LETTER OF INTENT to DEVELOP a NEW ACADEMIC PROGRAM [June 2015]

General Information	**Date:**
Campus: **University of Louisiana at Lafayette**	Program: Title, CIP, Degree/Certificate Awarded **Environmental Resource Science; CIP 03.0199, Master of Science in Environmental Resource Science**

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1. Program Objectives and Content

Describe the program concept: purpose and objectives; basic structure and components/concentrations; etc.

PURPOSE AND OBJECTIVES

The purpose of our program is to increase the pipeline of highly-trained students who can address challenges related to Louisiana's environmental resources. This master's degree program will focus primarily on water and soil resources, including their investigation/characterization, management, remediation, and associated technologies. Students also will be able to probe the relationships of these physical resources with biological processes. The objectives of our program are as follows: (1) To provide a superb curriculum with complementary research and internship experiences for training and educating students in the field of environmental resource science, (2) To prepare our students for a wide variety of possible careers in the environmental arena, and (3) To develop a highly-skilled, critical-thinking workforce for that will benefit the state of Louisiana.

Our program will be interdisciplinary, combining a variety of the foundational science domains (e.g., physical, earth, and biological sciences) that were identified in the FIRST Louisiana report. Environmental Resource Science is both strategic for Louisiana and aligned with Louisiana's workforce needs (i.e., is a key transitional research domain). Louisiana's core industry, science, and technology sectors are direct reflections of the natural resources available in our state. For example, Louisiana is the third leading producer of rice in the U.S. and is a global hub for the upstream and downstream petroleum industry. These industries require tremendous quantities of high-quality water. Our state also hosts 40% of the nation's freshwater wetlands, which are critical to the seafood industry and serve to mitigate coastal flooding. Like water, soil resources are fundamental for agricultural activities and coastal restoration efforts.

The focus of our program in combination with our Gulf-coast location and the expertise of the associated faculty will make this a premier program for Louisiana and throughout the region. Our program in Environmental Resource Science will further advance Louisiana as a national leader in environmental research and development.

RESOURCES

Primary Faculty with appropriate graduate faculty status

- Dr. Durga Poudel; Professor, Environmental Science
- Dr. Jenneke Visser; Associate Professor, Environmental Science
- Dr. Katie Costigan; Assistant Professor, Environmental Science
- Visiting Assistant Professor, Environmental Science. This position is currently filled by Dr. Rajith Mukundan. We anticipate continuing this arrangement or filling the position permanently in the future.
- Dr. Brian Schubert; Assistant Professor, Geology
- Dr. Carl Richter; Professor, Geology
- Dr. David Borrok, Professor, Geology
- Dr. Tim Duex, Associate Professor, Geology

Supporting faculty from other disciplines with appropriate graduate faculty status

- Dr. Paul Leberg; Professor, Biology
- Dr. Mark Hester; Professor, Biology
- Dr. Paul Klerks; Professor, Biology
- Dr. Emad Habib; Professor, Civil Engineering
- Dr. Daniel Gang; Professor, Civil Engineering
- Dr. Feebe Louka; Associate Professor, Chemistry
- Dr. Radhey Srivastava, Professor, Chemistry

GAs (number, funding source, full or tuition-waiver only):
UL Lafayette will support four masters-level graduate teaching assistantships for this program, which include monthly stipends, as well as tuition waivers. Two assistantships will be made available for the first year of the program, and two additional assistantships will be granted for the second year, for a total of 4 assistantships henceforth. Graduate assistantships are important for recruiting and retaining highly-qualified students. Graduate assistantships also help to offset faculty workloads, which are expected to increase with the inception of a graduate program. The cost of the requested assistantships will be offset by in-state and out-of-state tuition revenue from full-time students enrolled in the program, as well as internship support from local industry.

Labs:
We do not require any additional laboratory space for this program. We have high-quality research labs and instrumentation in Hamilton Hall (B08, B07, B09, 215, 219B). These are shared facilities within the School of Geosciences.

Other Physical Facility Needs:
We do not require additional room for research space, classrooms, or faculty and staff offices at this time. We will, however, require additional space for graduate research assistants and teaching assistants. It is important for teaching assistants to hold office hours in a consistent location where students from their courses can come to ask questions. It is also important that graduate research assistants have space near to the labs where they work so that faculty can appropriately supervise them.

Other Resources Needed:
None. We have the necessary space, faculty, and administrative support within the School of Geosciences to advance this program.

Competitive/Similar Programs in Louisiana and in Neighboring States:
There are currently two MS-level programs in Environmental Science in the state of Louisiana. LSU offers a 36-credit hour MS degree in "Environmental Science." This program has a CIP code of 03.0104, which is earmarked specifically for Environmental Science. Twenty-three, 9, 17, 7, and 9 students graduated from this program in the 2013-14, 2012-13, 2011-12, 2010-11, and 2009-10 academic years, respectively. The LSU Environmental Science program includes thesis and non-thesis options and has focus areas in (1) Biophysical systems, (2) Environmental planning and management, and (3) Environmental assessment and analysis. All students enrolled in this program take a common course titled "*Integrated Environmental Issues*" (3hrs) and a seminar course (1hr). The remaining 32 credit hours can be tailored from a list of approved courses. Six hours of thesis work are earmarked for the thesis option, while these 6 hours are used for additional courses and/or internships for the professional option.

