bulletin, American Mineralogist, Annals of the Association of American Geographers, Annals of Tourism Research, Applied Geochemistry, Bioscience, Bulletin of the AMS, Bulletins of American Paleontology, Cartography and Geographic Information Science, Chemical Geology, Climatic Change, Climate Dynamics, Computers and Geosciences, Computers Environment and Urban Systems,

Conservation Biology, Deep Sea Research, Earth and Planetary Science Letters, Ecological Applications, Ecology, Ecology and Society, Economic Geography, Environment and Planning Section A, Environmental Conservation, Environmental Ethics, Environmental Science & Policy, Environmental Science and Technology, Geochimica et Cosmochimica Acta, Geographical Analysis, Geographical Review, Geological Society of America Bulletin, Geology, Geophysical and Astrophysical Fluid Dynamics, Global Biogeochemical Cycles, Ground Water, Hydrogeology Journal, International Journal of Geographical Information Science, ISPRS Journal of Photogrammetry and Remote Sensing, Journal of Applied Meteorology and Climatology, Journal of Atmospheric and Oceanic Technology, Journal of the Atmospheric Sciences, Journal of Climate, Journal of Contaminant Hydrogeology, Journal of Geology, Journal of Geophysical Research, Journal of Historical Geography, Journal of Hydrology, Journal of Hydrometeorology, Journal of Paleontology, Journal of Petrology, Journal of Physical Oceanography, Journal of Quaternary Research, Journal of Regional Science, Journal of Transport Geography, Journal of Travel Research, Landscape Ecology, Marine Geology, Mathematical Geology, Monthly Weather Review, Oceanography, Paleobiology, Palaeoecology, Palaeogeography, Palaeoclimatology, Palaeoecology, Palaeontology, PALAIOS, Photogrammetric Engineering and Remote Sensing, Professional Geographer, Progress in Physical Geography, Remote Sensing of the Environment, Restoration Ecology, Transactions in GIS, Urban Geography, Water Resources Research, Weather and Forecasting, to name just a few.

DATABASES RELEVANT TO GEOSCIENCES

Chemistry

SciFinder Scholar - complete coverage of chemistry and the life sciences including biochemistry, biology, pharmacology, medicine, and related disciplines.

Engineering

Compendex - 1884- present - The broad subject areas of engineering and applied science are comprehensively represented. Coverage includes nuclear technology, bioengineering, transportation, chemical and process engineering, light and optical technology, agricultural engineering and food technology, computers and data processing, applied physics, electronics and communications, control, civil, mechanical, materials, petroleum, aerospace and automotive engineering as well as narrower subtopics within all these and other major engineering fields, including **Geological Engineering, Geophysics, Geosciences**.

Computing Reviews - A comprehensive source for technical literature in the field of computer science. Includes reviews of both articles and books.

CSA / ASCE Civil Engineering Abstracts Database - 1966-present - provides citations, abstracts, and indexing of the serials literature in civil engineering and its complementary fields. Geoscience related subjects covered include: geotechnical engineering; seismic engineering; surface & groundwater hydrology; land development,

irrigation & drainage; and more.

CSA Engineering Research Database - 1966-present - Covers the international serial and non-serial literature pertaining to civil, earthquake, environmental, mechanical, and transportation engineering including their complementary fields.

Earthquake Engineering Abstracts - 1971-present - Coverage of earthquake engineering and earthquake hazard mitigation, including geotechnical earthquake engineering, performance-based seismic engineering, disaster planning, earthquake resistant design and analysis, engineering seismology, risk and reliability seismic engineering, soil dynamics, and structural dynamics.

Environmental Engineering Abstracts - 1990-present - Covers the world literature pertaining to technological and engineering aspects of air and water quality, environmental safety, and energy production.

Environmental Sciences

ASFA 3: Aquatic Pollution and Environmental Quality - 1990-present - Devoted exclusively to research and policy on the contamination of oceans, seas, lakes, rivers, and estuaries. Some geoscience titles indexed include; Acta geographica sinica, Africa geoscience review, Applied Geochemistry, Aquatic Geochemistry, Bulletin of the Geobotanical Institute ETH, Comptes rendus: Geoscience, Environmental Geology, and more

Ecology Abstracts - 1982-present - Focuses on how organisms of all kinds - microbes, plants, and animals - interact with their environments and with other organisms. Included are relevant papers on evolutionary biology, economics, and systems analysis as they relate to ecosystems or the environment. Some geoscience titles indexed include; Australian Geographical Studies, Geographical Journal, Geographical Research, Global Ecology and Biogeography, Journal of Biogeography, and more.

EIS: Digests of Environmental Impact Statements - 1985-present - Provides detailed abstracts of environmental impact statements issued by the federal government. Major areas of coverage include: Air Transportation; Defense Programs; Energy; Hazardous Substances; Land Use; Parks, Refuges, and Forests; Research and Development; Roads and Railroads; Urban and Social Programs; and Water.

Environmental Sciences and Pollution Management - 1981-present - Multidisciplinary database, provides comprehensive coverage of the environmental sciences. Some Geoscience titles indexed include; Africa geoscience review, Annals of the Association of American Geographers, Applied Geography, Aquatic Geochemistry, Biogeochemistry, Cartography and Geoinformation, Journal of Geographical Sciences, and more.

