

# Environmental Engineering (MR)

## Master of Environmental Engineering Degree Requirements

Students may choose from the degree tracks below to complete coursework within a focus area:

- Air Pollution Engineering Specialization (p. 1)
- Engineering: Coastal Engineering Specialization (p. 2)
- Energy Systems Analysis Specialization (p. 2)
- Environmental Process Engineering Specialization (p. 3)
- Environmental, Water Resources, and Coastal Engineering Specialization (p. 4)
- Modeling and Systems Analysis Specialization (p. 4)
- Water Resources Engineering Specialization (p. 6)

Degrees earned will be distributed as: "Master of Environmental Engineering" without specialization specifications.

### Air Pollution Engineering Specialization

Code	Title	Hours	Counts towards
<b>Core Courses</b>			
CE 576	Engineering Principles Of Air Pollution Control	3	
CE 579	Principles of Air Quality Engineering	3	
CE 772	Environmental Exposure and Risk Analysis	3	
CE 779	Advanced Air Quality	3	
<b>Core Electives</b>			
<b>Technical Electives</b>			
<b>Total Hours</b>		<b>12</b>	

### Core Electives

Code	Title	Hours	Counts towards
CE 596	Special Topics in Water Resource and Environmental Engineering (Energy and Climate)	3	
CE 775	Modeling and Analysis Of Environmental Systems	3	
CE 776	Advanced Water Management Systems	3	

CHE 575	Advances in Pollution Prevention: Environmental Management for the Future	3
MEA 510	Air Pollution Meteorology	3
MEA 580	Air Quality Modeling and Forecasting	4
MEA 703	Atmospheric Aerosols	3
MEA 710	Atmospheric Dispersion	3

### Technical Electives

Code	Title	Hours	Counts towards
CE 536	Introduction to Numerical Methods for Civil Engineers	3	
CE 537	Computer Methods and Applications	3	
CE 538	Information Technology and Modeling	3	
CE 571	Physical Principles of Environmental Engineering	3	
CE 577	Engineering Principles Of Solid Waste Management	3	
GIS 510	Fundamentals of Geospatial Information Science and Technology	3	
MAE 406	Energy Conservation in Industry	3	
MAE 408	Internal Combustion Engine Fundamentals	3	
MAE 412	Design of Thermal System	3	
PA 550	Environmental Policy	3	
ST 515	Experimental Statistics for Engineers I	3	

ST 516	Experimental Statistics For Engineers II	3
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## Engineering: Coastal Engineering Specialization

Code	Title	Hours	Counts towards
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### Typical Course Selections

CE 583	Engineering Aspects Of Coastal Processes	3
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CE 596	Special Topics in Water Resource and Environmental Engineering (Introduction to Coastal and Ocean Engineering)	1-6
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CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics)	1-6
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CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Structures)	1-6
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CE 596	Special Topics in Water Resource and Environmental Engineering (Fluid Mechanics in Natural Environments)	1-6
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MEA 540	Principles of Physical Oceanography	3
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MEA 562	Marine Sediment Transport	3
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MEA/GIS 582	Geospatial Modeling	3
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MEA 792	Advanced Special Topics in Earth Sciences (Advanced Geospatial Modeling with Open Source GIS)	3
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MA 501	Advanced Mathematics for Engineers and Scientists I	3
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MA 534	Introduction To Partial Differential Equations	3
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ST 515	Experimental Statistics for Engineers I	3
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## Energy Systems Analysis Specialization

Code	Title	Hours	Counts towards
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### Suggested Core Courses

CE 537	Computer Methods and Applications	3
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CE 578	Energy and Climate	3
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CE 775	Modeling and Analysis Of Environmental Systems	3
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CE 796	Advanced Topics in Water Resource and Environmental Engineering (Energy Modeling)	1-3
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### Core Electives

#### Technical Electives

<b>Total Hours</b>	<b>10-12</b>
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## Core Electives

Code	Title	Hours	Counts towards
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CE 576	Engineering Principles Of Air Pollution Control	3
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CE 579	Principles of Air Quality Engineering	3
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CE 772	Environmental Exposure and Risk Analysis	3
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CE 791	Advanced Topics in Civil Engineering Computing (High Performance Computer Modeling)	1-3
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ECG 515	Environmental and Resource Policy	3
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## Technical Electives