McNeese State University offers a MS degree in "Environmental and Chemical Science." This program has a CIP code of 40.0599, which places it in the "Chemistry" category. Twelve, 19, 30, 17, and 12 students graduated from this program in the 2013-14, 2012-13, 2011-12, 2010-11, and 2009-10 academic years, respectively. McNeese's program includes thesis (37 hours) and non-thesis (31 hours) options and is comprised of coursework in the disciplines of Chemistry, Agricultural Sciences, and Environmental Science.

Tulane and the University of New Orleans have programs in Earth and Environmental Science at the MS-level, but these are Geology- or Geoscience-based programs. The CIP code for these programs reflects their focus on Geosciences.

Programs offering MS-degrees in Environmental Science or Environmental Studies in the surrounding region include the University of Houston Clear-Lake and Lamar University.

Why our program is different:
Our proposed program is in *Environmental Resource Science (CIP 03.0199) with water and soil resources as the central theme*. Although the other MS programs in Environmental Science (CIP 03.0104) or Environmental Chemistry (CIP 40.0599) are healthy and have courses that address water and soil resources among their offerings, this is clearly not their programmatic focus.

On-line Delivery Possible/Probable/Feasible?
Dr. Durga Poudel is a "Certified Course Designer" for distance learning at UL Lafayette. In addition to his participation in a series of distance learning workshops, Dr. Poudel successfully completed the 10-week "Course Design Practicum" for distance learning offered by UL Lafayette's Office of Distance Learning. Dr. Poudel is planning on developing a Hybrid online course on "Surface Water Quality" that can be used within our program.

Consortial Delivery Possible? With what institution(s)?
Our program will be self-sufficient. It is supported by highly-qualified faculty with unmatched expertise in the fields of water and soil resources. The vast majority of the necessary courses are already available and being taught at UL Lafayette.

Other Special Considerations:
Through our current undergraduate program in Environmental Science, we have developed a broad network of collaborators and partnerships in Louisiana that will become even more useful for the graduate program (see "Institutional Partnerships" below).

Adjunct Faculty: Adjuncts help to support research, teaching, and in some cases can serve on graduate thesis committees.

- Dr. Thomas Doyle – US. Geologic Survey, National Wetlands Research Center
- Dr. Ken Krauss – US. Geologic Survey, National Wetlands Research Center
- Mr. Bill Schramm – Louisiana Department of Environmental Quality

Institutional Partnerships: These organizations are already partnering with us to support Environmental Science student internships at the undergraduate level.

- RT Environmental Services
- Sherry Laboratories
- Hydro-Environmental Technology Inc.
- T. Baker Smith, LLC
- Icon Environmental Services
- KourCo Environmental Services
- Stokes and Spiehler Engineering and Consulting
- CH2M Hill
- Dove Environmental
- Lafayette Consolidated Government
- US Department of Agriculture – National Resources Conservation Service
- National Park Service
- Louisiana Department of Environmental Quality
- US Geological Survey National Wetlands Research Center

BASIC STRUCTURE AND COMPONENTS/CONCENTRATIONS

Prerequisites

Prerequisites for acceptance into the MS Program of Environmental Resource Science include a Bachelor's degree in a related scientific or engineering field. At a minimum, the completion of the following general science requirements (or their equivalents) is expected: CHEM 108, 115; BIOL 110, 111, 112, 113; PHYS 207, 208, 215, 216; MATH 143, 250. In addition, the following undergraduate leveling courses may be required for students admitted to the program without the necessary background in Environmental Science (ENVS 100, 285, 455, 464; GEOL 111). Substitutions may apply to the leveling course requirements and will be determined on a case-by-case basis by the Environmental Science graduate committee. An undergraduate GPA of at least 3.0, satisfactory GRE scores, and three supportive letters of recommendation are amongst the criteria used for admission evaluation.

Total Number of SCHs Required and Estimated Time Required for Student Completion:
We propose a 35-hour curriculum with thesis and non-thesis options. Courses within our degree program have been organized into the categories of (1) Water Resources, (2) Soil Resources, (3) Environmental Methods (applied to water and soil resources), and (4) Biophysical Relationships. Our proposed program relies on 47 graduate courses already in existence at UL Lafayette, creating a diverse and exhaustive curriculum that offers a good indication of our established strength in this field. The Water Resources, Soil Resources, and Environmental Methods (applied to water and soil resources) courses constitute the program core. The Water and Soil Resources courses will provide students with a scientific foundation for addressing challenges within the field of environmental resources, while the Environmental Methods courses will provide students with an understanding of the tools used to address these challenges. The Biophysical Relationships courses are available so that students can develop a basic understanding of the interface of soil and water resources with biological systems. In addition to this rich curriculum, we will create 5 new program-specific courses (see Table 2 below).

Substantial flexibility is built into the program regarding which courses are available to satisfy the Environmental Methods requirement and 12 hours of electives. With the exception of two required courses each in the Water and Soil Resources category, no specific sequence of additional courses will be required. This flexible structure will provide students with the opportunity to individualize their curriculum within the over-arching theme of water and soil resources. This flexible, inter- and multi-disciplinary approach is important for the development of a broad-based applied science program, but at the same time allows for an appreciable level of specialization. We feel that this educational approach is precisely what is required to develop a workforce that can address a variety of environmental challenges, particularly those dealing with water and soil issues that are specific to Louisiana.