Florida Environments Online (FEOL) - The core of Florida Environments Online database consists of eight merged research bibliographies including 1) Florida Ecosystems 2) Florida Ornithology, 3) Fishes of Florida, 4) Florida Herpetology, 5)

Florida Geology, 6) Bibliography of Literature Useful to the Study of Florida Plants - and the Herbarium Library of Books and Reprints, 7) Florida FreshWater Bibliography, and 8) Florida Agricultural History.

Pollution Abstracts -1981-present - Pollution Abstracts combines information on scientific research and government policies in a single resource. Topics of growing concern are extensively covered from the standpoints of atmosphere, emissions, mathematical models, effects on people and animals, and environmental action in response to global pollution issues. Major areas of coverage include: Air Pollution, Marine Pollution, Freshwater Pollution, Sewage and Wastewater Treatment, Waste Management, Land Pollution, Toxicology and Health, Noise, Radiation, and Environmental Action.

Toxicology Abstracts - 1981-present - Toxicology Abstracts covers issues from social poisons and substance abuse to natural toxins, from legislation and recommended standards to environmental issues. Major areas of coverage include: Pharmaceuticals; Food, Additives, and Contaminants; Agro-chemicals; Cosmetics, Toiletries, and Household Products; Industrial Chemicals; Metals; Toxins and Other Natural Substances; Social Poisons and Drug Abuse; Polycyclic Hydrocarbons; Nitrosamines and Related Compounds; Radiation and Radioactive Materials; Methodology; and Legislation and Recommended Standards.

TOXLINE (CSA) - 1994-present - This database, produced by the U.S. National Library of Medicine, provides bibliographic citations and abstracts from the core journal literature in toxicology. This version of TOXLINE does not contain information from Chemical Abstracts Service, BIOSIS, or International Pharmaceutical Abstracts.

Water Resources Abstracts - 1967-present - Water Resources Abstracts provides summaries of the world's technical and scientific literature on water-related topics covering the characteristics, conservation, control, pollution, treatment, use and management of water resources. Major areas of coverage include: Groundwater; Lakes; Estuaries; Erosion and sedimentation; Water supply and conservation; Desalination; Water yield improvement; Water quantity management and control; Watershed protection; Water quality management; Water resources planning; Water law; Engineering works and hydraulics.

General Science

Applied Science and Technology Full Text - 1983-present – Covers leading trade and industrial publications, professional and technical society journals, specialized subject periodicals, plus buyers' guides, directories, and conference proceedings in the applied sciences. Includes such subjects as Atmospheric Sciences, Chemistry, Civil Engineering, Communication & Information Technology, Computer Databases & Software, Energy Resources & Research, Environmental Engineering, Geology, Metallurgy, Mineralogy, Oceanography, Petroleum & Gas, Transportation, and more.

General Science Full Text - 1984-present - Covers a **broad range of fields** in general

interest periodicals—including The New York Times Science section—and specialized journals as well. Subjects covered include: Astronomy, Atmospheric Science, Biology, Botany, Chemistry, Conservation, Earth Science, Environment, Food, Genetics, Health, Mathematics, Medicine, Microbiology, Nutrition, Oceanography, Physics, Physiology, Zoology

GeoSciences

GeoRef - 1785-present - The GeoRef database covers the geology of North America from 1693 to the present and the geology of the rest of the world from 1933 to the present. The database includes references to all publications of the U.S. Geological Survey.

Florida Geological Survey Publications (FGS) - This collection consists of publications of the Florida Geologic Survey, including Bulletins, Reports and Maps.

GEOBASE - 1980-present – Covers worldwide literature on geography, geology, and ecology. Major subject areas include cartography, climatology, energy, environment, geochemistry, geomorphology, geophysics, hydrology, meteorology, paleontology, petrology, photogrammetry, sedimentology, and volcanology. Also included are remote sensing, GIS, aerial photography and satellite observations.

Oceanography

ASFA 2: Ocean Technology, Policy and Non-Living Resources - 1978-present - Coverage spans the wide-ranging fields of oceanography: physical, descriptive, dynamical, chemical, geological, and biological aspects, as well as limnology, ocean engineering, and specific resources from international policy and legislation to meteorology and climatology to technology and engineering.

Oceanic Abstracts – 1981-present - The database focuses on marine biology and physical oceanography, fisheries, aquaculture, non-living resources, meteorology and geology, plus environmental, technological, and legislative topics. This database is totally comprehensive in its coverage of living and non-living resources, meteorology and geology, plus environmental, technological, and legislative topics.

Physics

INSPEC – 1970-present - providing access to the world's scientific and technical literature in physics, electrical engineering, electronics, communications, control engineering, computers, computing, information technology, manufacturing, production and mechanical engineering. It also has significant coverage in areas such as materials science, oceanography, nuclear engineering, geophysics, biomedical engineering and biophysics.

Social Sciences

Human Population & Natural Resource Management - 1995-present - Covers human population and demography topics, as well as societal issues involving natural resource management. Major areas of coverage include: Human population dynamics, Demography, Population - Environment Relations, Population Statistics, Population Policy, Ecotourism, Sustainable Living, Sustainable Consumption, Environmental Awareness, and Environmental Education.