Code	Title	Hours	Counts towards
<b>Suggested Technical Electives</b>			
CE 776	Advanced Water Management Systems	3	
CE 779	Advanced Air Quality	3	
CE 791	Advanced Topics in Civil Engineering Computing (Complex Adaptive Systems Analysis)	3	
CE 796	Advanced Topics in Water Resource and Environmental Engineering (Environmental Life-Cycle Analysis)	3	
CE 796	Advanced Topics in Water Resource and Environmental Engineering (Hydroclimatology)	3	
ECE 550	Power System Operation and Control	3	
ISE 510	Applied Engineering Economy	3	
ISE 519	Database Applications in Industrial and Systems Engineering	3	
ISE 712	Bayesian Decision Analysis For Engineers and Managers	3	
ISE 731	Multi-Attribute Decision Analysis	3	
OR 501	Introduction to Operations Research	3	
OR 504	Introduction to Mathematical Programming	3	
OR 505	Linear Programming	3	
PA 511	Public Policy Analysis	3	

PA 550	Environmental Policy	3
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## Environmental Process Engineering Specialization

Code	Title	Hours	Counts towards
<b>Core Courses</b>			
CE 571	Physical Principles of Environmental Engineering	3	
CE 573	Biological Principles of Environmental Engineering	3	
CE 574	Chemical Principles of Environmental Engineering	3	
<b>Core Electives</b>			
<b>Technical Electives</b>			
<b>Total Hours</b>		<b>9</b>	

## Core Electives

Code	Title	Hours	Counts towards
CE 537	Computer Methods and Applications	3	
CE 576	Engineering Principles Of Air Pollution Control	3	
CE 577	Engineering Principles Of Solid Waste Management	3	
CE 584	Hydraulics Of Ground Water	3	
CE 588	Water Resources Engineering	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Water and Sanitation for Developing Countries)	1-6	
CE 771	Physical-Chemical Water Treatment Processes	3	
CE 774	Environmental Bioprocess Technology	3	

CE 775	Modeling and Analysis Of Environmental Systems	3
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### Technical Electives

Code	Title	Hours	Counts towards
<b>Suggested Technical Electives</b>			
CE 596	Special Topics in Water Resource and Environmental Engineering	1-6	
CE 772	Environmental Exposure and Risk Analysis	3	
CHE 546	Design and Analysis of Chemical Reactors	3	
CHE 575	Advances in Pollution Prevention: Environmental Management for the Future	3	
MAE 560	Computational Fluid Mechanics and Heat Transfer	3	
MEA 579	Principles of Air Quality Engineering	3	
PA 550	Environmental Policy	3	
SSC 521	Soil Chemistry	3	
ST 511	Statistical Methods For Researchers I	3	
ST 512	Statistical Methods For Researchers II	3	

### Environmental, Water Resources, and Coastal Engineering Specialization

- 30 graduate-level credit hours

Code	Title	Hours	Counts towards
<b>Required Course</b>			
CE 607	Water Resource and Environmental Engineering Seminar	1	
<b>Total Hours</b>		<b>1</b>	

### Modeling and Systems Analysis Specialization

Code	Title	Hours	Counts towards
<b>Core Courses</b>			
CE 775	Modeling and Analysis Of Environmental Systems	3	
CE 776	Advanced Water Management Systems	3	
CE 791	Advanced Topics in Civil Engineering Computing (Complex Adaptive Systems Analysis)	1-3	
<b>Core Electives</b>			
<b>Technical Electives</b>			
<b>Total Hours</b>		<b>7-9</b>	

### Core Electives

Code	Title	Hours	Counts towards
CE 536	Introduction to Numerical Methods for Civil Engineers	3	
CE 537	Computer Methods and Applications	3	
CE 737	Computer-Aided Engineering Systems	3	
CE 772	Environmental Exposure and Risk Analysis	3	
CE 791	Advanced Topics in Civil Engineering Computing (Evolutionary Computation)	1-3	
CE 791	Advanced Topics in Civil Engineering Computing (High Performance Computer Modeling)	1-3	

CE 796	Advanced Topics in Water Resource and Environmental Engineering (Statistical Methods)	1-3
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CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics)	1-6
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## Technical Electives