Thesis Option:

- Thesis = 6 hours
- Seminar = 2 hours
- Water Resources = 6 hours (*denotes a required course in Table 2)
- Soil Resources = 6 hours (*denotes a required course in Table 2)
- Environmental Methods = 3 hours
- Electives = 12 hours. Any of the approved courses (Table 2) with no more than 9 hours from the Biophysical Relationships category.
- Before or in the early stages of thesis research, the student will submit a written research proposal for approval by their advisor and thesis committee.

Non-Thesis Option:

- This will be identical to the thesis option except that the 6 thesis hours will be divided into either (1) 3 additional hours of electives from any of the approved courses and a final 3-credit hour capstone project, or (2) a 6-credit hour internship.

  The Final Capstone Project (ENVS 589, 3hrs) will be assigned by a faculty advisor and approved by the graduate committee of the Environmental Science Program. The outcome of the project must include a ~10 to 15 page written report, which must be approved by the student's faculty advisor and graduate

committee members of the Environmental Science Program.

The Internship (ENVS 579, 6hrs) must include the equivalent of 1 semester of part-time work with an industry partner. Prior to initiation of the internship, the student will be required to develop a plan with the company/agency and his/her graduate faculty advisor as to what requirements or products are expected. At a minimum, the student will complete a final written report and presentation of his or her work. Details regarding the length and format of the report and presentation will be developed by the student's faculty advisor and graduate committee members of the Environmental Science program in conjunction with the industry partner. We have already lined up a variety of industry partners for participation in the internship program (see list below).

Degree requirements:

1. 400-level courses taken for undergraduate credit prior to acceptance in the MS-degree program will NOT count toward the course requirements for the graduate degree.
2. At least 12 credit hours of 500-level courses that count toward the degree must be taken.
3. Students who may have already completed a required course within another program may substitute a different course within the same category. The course substitution must be approved by the graduate committee of the Environmental Science program.
4. For the thesis option, a written thesis proposal and oral proposal defense are required. This must be completed at least one semester before the graduating semester.
5. For the thesis option, a written thesis is required.

Courses:

Table 2. Courses for MS-degree in Environmental Resource Science.

Course Level/ Number	Course Name and Department Offering Course	Max Feasible Enrollment	Who is currently qualified to teach this course?	New or Existing Course
Program-specific courses				
ENVS 559	**Environmental Resources Seminar (1, 0, 1)**	100	All core faculty	*New Course
ENVS 569	**Special Topics (3, 0, 3).**	NA	All core faculty	New Course
ENVS 579	**Internship (6hrs)**	NA	All core faculty	New Course
ENVS 589	**Capstone Project (3hrs)**	NA	All core faculty	New Course
ENVS 599	**Thesis hours (6hrs)**	NA	All core faculty	New Course
Water Resources				
ENVS 445(G)	**COASTAL SCIENCES. (3, 0, 3).** Management of coastal aquatic ecosystems; emphasis on interactions with terrestrial and atmospheric systems; hydraulic and ecological modeling; and coastal restoration. Prereq: ENVS 100, 150, 151, and 285. Restr: Permission of instructor required.	30	Visser	Existing
***ENVS 484(G)**	**WATERSHED SCIENCE. (3, 0, 3**). Application of the planning process at the watershed (and larger) scale emphasizing the use of GIS and computer modeling tools.	35	Costigan; Borrok; Poudel	Existing
ENVS 486(G)	**WATER QUALITY. (3, 2, 4).** Design of data collection and analysis of chemical and biological properties necessary to support the planning process. Prereq: CHEM 107, 115, and ENVS 285.	35	Poudel; Borrok; Mukundan	Existing
[1]**ENVS 580**	**FATE OF POLLUTANTS IN SOILS AND NATURAL WATERS. (3, 0, 3).** Thermodynamics and surface reactions affecting the presence, distribution, and fate of pollutants. Prereq: CHEM 101, 240; ENVS 285.	35	Poudel; Borrok; Mukundan	Existing