Humanities & Social Sciences Retrospective - 1907-1984 - This database offers the ability to search a wide range of important journals in the humanities and social sciences as far back as 1907. Coverage also includes content from H.W. Wilson's International Index. Subject coverage includes geography and a ample of journal titles covered include: Annales de Geographie, Economic Geography, Geographical Review, Journal of Geology, Journal of Historical Geography, and The Professional Geographer.

SocINDEX with Full Text - 1895-present - Indexes and abstracts of articles from English-language periodicals published in the United States and elsewhere plus the full text of selected periodicals. Coverage includes a wide range of interdisciplinary fields covered in a broad array of social sciences journals including those in the database above and more.

Sociological Abstracts - 1952-present - Abstracts and indexes the international literature in sociology and related disciplines in the social and behavioral sciences. Some geoscience titles indexed include; Cultural Geographies, Geoforum, Geografiska Annaler, Series B: Human Geography, Geographical Bulletin, Geographical Research, Political Geography, Progress in Human Geography, Social & Cultural Geography, and Tourism Geographies.

General

ArticleFirst - 1990-present - Contains bibliographic citations with some full text from more than 13,000 journals in science, technology, medicine, social science, business, the humanities, and popular culture. Incorporates OCLC's ContentsFirst as of 10/15/01. Some geoscience titles indexed include Acta Geophysica, Advances in geophysics, Advances in physical geochemistry, Aquatic Geochemistry, Cartography and geographic information science, Chemical geology, Computational Geosciences, Cultural Geographies, Developments in economic geology, Economic geography, Environmental geochemistry and health, Environmental geology and water sciences, Exploration geophysics, Journal of geography Photogrammetric engineering and remote sensing, Remote sensing of environment, Remote sensing reviews, Weather and Forecasting, Theoretical and applied climatology, Tourism Geographies and more.

Current Contents Connect - 1998-present -Current Contents Connect provides access to current awareness research from seven broad disciplines. Those of relevance to the geosciences are: Agriculture, Biology & Environmental Sciences; Engineering, Computing & Technology; Life Sciences; Physical, Chemical & Earth Sciences; and Social & Behavioral Sciences.

PapersFirst – 1993-present - Provides access to individual papers presented at conferences, congresses, symposia, expositions, workshops and meetings.

ProceedingsFirst -1993-present - Indexes the contents of papers presented at conferences worldwide.

ProQuest Dissertations and Theses - 1861-present

Web of Science - 1945-present - Contains information gathered from thousands of scholarly journals in all areas of research. Geosciences would be covered in the *Science Citation Index* and *Social Sciences Citation Index* portion of this database.

WorldCat - The world's most comprehensive bibliography, with over 48 million bibliographic records representing over 400 languages and covering all the records cataloged by OCLC member libraries worldwide.

WorldCat Dissertations and Theses – Contains records for dissertations and theses from OCLC member libraries. This is an excellent source for documents that may not have been submitted to ProQuest for publication.

B. Describe additional library resources that are needed to implement and/or sustain the program through Year 5. Include projected costs of additional library resources in Table 2.

Ample library resources are available to meet the initial needs of the proposed program, particularly since during the initial years students will be enrolled in coursework leading to their advanced research. As many of these courses are currently offered at FAU, and instructors feel the current library resources adequately support those courses, initial additional resources are not required. Thus, in the first 3 years of the program resources are fine and not until after that time, investment in geoscience-related materials for the library will be necessary to support advanced research.

After a few years into the program, however, the Department feels that additional investment in geoscience-related materials for the library will be necessary to support advanced research. We have worked with the Director of the Library and his staff and feel that the amount needed for the Library to increase the geoscience-related holdings by year 5 is estimated to be \$20,000. This would add important research resources such as *Global Biogeochemical Cycles*, *Ethnobotany Research and Applications*, *Journal of Ethnobiology*, and the *Geoscience World* Database package, which includes several specialized geology research publications.

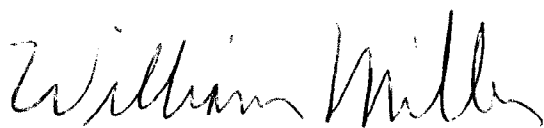
Hard Copy has signature of Dr. William Miller

Library Director

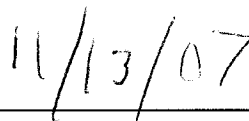
Date

investment in geoscience-related materials for the library will be necessary to support advanced research.

After a few years into the program, however, the Department feels that additional investment in geoscience-related materials for the library will be necessary to support advanced research. We have worked with the Director of the Library and his staff and feel that the amount needed for the Library to increase the geoscience-related holdings by year 5 is estimated to be \$20,000. This would add important research resources such as *Global Biogeochemical Cycles*, *Ethnobotany Research and Applications*, *Journal of Ethnobiology*, and the *Geoscience World Database* package, which includes several specialized geology research publications.



Library Director



Date

C. Describe classroom, teaching laboratory, research laboratory, office, and other types of space that are necessary and currently available to implement the proposed program through Year 5.