Code	Title	Hours	Counts towards
CE 538	Information Technology and Modeling	3	
CE 573	Biological Principles of Environmental Engineering	3	
CE 574	Chemical Principles of Environmental Engineering	3	
CE 576	Engineering Principles Of Air Pollution Control	3	
CE 577	Engineering Principles Of Solid Waste Management	3	
CE 579	Principles of Air Quality Engineering	3	
CE 582	Coastal Hydrodynamics	3	
CE 584	Hydraulics Of Ground Water	3	
CE 586	Engineering Hydrology	3	
CE 588	Water Resources Engineering	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Fluid Mechanics in Natural Environments)	1-6	
CE 596	Special Topics in Water Resource and Environmental Engineering (Introduction to Coastal and Ocean Engineering)	1-6	

CE 596	Special Topics in Water Resource and Environmental Engineering (Energy and Climate)	1-6
CE 784	Ground Water Contaminant Transport	3
CE 796	Advanced Topics in Water Resource and Environmental Engineering (Hydroclimatology)	1-3
ECG 515	Environmental and Resource Policy	3
ECG 715	Environmental and Resource Economics	3
ECG 716	Topics In Environmental and Resource Economics	3
FOR 734	Advanced Forest Management Planning	3
OR 501	Introduction to Operations Research	3
OR 504	Introduction to Mathematical Programming	3
OR 505	Linear Programming	3
OR 506	Algorithmic Methods in Nonlinear Programming	3
OR 565	Graph Theory	3
OR 706	Nonlinear Programming	3
OR 708	Integer Programming	3
OR 709	Dynamic Programming	3
ST 515	Experimental Statistics for Engineers I	3

PA 550	Environmental Policy	3
MEA/GIS 582	Geospatial Modeling	3

## Water Resources Engineering Specialization

Code	Title	Hours	Counts towards
CE 584	Hydraulics Of Ground Water	3	
CE 586	Engineering Hydrology	3	
CE 588	Water Resources Engineering	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Fluid Mechanics in Natural Environments)	1-6	
Core Electives			
Technical Electives			
<b>Total Hours</b>		<b>10-15</b>	

## Core Electives

Code	Title	Hours	Counts towards
CE 583	Engineering Aspects Of Coastal Processes	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics)	1-6	
CE 772	Environmental Exposure and Risk Analysis	3	
CE 776	Advanced Water Management Systems	3	
CE 784	Ground Water Contaminant Transport	3	
CE 791	Advanced Topics in Civil Engineering Computing (Complex Adaptive Systems Analysis)	1-3	

CE 796	Advanced Topics in Water Resource and Environmental Engineering (Statistical Methods)	1-3
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## Technical Electives

Code	Title	Hours	Counts towards
CE 536	Introduction to Numerical Methods for Civil Engineers	3	
CE 537	Computer Methods and Applications	3	
CE 571	Physical Principles of Environmental Engineering	3	
CE 574	Chemical Principles of Environmental Engineering	3	
CE 583	Engineering Aspects Of Coastal Processes	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Introduction to Coastal and Ocean Engineering)	1-6	
BAE 573	Introduction to Hydrologic and Water Quality Modeling	3	
BAE 574	DRAINMOD: Theory and Application	3	
BAE 575	Design of Structural Stormwater Best Management Practices	3	
BAE 581	Open Channel Hydraulics for Natural Systems	3	
BAE 584	Introduction to Fluvial Geomorphology	3	
MEA 540	Principles of Physical Oceanography	3	

MEA/GIS 582	Geospatial Modeling	3
MEA 700	Environmental Fluid Mechanics	3
NR 500	Natural Resource Management	4

undergraduate and graduate programs, after which you will be notified.

### Step 3 – While in the ABM program, maintain status by following the steps below:

- With the specialty area ABM advisor's help, prepare a tentative Graduate POW, that complements the Undergraduate POW.
  - Up to 9 credit hours can be double counted, they must be at the 500 level, and they must be selected from the approved list of courses in the specialty area (provided in the subsequent pages).
  - The (tentative) Graduate POW must be formally approved by the ABM advisor.
- It is your responsibility to ensure that both the Graduate POW and Undergraduate POW satisfy the respective master's and undergraduate degree requirements
- You must maintain an overall GPA # 3.5 and a major GPA # 3.25 until you enter the master's program.
- Only graduate courses with a grade # B can be double counted. Courses with a grade # B- cannot be counted towards the master's degree.
- Towards the end of your bachelor's program, you must formally apply to the master's program, per deadlines published by the graduate school. Note that the GRE may be waived for ABM students – consult with your ABM advisor. The application must include to include a completed and signed ABM Plan of Work (<https://grad.ncsu.edu/wp-content/uploads/2015/11/abm-plan-of-work.pdf>).
- You must complete the master's degree within a time limit (12 months if MCE/MENE, 18 months if MSCE/MSENE), to take advantage of the double counting associated with the ABM. If you do not graduate within this time, you will be considered a regular master's student needing to take the full 30/31 graduate credits solely towards your master's degree.

## Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master's (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor's and Master's degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master's degree in the same field within 12 months of completing the Bachelor's degree, or obtain a thesis-based Master's degree in the same field within 18 months of completing the Bachelor's degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.

## CCEE Department ABM Admission

The CCEE department encourages excellent undergraduate students to obtain a master's degree in their chosen field of specialization within 2 to 3 semesters past BS graduation, through double counting up to 9 credit hours towards both bachelor's and master's degrees. This is referred to as the Accelerated Bachelor's/Master's (ABM) degree program. Following is the pathway for the ABM program.

### Step 1 – Verify your eligibility for applying to the ABM program

- You must have completed at least 75 credit hours (this typically means junior standing)
  - If you are a transfer student, you must have completed at least two semesters at NCSU, earning a minimum of 24 credit hours
- You must not have already received a BS degree
- You must have an overall GPA # 3.5 and major GPA # 3.25

### Step 2 – Apply for ABM by following the steps below

- Determine your area of interest from the list of graduate specialty areas on the next page.
- Talk to the ABM advisor in the specialty area (provided below), and agree on a tentative ABM Plan of Work (POW) that would suit your interests and satisfy the ABM requirements. A finalized ABM POW must be in place before completion of the BS degree.
- Submit an application at [go.ncsu.edu/ccee-abm](https://go.ncsu.edu/ccee-abm) (<https://applygrad.ncsu.edu/register/?id=4d63529c-6ad8-4680-9655-e4e49554ac56>), which includes the tentative ABM POW.
  - The application will first be reviewed by the ABM advisor and a recommendation will be made to the department. The final determination will be made after a joint review by the directors of

## Graduate Specialty Areas for ABM

Degrees earned will be distributed as: "Master of Civil Engineering" without specialization specifications.

- Computing and Systems
- Construction Engineering
- EWC – Air
- EWC – Environmental Process Engineering
- EWC – Water Resource and Coastal Engineering
- Geotechnical Engineering
- Structural Engineering and Mechanics
- Transportation Materials
- Transportation Systems

## Allowable Courses by Specialty Area COMPUTING SYSTEMS

Code	Title	Hours	Counts towards
CE 536	Introduction to Numerical Methods for Civil Engineers	3	
CE 537	Computer Methods and Applications	3	

CE 538	Information Technology and Modeling	3
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CE 590	Special Topics In Civil Engineering (Civil Engineering Systems)	1-6
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### CONSTRUCTION ENGINEERING

Code	Title	Hours	Counts towards
CE 561	Construction Project Management	3	
CE 562	Lean Construction Concepts and Methods	3	
CE 564	Legal Aspects of Contracting	3	
CE 565	Construction Safety Management	3	
CE 567	Risk and Financial Management in Construction	3	
CE 592	Special Topics in Construction Engineering	1-6	

Other courses may selected and approved in conjunction with the academic committee, examples include but are not subject to:

CE 515	Advanced Strength of Materials		
CE 522	Theory and Design Of Prestressed Concrete		
CE 523	Theory and Behavior Of Steel Structures		
CE 524	Analysis and Design Of Masonry Structures		
CE 548	Engineering Properties Of Soils I		

### EWC – AIR

Code	Title	Hours	Counts towards
CE 576	Engineering Principles Of Air Pollution Control *	3	

CE 578	Energy and Climate *	3
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CE 579	Principles of Air Quality Engineering *	3
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### EWC – ENVIRONMENTAL PROCESS ENGINEERING

Code	Title	Hours	Counts towards
CE 571	Physical Principles of Environmental Engineering	3	
CE 573	Biological Principles of Environmental Engineering	3	
CE 574	Chemical Principles of Environmental Engineering	3	
CE 577	Engineering Principles Of Solid Waste Management *	3	
CE 578	Energy and Climate *	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Global Sanitation) *	1-6	