GEOL 431(G)	**INTRODUCTION TO GEOCHEMISTRY. (3, 0, 3).** Introduction to the concepts and principles of Geochemistry. Prereq: GEOL 292 and CHEM 107. If prerequisites not met permission of instructor required.	40	Schubert; Borrok	Existing
GEOL 440(G)	**OCEANOGRAPHY. (2, 2, 3).** Formation of the earth's oceans and the role they play in the global geologic, climatologic, and biologic systems.	50	Richter	Existing
***GEOL 470(G)**	**GROUND WATER. (3, 0, 3).** Occurrence, movement, distribution, and discussion of problems associated with supply and change in composition of ground water. Prereq: GEOL 292, 314 or permission of instructor.	70	Duex; Poudel; Borrok; Costigan	Existing
[1]**GEOL 510**	**ADVANCED ENVIRONMENTAL GEOLOGY. (2, 3, 3).** Content varies. May be repeated for credit. Application of Geology to problems resulting from the increasingly intense use of the earth and its resources. Restr: Permission of instructor required.	35	Duex; Schubert; Borrok; Costigan	Existing
GEOL 509	**ADVANCED GROUND WATER HYDROLOGY. (3, 0, 3).** Discussion of case histories and examples that apply the basic principles of ground water Hydrology to specific sites and problems. A summary of current thoughts, ideas, and practical applications related to Hydrology. Prereq: GEOL 470(G) or permission of instructor required.	35	Duex; Costigan	Existing
GEOL 532	**PETROLEUM GEOCHEMISTRY. (2, 3, 3).** Concepts and principles of Geochemistry. Course includes examination of natural samples. Prereq: GEOL 292, CHEM 108 or permission of instructor required.	45	Borrok	Existing
[1]**BIOL 407(G)**	**ENVIRONMENTAL TOXICOLOGY. (3, 3, 4).** Overview of occurrence of pollutants in aquatic and terrestrial environments and the atmosphere, pollutant dynamics and metabolism, and pollutant effects on biota at different organizational levels. Laboratory centers on methodology, instrumentation, and other practical aspects. **Prereq:** BIOL 110, 111; CHEM 107, or permission of instructor required.	20	Biology Faculty	Existing
BIOL 441(G)	**LIMNOLOGY AND OCEANOGRAPHY. (3, 3, 4).** Origins, geology, physics, chemistry, and biological productivity of inland water bodies, estuaries, and oceans. Laboratory centers on methodology, instrumentation, and other practical aspects of freshwater and marine studies; required field trips. **Prereq**: BIOL 203 CHEM 108, and MATH 140 or 143, or equivalents.	25	Biology Faculty	Existing
CIVE 506	**ADVANCED HYDROLOGY. (3, 0, 3).** Quantitative approaches for modeling rainfall-runoff processes. Topics include lumped and distributed models, treatment of spatial and temporal hydrologic variability, hydrologic data quality control, and design of hydrologic networks. Restr: Permission of instructor required.	20	Habib; Civil Engineering Faculty	Existing
CIVE 546	**PROBABILISTIC METHODS IN HYDROSCIENCE. (3, 0, 3).** General review of advanced probability and statistics concepts, Monte Carlo simulation of hydro-systems, probabilistic models of observed hydrologic data, optimal estimation and interpolation of geophysical fields. Use of data-intensive computer applications is emphasized. Restr: Permission of instructor required.	20	Habib; Civil Engineering Faculty	Existing
CIVE 561	**WATER TREATMENT. (3, 0, 3).** Design of domestic and industrial water treatment facilities with emphasis on the basic scientific principles underlying the design procedures. Prereq: CIVE 321 or permission of instructor required.	25	Habib; Gang	Existing

Soil Resources				
***ENVS 490(G)**	**ENVIRONMENTAL PEDOLOGY. (3, 0, 3).** Soil-solute interactions occurring as a result of natural and human activities. Prereq: ENVS 285 or permission of instructor required.	35	Poudel; Mukundan	Existing
ENVS 493(G)	**SOIL-PLANT RELATIONSHIPS. (3, 0, 3).** Chemical, biological, and physical properties of soils in relation to nutrient cycling and plant growth, including evaluation of soil supplements. Prereq: ENVS 285 or permission of instructor required.	35	Mukundan; Visser; Foret	Existing
ENVS 495(G)	**SOIL GENESIS AND SURVEY. (3, 0, 3).** Formation, distribution, and classification of soils as natural bodies. Restr: Non-majors, permission of instructor required.	35	Poudel; Mukundan	Existing
ENVS 498(G)	**SOIL BIOLOGY. (3, 0, 3).** Role of plants, animals, and microbes in soil generation and the biochemical transformations in soil ecosystems; required for plant nutrition. Prereq: ENVS 285 or permission of instructor required.	35	Mukundan; Poudel	Existing
***[1]ENVS 580(G)**	**FATE OF POLLUTANTS IN SOILS AND NATURAL WATERS. (3, 0, 3).** Thermodynamics and surface reactions affecting the presence, distribution, and fate of pollutants. Prereq: CHEM 101, 240; ENVS 285.	35	Poudel; Mukundan; Borrok	Existing
GEOL 433(G)	**CLAY MINERALOGY. (2, 2, 3).** Classification, identification, occurrence, and properties of clays. Prereq: GEOL 339; CHEM 108, or permission of instructor.	50	Schubert; Mukundan; Poudel	Existing
[1]GEOL 510	**ADVANCED ENVIRONMENTAL GEOLOGY. (2, 3, 3).** Content varies. May be repeated for credit. Application of Geology to problems resulting from the increasingly intense use of the earth and its resources. Restr: Permission of instructor required.	35	Duex; Schubert; Borrok	Existing
[1]BIOL 407G	**ENVIRONMENTAL TOXICOLOGY. (3, 3, 4).** Overview of occurrence of pollutants in aquatic and terrestrial environments and the atmosphere, pollutant dynamics and metabolism, and pollutant effects on biota at different organizational levels. Laboratory centers on methodology, instrumentation, and other practical aspects. **Prereq:** BIOL 110, 111; CHEM 107, or permission of instructor required.	20	Biology Faculty	Existing
CIVE 563	**SOLID AND HAZARDOUS WASTE MANAGEMENT. (3, 0, 3).** Current issues and legislation. Collection, storage and disposal. Treatment technologies including incineration and sanitary and hazardous waste landfills. Prereq: CIVE 321 or permission of instructor required.	30	Civil Engineering Faculty	Existing
Environmental Methods				
ENVS 473(G)	**REMOTE SENSING IN GIS. (2, 2, 3).** GIS remote sensing and analysis based on aerial photography and satellite imagery, applying this technology for analyzing spatial issues. Prereq: ENVS 455(G) or GEOL 330.	30	Richter; Yantis	Existing
ENVS 487(G)	**ADVANCED GIS ANALYSIS AND APPLICATIONS. (2, 2, 3).** Prereq: ENVS 464(G) and ENVS 473(G).	30	Yantis	Existing
ENVS 455(G)	**GEOGRAPHIC INFORMATION SCIENCE 1 (3,2,2).** GIS theory and methodology, practical GIS software skills and basic scientific computing skills, map development and basic photo interpretation. Prereq: Prereq. Literacy in Micro-Computers.	20	Yantis	Existing
ENVS 464(G)	**GEOGRAPHIC INFORMATION SCIENCE 2 (3,2,2).** Emphasis on practical GIS applications, advanced GIS software skills map development and modeling. Prereq: ENVS 455(G)	20	Yantis	Existing
GEOL 420(G)	**GEOPHYSICS I. (3, 2, 4).** Concepts, techniques, and applications. Emphasis on utility of gravity, magnetic, electrical, electromagnetic; and seismic data in the investigation of the subsurface at various depths. Prereq: MATH 270; PHYS 208, 216. Restr: If prerequisites not met permission of instructor required.	50	Geology Faculty	Existing