The Department is currently housed in the east wing of the Physical Sciences building with additional overflow space in the Social Science Building and T5 and T6. The total office and related storage space of the Department is currently 4,600 square feet, the research lab space is 4,560 square feet, teaching lab and related equipment storage space is 9,496 square feet, and miscellaneous storage. This does not include the boat and large equipment storage space and dirty lab space in T5.

Geosciences Current Space

Dept. Office	300 sq. ft.
Chair Office	180 sq. ft.
Budget Coordinator Office	100 sq. ft.
Supplies	120 sq. ft.
Mail/breakroom	320 sq. ft.
Conference Room	324 sq. ft.
Computer Teaching Lab (Undergraduate)	1260 sq. ft.
Computer Teaching Lab (Graduate)	640 sq. ft.
Server Room	320sq. ft.
Teaching Lab (Large)	1024 sq. ft.
Prep Room for Above	320 sq.ft.
Teaching Lab (Large WITH SINK)	1024 sq. ft.
Prep Room for Above	320 sq.ft
Teaching Lab (Small WITH SINK/AND FUME HOOD)	640 sq. ft.
Prep Room for Above	320 sq.ft
Map Library	320 sq. ft.

C. Describe classroom, teaching laboratory, research laboratory, office, and other types of space that are necessary and currently available to implement the proposed program through Year 5.

The Department is currently housed in the east wing of the Physical Sciences building with additional overflow space in the Social Science Building and T5 and T6. The total office and related storage space of the Department is currently 4, 600 square feet, the research lab space is 4, 560 square feet, teaching lab and related equipment storage space is 9,496 square feet, and miscellaneous storage. This does not include the boat and large equipment storage space and dirty lab space in T5.

Geosciences Current Space

Dept. Office	300 sq. ft.
Chair Office	180 sq. ft.
Budget Coordinator Office	100 sq. ft.
Supplies	120 sq. ft.
Mail/breakroom	320 sq. ft.
Conference Room	324 sq. ft.
Computer Teaching Lab (Undergraduate)	1260 sq. ft.
Computer Teaching Lab (Graduate)	640 sq. ft.
Server Room	320sq. ft.
Teaching Lab (Large)	1024 sq. ft.
Prep Room for Above	320 sq.ft.
Teaching Lab (Large WITH SINK)	1024 sq. ft.
Prep Room for Above	320 sq.ft
Teaching Lab (Small WITH SINK/AND FUME HOOD)	640 sq. ft.
Prep Room for Above	320 sq.ft
Map Library	320 sq. ft.
Mineral Collection (now housed in T buildings)	1260 sq. ft.
Mineral Curator Office	100 sq. ft.
Hydro Modeling Lab	320 sq. ft.
Water Sampling Lab (with sink) and	
Rock/Fossil/Mineral Processing Lab (Sink with sediment trap)	320 sq ft.
Equipment Storage	320 sq. ft.
TA Office Space	1260 sq. ft.
Adjunct/Emeritus Space	1260 sq. ft.
GIS Research Lab	360 sq. ft.
Remote Sensing Lab	360 sq. ft.
Office Space/Corcoran	100 sq. ft.
Office Space/Fadiman	100 sq. ft.
Office Space/Gammack-Clark	100 sq. ft.
Office Space/Garcia-Quijano	100 sq. ft.
Lab Space/Garcia-Quijano	320 sq. ft.
Office Space/Hindle	100 sq. ft.
Office Space/Petuch	100 sq. ft.
Lab Space/Petuch (with sink)	320 sq. ft

Office Space/Oleinik	100 sq. ft.
Lab Space/Oleinik (with sink)	320 sq. ft.
Office Space/Restrepo	100 sq. ft.
Lab Space/Restrepo	320 sq. ft.
Office Space/Roberts	100 sq. ft.
Lab Space/Roberts	320 sq. ft.
Office Space/Root	100 sq. ft.
Lab Space/Root (with sink)	320 sq. ft.
Office Space/Warburton	100 sq. ft.
Lab Space/Warburton	320 sq. ft.
Office Space/Xie	100 sq. ft.
Office Space/Comas	100 sq. ft.
Lab Space/Comas ((WITH SINK))	320 sq. ft.
Office Space/Markwith	100 sq. ft.
Lab Space/Markwith ((WITH SINK))	320 sq. ft.
Teaching/Lab Classroom (first dibs scheduling in SO 300)	1024 sq. ft
Computer Teaching Lab for World Geography (first dibs in SO 200)	1024 sq. ft

Again, this list does not include the indoor and outdoor storage places for boats and larger equipment as well as the dirty lab space in T5.

- D. Describe additional classroom, teaching laboratory, research laboratory, office, and other space needed to implement and/or maintain the proposed program through Year 5. Include any projected Instruction and Research (I&R) costs of additional space in Table 2. Do not include costs for new construction because that information should be provided in response to X (J) below.**

No new space is required to implement the program, although the planned new Geosciences space in the proposed building on the Davie campus will be needed to accommodate the anticipated growth in the program through year 5. This space at Davie will include 4 faculty/staff offices, 2 wet labs (2000 NSF) plus 1 dedicated computer lab (1000 NSF). Additionally, we will need general dirty space for processing field work/samples with ground floor access and loading bay with boat/trailer storage.