### EWC – WATER RESOURCES, COASTAL

Code	Title	Hours	Counts towards
CE 581	Fluid Mechanics in Natural Environments	3	
CE 583	Engineering Aspects Of Coastal Processes	3	
CE 584	Hydraulics Of Ground Water	3	
CE 586	Engineering Hydrology	3	
CE 588	Water Resources Engineering *	3	
CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics) *	1-6	



CE 596	Special Topics in Water Resource and Environmental Engineering (Coastal Modeling)	1-6
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CE 596	Special Topics in Water Resource and Environmental Engineering (Surface Water Quality Modeling)	1-6
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## GEOTECHNICAL ENGINEERING

Code	Title	Hours	Counts towards
CE 548	Engineering Properties Of Soils I	3	
CE 584	Hydraulics Of Ground Water	3	
CE 593	Special Topics in Geotechnical Engineering (Dynamics of Soils and Foundations)	1-3	

Other courses may selected and approved in conjunction with the academic committee, examples include but are not subject to:

CE 515	Advanced Strength of Materials		
CE 526	Finite Element Method in Structural Engineering		
CE 577	Engineering Principles Of Solid Waste Management		

## STRUCTURAL ENGINEERING AND MECHANICS

Code	Title	Hours	Counts towards
CE 515	Advanced Strength of Materials	3	
CE 522	Theory and Design Of Prestressed Concrete	3	
CE 523	Theory and Behavior Of Steel Structures	3	

CE 524	Analysis and Design Of Masonry Structures	3
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CE 525	Advanced Structural Analysis	3
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CE 526	Finite Element Method in Structural Engineering	3
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CE 527	Structural Dynamics	3
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CE 528	Structural Design in Wood	3
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CE 529	FRP Strengthening and Repair of Concrete Structures	3
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CE 530	Properties of Concrete and Advanced Cement-Based Composites	3
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## TRANSPORTATION MATERIALS

Code	Title	Hours	Counts towards
CE 515	Advanced Strength of Materials	3	
CE 530	Properties of Concrete and Advanced Cement-Based Composites	3	
CE 548	Engineering Properties Of Soils I	3	
CE 595	Special Topics in Transportation Engineering (A - Asphalt and Bituminous Materials)	1-6	

## TRANSPORTATION SYSTEMS

Code	Title	Hours	Counts towards
CE 501	Transportation Planning *	3	
CE 502	Traffic Operations *	3	
CE 503	Transportation System Design *	3	
CE 504	Airport Planning and Design	3	

CE 505	Railroad System Planning, Design, and Operation	3
CE 509	Highway Safety	3

\* This course is not a prerequisite but recommended to be completed prior to enrollment.

## Full Professors

Sankarasubramanian Arumugam

Morton A. Barlaz

Emily Zechman Berglund

Joseph F. DeCarolis

**Area of Research:** Environmental Engineering & Energy Policy

Francis Lajara De Los Reyes III

Joel Ducoate

Henry C. Frey

Mohammed Awad Gabr

Detlef R. Knappe

Gnanamanikam Mahinthakumar

Margery Frances Overton

Ranji Ranjithan

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## Associate Professors

Douglas F. Call

**Area of Research:** Environmental Engineering & Water Resources

Joel Casey Dietrich

Andrew P. Grieshop

Brina Mortensen Montoya

Daniel R. Obenour

**Area of Research:** Environmental & Coastal Engineering

Benjamin Shane Underwood

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## Assistant Professors

Katherine Anarde

Tarek Aziz

Jorge Emilio San Juan Blanco

Fernando Garcia Menendez

Angela Rose Harris

Jordan Kern

Jacelyn Jaunice Rice-Boayue

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## Practice/Research/Teaching Professors

Florentino Banaag De La Cruz

Meagan Kittle Autry

James William Levis

Gregory W. Lucier

Elizabeth J. Sciaudone

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## Adjunct Faculty

Michael Scott Breen

Anderson Rodrigo de Queiroz

Daniel J. Findley

Alejandra C. Geiger-Ortiz

Aditya Sinha

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## Assistant Research Professor

Tongchuan Wei

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## Emeritus Faculty

Robert C. Borden

Earl Downey Brill Jr.