GEOL 432(G)	**INSTRUMENTAL EXAMINATION OF EARTH MATERIALS. (2, 2, 3).** Application of x-ray diffraction, x-ray fluorescence spectroscopy, scanning electron microscopy, and light microscopy to examine minerals, rocks, soils, and scale deposits.	35	Geology Faculty	Existing
GEOL 437(G)	**COMPUTER APPLICATIONS IN GEOLOGY. (2, 2, 3).** Geological applications software. Includes GIS, CAD, and mapping routines. Prereq: One course in computer literacy or programming, and a statistics course. Restr: If prereq. not met, permission of instructor is required.	30	Geology Faculty	Existing
ENVS 460(G)	**SITE ASSESSMENT AND REMEDIATION. (3, 0, 3).** Assessment and remediation of contaminated water sites and other geologic situations; includes risk and hazard analysis. Prereq or Coreq: GEOL 470 or permission of instructor.	35	Geology Faculty and adjuncts	Existing
BIOL 418(G)	**MICROSCOPY THEORY AND APPLICATIONS. (3, 0, 3).** Includes light, electron, fluorescence, and scanning probe microscopy. Emphasis on computer-based acquisition and processing of images. Prereq: BIOL 110; CHEM 108.	18	Biology Faculty	Existing
BIOL 427(G)	**EXPERIMENTAL DESIGN AND ANALYSIS. (3, 0, 3).** Fundamentals of designing and implementing field experiments from the initial planning stage to data analysis, interpretation, and publication.	25	Biology Faculty	Existing
BIOL 590	**ANALYTICAL TECHNIQUES. (3-6).** Training in the use of advanced research instrumentation including chromatography, fluorometry, image analysis and data interpretation. Restr: Permission of instructor required.	25	Biology Faculty	Existing
BIOL 502	**QUANTITATIVE ECOLOGY. (3, 0, 3).** Quantitative methods for analysis in Ecological studies including ecological models, model selection, maximum likelihood estimation, and mark-recapture analysis.	25	Biology Faculty	Existing
BIOL 503	**ECOLOGICAL MODELS AND DATA. (3, 0, 3).** Presents advanced statistical techniques that are a framework for comparing alternative mechanistic ecological models to empirical data. The combination of statics and models provides a quantitative basis for inferring the processes at work in an ecological system.	25	Biology Faculty	Existing
BIOL 575	**STATISTICAL ECOLOGY. (4, 0, 4).** Design, analysis, and presentation of results of ecological experiments and field studies, with emphasis on hypothesis testing and statistical modeling. Prereq: STAT 417(G) or permission of instructor required.	25	Biology Faculty	Existing
CIVE 567	**EXPERIMENTAL ANALYSIS FOR ENVIRONMENTAL ENGINEERS. (0, 6, 3).** Examination of laboratory techniques for assessing water quality and sludge contamination. Optical, electrical, gas chromatography, and x-ray methods are included. Prereq: Students must have taken CIVE 321 or equivalent course, or permission of instructor required.	25	Civil Engineering Faculty	Existing
CHEM 430 (G)	**INSTRUMENTAL ANALYSIS. (5, 4, 3).** Prereq: CHEM 221, CHEM 222, CHEM 301 or CHEM 303.	15	Chemistry Faculty	Existing
Biophysical Relationships				
BIOL 414(G)	**ORNITHOLOGY. (3, 3, 4).** Avian evolution, ecology, physiology, and behavior. Laboratories include required field trips and focus on identification, life history, and conservations of birds. Prereq: BIOL 215. Restriction: Permission of instructor required.	25	Biology Faculty	Existing
BIOL 445(G)	**ICHTHYOLOGY. (2, 4, 4).** Classification, zoogeography, and evolution of fishes. Includes ecological factors affecting fish community structure, adaptations of specialized fish fauna, including those of deep sea, epipelagic, polar, and coral reef habitats. Required field trips. Prereq: BIOL 203. Restriction: If	25	Biology Faculty	Existing