- E. Describe specialized equipment that is currently available to implement the proposed program through Year 5. Focus primarily on instructional and research requirements.**

*Parenthetical numbers indicate quantity of items

Computer hardware

- a. Dell Poweredge 2600 server (2)
- b. Dell Poweredge 700 server
- c. Dell Poweredge 830 server
- d. Dell Poweredge 4400 server
- e. Dell Powervault NAS
- f. Dell workstations (4)
- g. Dell Optiplex desktop lab PC's (48)

- h. Dell Optiplex desktop staff PC's (20)
- i. Smart Technologies SmartBoard
- j. LCD computer projectors (5)
- k. Dell Latitude laptops (6)
- l. Dell 5100 color laser printer
- m. HP DesignJet 2500CP Plotter

Survey/Mapping/GPS

- n. Leica TC307 electronic total station
- o. Spectra physics laser plane 520 laser level, lenker rod, 3 receivers
- p. Transits and Philadelphia rods (12 sets) – shared with Electrical Engineering
- q. R8 GNSS RTK/PP Base/Rover w/TSCe Data Logger: Real Time Kinematic GPS base station unit and Real Time Kinematic GPS rover unit with controlling software.
- r. Trimble Pro XR (2)
- s. Geo XT
- t. Trimble GeoExplorer 3 (5)
- u. Dell Axim pocket PC for GPS data collection (5)
- v. PathFinder Office software
- w. Bruntons (12)

GIS/Remote Sensing/Computer Modeling

- x. Field Portable Spectroradiometer. Model: ASP FieldSpec3 JR. Full spectral range (400 – 2500 nm), rapid integration time (.1 s), high SNR. Controlling IBM Thinkpad laptop and software
- y. 10 in x 10 in. calibrated Spectralon® plate: Reflectance standard for spectral research.
- z. ESRI educational site license (unlimited licenses)
 - i. ArcInfo
 - ii. ArcEditor
 - iii. ArcView 9.1
 - iv. ArcGIS extensions: ArcGIS Spatial Analyst, ArcGIS 3D Analyst, ArcGIS Geostatistical Analyst, ArcGIS Publisher, ArcGIS Schematics, ArcGIS Survey Analyst, ArcScan for ArcGIS, ArcGIS Military Analyst, Maplex for ArcGIS, and ArcGIS Network Analyst
 - v. ArcSDE
 - vi. ArcIMS
 - vii. ArcIMS Route Server
 - viii. ArcGIS Server License with ArcGIS Server Spatial Analyst extension, ArcGIS Server 3D Analyst extension, and ArcGIS Server Network Analyst extension options
 - ix. ArcGIS Engine Developer Kit
 - x. Mobile GIS
 - xi. ArcPad Application Builder including ArcPad
 - xii. Business GIS
 - xiii. BusinessMAP 4
 - xiv. ArcLogistics Route
 - xv. MapObjects—Windows Edition

- xvi. MapObjects—Java Edition
- xvii. NetEngine for Windows and UNIX
- xviii. Production Line Tool Set (PLTS) for ArcGIS—Mapping Agency Solution
- xix. ArcView 3.x Products
 - xx. ArcView 3.x (for Windows)
 - xxi. ArcView 3.0a (for Macintosh)
 - xxii. ArcView 3.x extensions: ArcView Spatial Analyst, ArcView Network Analyst, ArcView 3D Analyst, ArcPress for ArcView, and StreetMap 1.1
- xxiii. Virtual Campus—Unlimited seat
- aa. GeoMedia Pro 5 (15 licenses)
- bb. Leica Erdas Imagine (14 licenses)
- cc. Arc Hydro toolset for ArcGIS
- dd. Groundwater Vistas
- ee. SMT seismic analysis (5 licenses)

Field vehicles

- ff. 2000 Dodge Ram 4x4
- gg. 17' Carolina Skiff boat
- hh. 13' Carolina Skiff boat
- ii. 10' Jon boat
- jj. 8' inflatable boat

Environmental sampling/analytical equipment

- kk. Sieve shakers (2)
- ll. Standard testing sieves (multiple sets)
- mm. Vibracore with trailer
- nn. Unconfined compression test machine
- oo. Hand geoprobe sediment corer
- pp. Solomat 803 DS water quality probe
- qq. Solinst MS5 water quality probe
 - i. LDO probe
 - ii. pH probe
 - iii. Nitrate ion selective electrode
 - iv. Graphite conductivity probe
- rr. Surveyor 4a handheld interface for the MS5
- ss. pH probes and meters (2)
- tt. Conductivity probe/meter
- uu. DO probe/meter
- vv. Hach water chemistry analysis kits
 - i. Distillation apparatus
 - ii. Digital reactor block
 - iii. Digital titrator
 - iv. Portable spectrophotometer
 - v. Cold vapor mercury apparatus
 - vi. Related glassware and reagents
- ww. Weather station
- xx. Laboratory centrifuge

- yy. Fume hood
- zz. Solinst water level meters (2)
- aaa. Solinst pressure transducers (2)
- bbb. Solinst leveloader control for pressure transducers
- ccc. Solinst WaTerra hand pump
- ddd. Laboratory ovens (3)
- eee. Grinders (4)
- fff. Laboratory press
- ggg. Rock saws (2)
- hhh. Teaching stereographic microscopes (10)
- iii. Teaching petrographic microscopes (15)
- jjj. Research microscopes
 - i. Leica DMLS transmittant light microscope with mounted Sony CCD-IRIS high resolution digital camera
 - ii. Leica MZ8 reflected light binocular microscope with drawing attachment
 - iii. Olympus SZX12 binocular transmittant/reflected light binocular microscope with drawing attachment, multiple lenses, and digital camera attachment
 - iv. Olympus petrographic microscopes (4)
- kkk. Ohaus explorer digital precision lab scale
- lll. Optronics Magna Fire firewire digital camera
- mmm. Professional setup for macro- and micro-digital photography

Additionally, research and technical equipment within the Charles E. Schmidt College of Science will be available for Geosciences faculty and graduate students. These include two core facilities for proteomics and nucleic acids, as well as a machine shop with attendant machinist and part-time electronics technician. In addition, the College supports a computer information technology group that provides IT and computer support. In particular, this group maintains a “near” supercomputer, called Boca 5, which consists of 64 Dell CPU’s on a Beowolff cluster platform.

Boca 5" is a new cluster computer for the College of Science. Boca 5 runs Red Hat Linux and consists of 64 Dell 1850 servers. Each 1850 has two dual-core processors running at 2.8GHz. This gives Boca 5 roughly the equivalent processing power of a cluster that uses 256 single-core processors. The backbone of Boca 5 consists of two gigabit Ethernet switches, and its storage array is connected through fiber optic cables for optimum transfer rates.

F. Describe additional specialized equipment that will be needed to implement and/or sustain the proposed program through Year 5. Include projected costs of additional equipment in Table 2.

The Geosciences rely a great deal on cutting-edge computing, display and field technologies. Particularly as this program will be heavily tied to the professional community, it is vital that we stay on top of the latest technologies and expand the quantity and quality of these instruments in the Department as the program expands through year 5. With the growth of students in the

program, expansion to the Davie campus and expected changes in technology, we estimate the need for the geosciences technology equipment by year 5 to be \$175,000. This includes approximately 70 lab computers (replacing older ones and expanding the size of the labs to accommodate growth in the program) for 2 labs on the Boca Raton campus and 1 new lab on the Davie campus, an upgrading of printers in the labs, and upgrading/replacement of large map plotters. This total would also include growth and expansion of GPS units for field work. We anticipate that much of the funding would come from equipment money associated with the new Davie building and from grants.

G. Describe any additional special categories of resources needed to implement the program through Year 5 (access to proprietary research facilities, specialized services, extended travel, etc.). Include projected costs of special resources in Table 2.

There are no special categories of expenses specifically tied to the proposal for the Ph.D. in Applied Geosciences.

H. Describe fellowships, scholarships, and graduate assistantships to be allocated to the proposed program through Year 5. Include the projected costs in Table 2.

The current MA/MS graduate stipends will be *reallocated* to doctoral stipends. Current graduate teaching assistantships are 16@ approximately 10,000 each for the 9 month academic year. Additional funds will be needed to raise the stipend to \$20,000 each for the 12 month year for full-time doctoral students. This will be needed to start the program, and will need to be sustained through year 5 as related to the projected full-time student enrollment (Table 1B).

We currently have two scholarships in the Department awarded annually to graduate students to help support their research expenses. Both are in the amount of \$1,000 each from the Coastal Education and Research Foundation and from Coastal Planning and Engineering, Inc. The Coastal Education and Research Foundation has expressed an interest in providing a sizeable fellowship (amount discussed has been \$10,000) to be awarded annually to an incoming doctoral applicant to help us attract high quality students. In addition, the Graduate Dean at FAU has provided scholarships specifically targeted to recruitment of outstanding new graduate students. We will seek more scholarships and fellowships through our contacts with the Geosciences Professional Advisory Board.

In addition, it is expected that a number of research assistantships will be available as doctoral program faculty, especially the new junior faculty, become more successful at obtaining extramural grants.

I. Describe currently available sites for internship and practicum experiences, if appropriate to the program. Describe plans to seek additional sites in Years 1 through 5.

Geosciences undergraduate and graduate students regularly receive internships from CUES and the Center for Environmental Studies at FAU, Broward County Planning, Palm Beach County

Planning, Coastal Planning and Engineering, CEPEMAR, the Coastal Education and Research Foundation, the U.S. Geological Survey, and the South Florida Water Management District. We have also placed students in internships in a variety of smaller environmental consulting firms and various municipalities in South Florida. As part of our new relationship with the U.S. Geological Survey (USGS), we expect our graduate students to be even more successful in securing internships at that agency in the near future. Discussions with USGS have yielded opportunities in their STEP program (Student Temporary Employment Program), SCEP (Student Career Employment Program), Water Resources Research Institute Internship Program and post-doc programs through Mendenhall and the NRC. As the program grows, we will utilize the contacts of the professional advisory board as well as work with our alums to seek more internships and fellowships for our students.