	prerequisites not met, permission of instructor required.			
BIOL 415(G)	**BIOGEOGRAPHY. (3, 0, 3).** Integration of concepts of ecology, evolutionary biology, geology, and physical geography relative to distribution of species.	25	Biology Faculty	Existing
BIOL 580	**MARINE ECOLOGY. (3, 0, 3).** Discussions of basic principles of marine ecology, including productivity, dynamics of populations, factors affecting distribution, and interactions between organisms.	20	Biology Faculty	Existing
BIOL 542	**EVOLUTIONARY ECOLOGY. (3, 0, 3).** Ecological processes as phenomena that are subject to evolutionary change. Topics include optimality theory, predator-prey interactions, life-history strategies, sexual selection, and sociality. Prereq: A course in Statistics.	20	Biology Faculty	Existing
BIOL 412(G)	**CONSERVATION BIOLOGY AND BIODIVERSITY. (3, 0, 3).** Application of ecological and evolutionary theory to the management of rare and threatened species, communities, and ecosystems. Emphasis on human threats to wildlife species and habitats. Prereq: BIOL 203.	20	Biology Faculty	Existing
BIOL 461(G)	**AQUATIC AND WETLAND VASCULAR PLANTS. (2, 4, 4).** Identification, ecology, and adaptations of vascular aquatic and wetland plants.	20	Biology Faculty	Existing

2. Need

Outline how this program is deemed essential for the wellbeing of the state, region, or academy (e.g., accreditation, contribution to economic development; related to current or evolving needs within state or region). Cite data to support need: employment projections; supply/ demand data appropriate to the discipline and degree level, etc.

WELL-BEING OF THE STATE

We shaped the focus and structure of our program to match the most recent developments associated with Louisiana's workforce needs and projected growth areas. Our program captures recommendations put forth in the FIRST Louisiana report and the BOR 2011 Master Plan, targeting the need for a skilled interdisciplinary workforce that can address current and future challenges associated with the state's water resources and restoration activities. More recent recommendations to the Louisiana Board of Regents presented by the Master Plan Research Advisory Committee in 2014 highlight the need for the development of new academic programs in interdisciplinary applied sciences such as the one we present here.

Our program specifically addresses the following goals and objectives in the **BOR 2011 Master Plan**:

Goal 1, Objective 1.7: "*Develop a Skilled Workforce to Support an Expanding Economy*."
Our program will prepare a new generation of highly-skilled workers in an important STEM field. Our graduates will support technical management and problem-solving in areas associated with the environmental resources (water, soil, etc.) that are critical to the State of Louisiana. Contributing to the development of a qualified labor pool in the domain of the environmental sciences will facilitate business attraction and retention in Louisiana.

Goal 2, Objective 2.1: "*Maintain and Build Strength in Foundational Science and Technology Disciplines Identified in FIRST Louisiana.*"
Physical Science is recognized by FIRST Louisiana as a key foundational science. Water resources are fundamental to 4 of the 6 transitional research domains (coastal, environmental, agricultural, energy) and to at least 3 of the 7 core industry S&T sectors (petrochemical, energy and environmental, and agriculture and wood products) in FIRST Louisiana. The high-growth target industries of coastal resilience and energy production are also underpinned by water resource management. More recent recommendations to the Louisiana Board of Regents presented by the Master Plan Research Advisory Committee in 2014 highlight the need in Louisiana for the development of new academic programs in interdisciplinary applied sciences such as the one we present here.

"Recruit, cultivate, and retain research talent in the foundational sciences."
The addition of a master's degree program will allow us to greatly expand our research in water and soil resources, which will attract quality research-active faculty and provide an incentive for us to keep them.

"Develop and maintain cutting-edge infrastructure and facilities for fundamental science and technology research."
Although we already have cutting-edge laboratory and field facilities, the master's degree program will provide new opportunities to advance our infrastructure. We can leverage the new program to secure instrumentation through grants and can rely on the more highly-capable graduate students to help operate and maintain equipment.

Goal 2, Objective 2.2: ***"Promote Multidisciplinary and Multi-Institutional Collaborative Research Efforts."***
Environmental Science, by its very nature, is the most inter- and multi-disciplinary STEM field. Our program is built to accept qualified students with bachelor's degrees from a variety of disciplines, including Biology, Geology, Chemistry, Environmental Science, Civil Engineering, and related fields. Moreover, our curriculum includes the possibility of course work in all of these disciplines. New collaborations among students and faculty in these different disciplines will develop through research projects and coursework. We have 7 supporting faculty for our program from outside the School of Geosciences (in Civil Engineering, Chemistry, and Biology).

"Address multi-disciplinary and multi-institutional collaborations in campus research plans."
Our multidisciplinary approach reflects the University of Louisiana at Lafayette's strategic plan for advancing multidisciplinary research.

Goal 2, Objective 2.3: ***"Sustain and Advance Research Commercialization and Translational Activities that Promote Economic Development in Louisiana."***
We are embracing translational research as a key focus. This includes an emphasis on hands-on training and internship opportunities. Our program will remain tightly connected to industry, which can enhance commercialization and translational research.

"Promote Multidisciplinary and Multi-Institutional Collaborative Research Efforts."
As described in Goal 2, Objective 2.2 (above), our programmatic concentration areas include courses from multiple disciplines, which will foster joint research efforts. Many of our faculty members are already collaborating across disciplines at UL Lafayette. As an example, we recently received a multi-disciplinary BOR enhancement grant for building living wetland laboratories. This grant was led by a faculty member in our Environmental Science program with collaborators from Geology, Biology, and Civil Engineering. All of these collaborators are listed as primary or supporting faculty for our master's program in Environmental Resource Science.