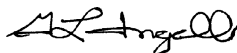
- J. If a new capital expenditure for instructional or research space is required, indicate where this item appears on the university's fixed capital outlay priority list. Table 2 includes only Instruction and Research (I&R) costs. If non-I&R costs, such as indirect costs affecting libraries and student services, are expected to increase as a result of the program, describe and estimate those expenses in narrative form below. It is expected that high enrollment programs in particular would necessitate increased costs in non-I&R activities.**

No new capital expenditure is directly related to the proposed program. Geosciences is expected to benefit from space expansions at both the Boca Raton campus and the Davie campus that are already planned, but neither of these are specifically tied to the proposed Ph.D. program.



MEMORANDUM

To: Dr. Gary Perry
Dean, Charles E. Schmidt College of Science

From: Dr. Gerald Ingalls 
Professor of Geography, University of North Carolina Charlotte

Re: Evaluation and Assessment of the Proposal to Establish a Ph.D. in Geosciences

Date: October 1, 2008

At your request I have completed an evaluation of the Proposal to Establish a Ph.D. in Geosciences. This evaluation is based upon a review and critique of two versions of the proposal. The initial review was completed and submitted on November 11, 2007. This report is an elaboration and more comprehensive review of an updated proposal which included site visit conducted on Thursday, September 25 and Friday, September 26, 2008. This report is organized into four segments:

- Part A, a summary of the proposed program's strengths;
- Part B, an assessment of the potential issues;
- Part C, an overall assessment of the proposed program;
- Part D, an outline of my own experience and my summary vita.

Review Ph.D. in Earth Systems and GeoInformation Sciences

Part A. Strengths of the Proposed Program

The proposed program has considerable promise. This proposal describes a program that would be professionally oriented or applied, cross-disciplinary, integrated and innovative. Given my review, I agree with this description. This program would build on a strong base of current faculty, a solid and successful master's program. It would be situated within a region with a need and a strong market for its graduates. There seems to be a strong base of potential students including in-service professionals who need and want the additional training needed to do their current jobs.

As I see it the proposed program's strongest features would be: a strong market within a region where trained environmental professional are needed and where no alternative programs exist; a solid, diverse faculty with experience in graduate education; its cross-disciplinary, problem solving character; its administrative clarity; and the fact that there are appropriate resources to accomplish its goals:

Market.

There are two sides to this question of market. There is the market for the program's product and the market for the program itself – the students who would enroll. It seems evident that the program would be established within a very strong market for the professionals it would produce. The proposal provides substantive evidence of both public agencies and private sector consulting firms (Proposal, pages 25-26) within the region that see the graduates of this proposed program as potential employees.

In my opinion, the proposal may underestimate the potential market for its graduates. There is a substantial national market for environmental scientists from strong interdisciplinary programs. The market for technically proficient geoscientists trained in a strong interdisciplinary environment is very competitive. The regional agencies may find themselves in competition for FAU graduates with universities and agencies well outside of Florida.

It seems evident that there is an eager and readily available base of potential students. The proposal outlines (pages 17-19) this demand, but my own discussion with current and former students of the Department of Geosciences seemed to confirm this strong potential student base. I foresee little problem with meeting the projected enrollment outlined in the proposal.

Need.

As one of the three fastest growing state populations in the country, Florida is well acquainted with the pressures of urban expansion. Few areas of the country can rival southern Florida in terms of the tension between high impact urban development and a sensitive environmental base. The proposal makes a compelling and very realistic

case for a program that would train technically proficient, interdisciplinary professionals equipped to understand, study and mitigate the human and environmental conflict that result in the wake of rapid and sustained population expansion. Since the Everglades represent one of the most dramatic and ambitious efforts at environmental restoration in history, southern Florida and the region around FAU seem to be a ready made laboratory for such a program. This program would be extremely well placed and very timely.

Faculty Resources.

The most important indicator of success of any new program its faculty. The Department of Geosciences currently has 16 faculty. This is somewhat marginal for a department which sustains undergraduate, masters while developing a research-oriented Ph.D. program. However, the University commitment to hire three new faculty and the availability of Cognate and a large pool of part-time faculty are more than sufficient resources to support this program.

While numbers of faculty are critical there are other equally critical measures of faculty resources when it comes to interdisciplinary programming. The Department of Geosciences is very solid blend of faculty with prior experience operating a well-established, applied graduate program and new faculty who are relatively early in their academic careers. This provides a solid foundation for the sustained effort required to make the proposed program successful.

Faculty Commitment

The faculty of Geosciences seem to be committed both to the development of this research degree and to its interdisciplinary character. There is an attitude of commitment to collaborative research and teaching and evidence that such interdisciplinary activity is already in place. As the former director of an interdisciplinary Ph.D. program and the former chair of a department of Geography and Earth Sciences, I can speak to the necessity of faculty commitment to cooperative, interdisciplinary programming and research. It is often difficult to establish. The fact that there is evidence that it already exists gives this proposed program a marked advantage.

Competing or Overlapping Programs.

One clear advantage of the program outlined in this proposal is the lack of duplication. To my knowledge no programs in Florida address the specific interdisciplinary, geoscience and environmental content of this proposed program. Frankly, I do not know of any in the Southeastern U.S.

Administrative Clarity.

Many interdisciplinary programs suffer from governance issues, including a lack of administrative and decision-making clarity. This is especially true when faculty of an interdisciplinary program are scattered over several departments or even colleges

within a university. The problem is that faculty often are unclear about the advantages of participation and concerned over the potential disadvantages in the form of tenure, promotion and salary decisions that are not made in the interdisciplinary program, but in their own disciplinary unit. This program would be based solely within one department. The decision-making on faculty career issues and resource allocation would be clear. In fact the decision-making would not change from its current form. If reasonable reward mechanisms can be established to encourage the participation of cognate faculty, program administration should not be a problem.

Part B. Assessment of Potential Issues

The strengths of this proposed program far outweigh any potential constraints. However, there are two important issues that must be addressed to assure the continued success of the proposed program. These are space and assistantship funding.

Space.

As it stands now, the amount of space available to the Department of Geosciences would not sustain the growth and development of the proposed Ph.D. program. Given the number of projected fulltime students, space would become a major constraint within a matter of two to three years. In conversations during my visit, there was a clear commitment by university administration to deal with this issue in the near future. I understand that the next building to be constructed at FAU was dedicated while I was there and that this building is intended to help solve the Department of Geosciences space constraints. As new space is occupied and older, vacated space is renovated, this new building will have the ripple impact that would provide the Department of Geosciences with adequate space to grow and develop its programming and research. This should resolve the program's space needs.

Assistantship Funding.

Funding for the fulltime students in the proposed new program would come from the resources already in place that support current fulltime Geoscience MA students on assistantship and from additional resources that the College and University have committed to upgrade existing stipends. While this provides adequate an number of assistantships and adequate stipends to sustain the development of the proposed Ph.D. program, it deflects funding from a well established MA program. Over the long term this could prove problematic.

However, the market for well trained and technically proficient environmental and geoinformation scientists at the master's level is as strong as the market for Ph.D. graduates. While one solution outlined in the proposed is a non-thesis option for MA students, another option would be replacement funding. I am relatively certain that internship and assistantship funding from the public and private sector could be developed and perhaps come close to replacing the funding being diverted to this proposed Ph.D. program. I suggest that the College and the Department consider the

appointment of faculty member to oversee the management of a community outreach effort --- one whose partial responsibility would include an aggressive search for such town-gown relationships. During the late 1980s and early 1990s, I managed such an outreach program in Charlotte that routinely provided funding for 15-20 such public and private sector assistantships in the MA in Geography at UNC Charlotte. Such a outreach program could well help to assure an active master's program to complement the new Ph.D. program.

Part C. Overall Assessment

After this second review and a subsequent visit with faculty and staff of the Department of Geosciences at FAU, I am even more convinced than I was in the fall of 2007 that this is a well designed, programmatically sound proposal. The proposed program has considerable strength. The potential conflicts and constraints are few and have either been addressed already or could easily be addressed in short order.

This is a program that is needed, has a strong market, and a department faculty and university administration committed to it success. I am convinced that this is the right program, in the right place at the right time.

Part D. Reviewer Credentials.

The following is a brief summary of relevant background of the reviewer:

Dr. Gerald L. Ingalls
Professor of Geography
Department of Geography and Earth Sciences
University of North Carolina Charlotte

BA, History, University of Southwestern Louisiana, 1968
MA, Latin American Studies, University of Florida, 1970
Ph.D., Geography, Michigan State University, 1973.

Administrative Positions:

Chair, Department of Geography and Earth Sciences, 2003-2008
Director, Ph.D. in Public Policy, 2001-2005 Interdisciplinary, across seven departments and three colleges (Wrote proposal, began program)
Coordinator, MA in Geography, 1986-1998

Interdisciplinary Experience

Faculty member in a joint Geography and Earth Sciences Department for 35 years. Currently the Department of Geography and Earth Sciences offers the following undergraduate degrees:
Geography BA and BS
Earth Sciences, BA and BS
Geology BS
Meteorology BS

Currently the Department of Geography and Earth Sciences offers the following graduate degrees:

MA in Geography

MS in Earth Sciences

Ph.D. in Geography

The Department is also a primary supporting unit for two interdisciplinary Ph.D.

Programs including:

Infrastructure and Environmental Systems (Other supporting units include Civil Engineering and Biology) (Served on proposal committee).

Ph.D. in Public Policy (Other supporting units include Economics, Criminal Justice, Political Science, Sociology and Health and Human Systems)

Assisted in writing proposal; took proposal to University System

Directed program for first 4 years

Research and Teaching Interests:

Teaching: Urban and political geography, Global urbanization, Europe

Research: Election behavior, Election Campaigning; Campaign financing;

Urban administrative structure; Urban neighborhoods; Adaptive Reuse

Publications:

Past: More than a dozen books and monographs and 50 journal articles published

In progress: Two book chapters submitted; three journal articles in progress

Funding:

More than \$750,000 in local, state and federal grants and contracts

Relevant Faculty Elected Committee Positions:

Elected member of the Faculty Graduate Affairs Committee, 1986 to present

Served as Chair of the Faculty Graduate Affairs Committee, 2000 to present

In this capacity have reviewed each of the proposals to establish for the 18 Ph.D. currently established and the four proposed programs at UNC Charlotte