"Foster networking and strategic collaborations between higher education, government, and Louisiana's existing and prospective high-growth industry sectors."
Louisiana's high-growth industry sectors include *Energy Production* and *Coastal Resilience*. Proper understanding and management of water and soil resources are critical for these industries. We will be working with local industry in these areas via internship and research opportunities.

"Build capacity in areas of competitive advantage and target niches which align with campus and State research priorities."
As described above, our target niches are closely aligned both with the research priorities of UL Lafayette and the State of Louisiana. By filling these niches, we add value to our program for our students, our community, and society.

EMPLOYMENT PROJECTIONS

The Louisiana Workforce Commission indicates that Environmental Science is a high-demand job for Louisiana. There are projected to be 80 annual job openings (30 new + 50 replacements) over the next decade for *Environmental Scientists and Specialists* (Table 3). There is additional demand for Environmental Scientists as *Natural Science Managers* and *Conservation Scientists,* as 30 new positions will be available in Louisiana over the

next decade (Table 3).

Although some environmental science jobs are obtainable with a BS degree, there are considerable advantages for students who earn a graduate degree in Environmental Science. In most areas of Environmental Science, earning a graduate degree will provide students with more career options, positions of greater responsibility, and increased pay. For example, according to federal pay scales, an entry-level environmental scientist with a BS degree would start out as a GS 5, making around $32,000 annually (depending on location). An individual holding a MS degree in the same field would start out as a GS 9, making around $48,000 annually. To test whether these financial differences were also present in the private sector, we interviewed 5 businesses that hire environmental scientists in our region. The average starting salary difference between an environmental scientist holding only a BS degree and one additionally holding a MS degree was 26.8%, with the MS-degree holders having the higher salaries.

Table 3. Louisiana Workforce Commission Occupational Projections

Occ. Code	Occupational Title	2012 Estimate	2022 Projected	10 Year Growth	Annual New Growth	Annual Replacement	Annual Total Openings
11-9121	Natural Sciences Managers	400	450	50	10	10	20
19-1031	Conservation Scientists	160	180	20	0	10	10
19-2041	Environmental Scientists and Specialists, Including Health	1,660	1,950	290	30	50	80

In addition, job openings in Louisiana directly related to science and engineering associated with coastal restoration activities are estimated to range from 16,341 to 22,716 new jobs per year for the next 50 years (Ryan, 2014; *The economic impact of coastal restoration and hurricane protection*; **Tulane Institute on Water Resources Law and Policy).** A measurable portion of these jobs could be filled by Environmental scientists. The need for Environmental Scientists is also growing nationally. Job growth is expected to be around 15% over the next decade, which is substantially faster than the national average for all jobs (Table 4; Figure 1).

Table 4. U.S. Bureau of Labor Statistics Quick Facts about Environmental Science Jobs

2012 Median Pay	$63,570 per year $30.56 per hour
Entry-Level Education	Bachelor's degree
Work Experience in a Related Occupation	None
On-the-job Training	None
Number of Jobs, 2012	90,000
Job Outlook, 2012-22	15% (Faster than average)
Employment Change, 2012-22	13,200

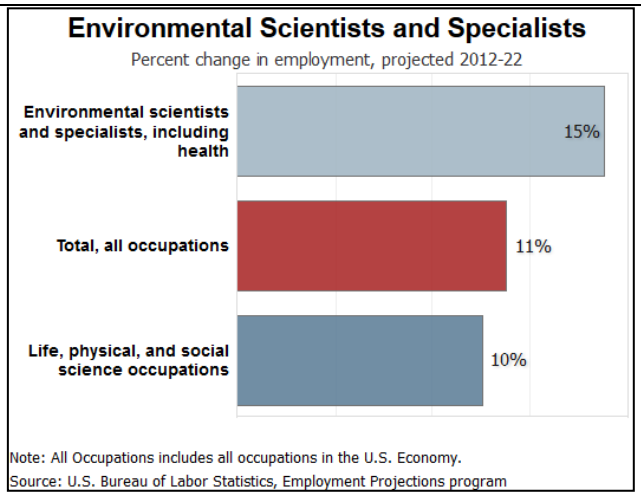

Figure 1. Projected job growth for environmental scientists 2012-2022 from the U.S. Bureau of Labor Statistics.

According to the U.S. Bureau of Labor Statistics, job demand in Environmental Science is driven by "Heightened public interest in the hazards facing the environment, as well as the increasing demands placed on the environment by population growth." At the national level, 36% of environmental science jobs fall within the area of "Professional, Scientific, and Technical Services, while 20% fall within "Management, Scientific, and Technical Consulting Services." Thirty two % of Environmental Science jobs are associated with state and local governments.

3. Relevance

Explain why this program is an institutional priority at this time. How will it (a) further the mission of the institution and (b) increase the educational attainment of the state's adult population or foster innovation through research.

The University of Louisiana at Lafayette is the largest member of the University of Louisiana System and is designated within the Carnegie classification as a Research University with high research activity. In addition to the pursuit of excellence in education and research at all levels, the mission of the University is to promote regional economic and cultural development, to explore solutions to national and world issues, and to advance its reputation among its peers. Our proposed master's program in Environmental Resource Science would strengthen UL Lafayette's existing role as a developing research university and support UL Lafayette's mission by producing graduates who will strengthen the local and regional economy and be able to use their expertise to help find solutions to societal issues at the state, national, and global levels.

The proposed MS program in Environmental Resource Science is an institutional priority for UL Lafayette because it will provide new opportunities for our students, increase the number of students receiving STEM degrees, and support the strategic directions for research at the University. Among other key disciplines, UL Lafayette aims to become a leader in research and education focused on water resources and management. We are positioning ourselves as an institution to become leaders in translational research in this area, bridging the gap between fundamental and application-based research. Hence, the focus of our master's level program on water (and soil) resources fits perfectly within the strategic research and educational interests of our university.

4. Students

Summarize student interest/demand for the proposed program.

We will be able to recruit students on our own campus who receive BS degrees in Environmental Science, Geology, Biology, Physics, and Chemistry. It is difficult to assess demand among graduates of programs outside of Environmental Science, but the sheer number of annual graduates in all of these programs alone suggests that we would have an immediate and large demand for this program. For example, Biology, Chemistry, and Geology respectively graduate around 70, 15, and 10 students annually. Our proposed MS in Environmental Resource Science would provide a new and compelling opportunity for these graduates.

Our current BS-degree in Environmental Science is growing rapidly, and its enrollment and graduation rates provide a good example of the usefulness and appeal of this field in the region. We began with 31 students enrolled in 2011/2012, and this has quickly expanded to an enrollment of 68 in Fall 2014 (we are expecting close to 80 in Fall 2015). We are actively recruiting students for our program and have recently developed a 2+2 relationship with Southwest Louisiana Community college (although the paperwork is still pending approvals).

To assess demand for the master's degree program among our current students, we used a survey. Forty students responded to the survey, including 33 juniors and seniors. Of the surveyed students, 27.5% were already planning on obtaining a MS degree somewhere regardless of our new program. However, when asked if they would be interested in enrolling in a MS-degree program if one were developed at UL Lafayette, 21 students (over 50%) said yes, while 17 were unsure and only two were uninterested. When asked about their motivation for pursing a MS degree, 85% of the surveyed students indicated that the opportunity to earn a higher salary was important or very important. More than 72% of respondents suggested that the opportunity to advance more quickly in industry was important or very important.

Projected Student Enrollment:

Table 1. Projected enrollments and student funding mechanisms for years 1-5.

	Students			Funding			
Year	Total Enrolled	New Students	Graduated	Industry-Funded	Self-Funded	Research-Funded	Graduate Assistantships
1	5	5	0	2	0	1	2
2	10	8	3	3	1	2	4
3	14	10	6	5	2	3	4
4	18	12	8	6	4	4	4
5	21	13	10	7	4	6	4

The enrollment projections in Table 1 are conservative, based on the analysis of enrollment patterns for similar programs. The most recent MS degree program that is related to environmental science that was created in Louisiana (2002) is the program in "Environmental and Chemical Science" at McNeese State University. Although this program has a CIP code of 40.0599, which places it in the "Chemistry" category, it is still a reasonable comparison for enrollment because of its focus on Environmental Chemistry. Enrollments in McNeese State's MS program reached 33 students in just 3 years, which is higher than our projected enrollments in year 5.

In addition to these projections, it is clear that the production of Bachelor's level degrees in Environmental Science in Louisiana is quite high and growing. For example, over the last 5 years Louisiana Tech's BS degree program in Environmental Science has averaged 11.4 graduates, while LSU's BS degree program in Environmental Management Systems has averaged 11 graduates. Moreover, LSU's BS program in Coastal Environmental Science has graduated more than 10 people in the last 2 years (this is a relatively new program). Environmental Science BS-degree programs at private institutions in Louisiana (Tulane and Loyola University) account for another 5 to 10 graduates annually. Finally, UL Lafayette's BS degree program in Environmental Science that began in 2011 already has more than 60 enrolled students, which is on a track to graduate about 10 students a year. Hence, in combination, the production of students graduating with BS-degrees in Environmental Science in Louisiana alone is (or will shortly be) 45 to 50 students annually. This — along with growth in majors in other environmentally-relevant programs at UL Lafayette and throughout the state in areas such as Biology, Geology, and Chemistry — will provide a rich pipeline for graduate students in our program.

One of our initial recruiting strategies will be to send out recruiting information to all environmental science programs that offer BS degrees in the Gulf Coast region. We will additionally use the GRE exam service to obtain a list of potential candidates for our program and will reach out to all of them via e-mail. This has been an enormously successful recruiting tactic for our other graduate programs. In addition to these efforts, we plan to build a social media and web-based recruitment initiative.

5. Cost

Estimate costs for the projected program for the first five years. Indicate amounts to be adsorbed out of current sources of revenue and needs for additional appropriations (if any). Commit to provide adequate funding to initiate and sustain the program.

Our proposed program can be fully implemented with little new costs to UL Lafayette. This includes no new additional funds required for faculty, supplies, operating expenses, or travel. Costs incurred by graduate assistantships represent a necessary investment in the success of the program. Besides the four graduate assistantships requested from UL Lafayette, many will be funded by external research funds and by industry partners, either through the creation of company-sponsored assistantship or corporate funding as a business recruiting tool for graduates. Finally, Master's students will have full access both to the UL Lafayette and the LSU libraries, as well as resources provided through the LOUIS consortium, so no additional library costs are anticipated.

CERTIFICATION:

_____	_____
Chief Academic Officer	Date
_____	_____
Chancellor/President	Date
_____	_____
Management Board	Date