PhD in Natural Resources with Emphasis in Water Resources

The Water Resources emphasis area is an interdisciplinary graduate degree program encompassing all fields of natural sciences and, through collaboration, involves expertise from throughout the University of Missouri (MU). The geographic location of MU allows directed research to better understand water movement, biogeochemical cycling, biological and hydroecological processes of flowing and impounded waters in forested, prairie, agricultural and urban landscapes of the midcontinent. The Water Resources graduate emphasis area offers a Ph.D. degree program specializing in the occurrence, circulation, distribution, chemical and physical properties, and environmental interaction of atmospheric, surface and subsurface waters. Specific areas of investigation often include (but are not limited to) precipitation floods and drought regimes, lakes and reservoirs, groundwater, water use, water quality, water contamination, plant water use, environmental measurement methods, hydrologic modeling and International water resources.

Participating faculty in the Water Resources emphasis area are engaged in both scientific understanding of water resources (physical, chemical and biological) and its management, and the decision-making processes used to address competing societal values (social, economic and legal). The program has no geographic boundaries but benefits from a distinct midcontinent climate, and physiography. Multi-use watersheds (e.g. forest, agriculture, urban), streams, lakes, rivers, wetlands and subsurface waters are ideal areas for basic and applied research that is easily transferable to other regions. The program provides Global impact by graduating highly qualified internationally aware water resource professionals.

Water Resources program applicants must meet the program requirements of the University of Missouri Graduate School for Ph.D. programs and meet any additional application criteria of the Water Resources graduate emphasis area. Water Resources graduate students are often supported by grant-funded research assistantships, scholarships or fellowships, teaching assistantships, or are self-funded. Other opportunities may be available to eligible students.

Upon successful completion of the School of Natural Resources Water Resources graduate program, students will possess strong technical skills in water resources and related sub-disciplines. Graduates will have developed a holistic understanding of the hydrologic cycle related to ecosystem processes and the interdisciplinary background necessary to understand and address contemporary water resources problems.

**Degree Requirements**

- A minimum of 72 hrs beyond the Baccalaureate degree for the Ph.D.
- A maximum of 30 hours of post baccalaureate graduate credit from an accredited university can be transferred toward the Ph.D. degree program.
- The program must include a minimum of 15 hours of 8000 level course work, exclusive of problems, readings and research.
- Ph.D. students are required to publish at least three articles in the primary literature stemming from their dissertation; at least one prior to graduation (requirements may vary by advisor).

**Must take at least 9 credit hours from the following:**

- **Aquatic Ecosystem Science**
  - F_W 8460 Wetland Ecology 3
  - F_W 8520 Stream Ecology 3
  - F_W 7400 Techniques for Fisheries Management and Conservation 3
  - F_W 7100 Limnology 3-4
  - F_W 8450 Advanced Limnology 3
  - F_W 8550 Advanced Waterfowl Ecology 3

- **Climate and Climatology**
  - ATM_SC 7400 Micrometeorology 3
  - ATM_SC 7520 Environmental Biophysics 3
  - ATM_SC 7590 Radar Meteorology 3
  - ATM_SC 8400 Atmospheric General Circulation 3
  - ATM_SC 8600 Advanced Climate Dynamics 3

- **Environmental Chemistry**
  - ENV_SC 7318 Environmental Soil Chemistry 3
  - ENV_SC 8500 Chemistry of the Vadose Zone 3
  - F_W 7800 Environmental Toxicology 3

- **Hydrologic Science and Water Quality**
  - ATM_SC 7520 Environmental Biophysics 3
  - ATM_SC 7550 Atmospheric Physics 3
  - FORREST 8390 Physical Hydrology 3
  - ENV_SC 7320 Hydrologic and Water Quality Modeling 3
  - ENV_SC 7305 Environmental Soil Physics 3
  - ENV_SC 7306 Environmental Soil Physics Laboratory 2
  - ENV_SC 8400 Solute Transport in the Vadose Zone 3

- **Water Management Technology**
  - NAT_R 8290 Hydrologic Measurement and Synthesis 2
  - ATM_SC 7510 Remote Sensing for Meteorology and Natural Resources 3
  - ATM_SC 7590 Radar Meteorology 3

- **Watershed Science and Management**
  - FOREST 7390 Watershed Management and Water Quality 3
  - FOREST 8620 Plant-Water Relations 3
  - FOREST 8625 Plant-Water Relations Laboratory 2

- **Elective Courses**
  - AG_EC 7356 Environmental Law and Policy 3
  - AG_S_M 7420 Surface Water Management 3
  - AG_S_M 7440 Water Quality and Pollution Control 3
  - AG_S_M 7460 Irrigation and Drainage 3
  - BIOL_EN 8150 Natural Systems for Wastewater Treatment 3
  - BIOL_EN 8250 Water Management Theory 3
  - CV_ENG 7230 Introduction to Water Quality 3
  - CV_ENG 7240 Water Quality Analysis 3
  - CV_ENG 7290 Wastewater Treatment and Process Design 3
  - CV_ENG 7700 Hydraulics of Open Channels 3
  - CV_ENG 7703 Applied Hydrology 3
  - CV_ENG 7710 Soil and Water Conservation Engineering 3
  - CV_ENG 7720 Watershed Modeling Using GIS 3
  - CV_ENG 7792 Analysis of Water-Resource Systems 3
  - CV_ENG 8200 Water Quality Modeling 3
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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tr>
<td>CV_ENG 8210</td>
<td>Groundwater Pollution Evaluation and Modeling</td>
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<td>CV_ENG 8215</td>
<td>Environmental Transport Phenomena</td>
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<td>CV_ENG 8225</td>
<td>Aquatic Chemistry</td>
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<td>CV_ENG 8270</td>
<td>Design of Water and Wastewater Treatment Facilities</td>
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<td>CV_ENG 8280</td>
<td>Engineering Aspects of Water Quality</td>
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<td>CV_ENG 8740</td>
<td>Hydrodynamics</td>
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<td>GEOG 7630</td>
<td>River and Stream Dynamics</td>
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<td>GEOL 7100</td>
<td>Groundwater Hydrology</td>
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<td>GEOL 7110</td>
<td>Karst Hydrology</td>
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<td>GEOL 7130</td>
<td>Groundwater Modeling</td>
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<td>GEOL 7210</td>
<td>Marine Geology</td>
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<tr>
<td>GEOL 7300</td>
<td>Introduction to Low-Temperature Geochemistry</td>
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<td>GEOL 7318</td>
<td>Environmental Soil Chemistry</td>
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<td>GEOL 7400</td>
<td>Geomicrobiology and Microbial Biogeochemistry</td>
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<td>GEOL 7500</td>
<td>Organic Geochemistry</td>
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<td>GEOL 8210</td>
<td>Advanced Aqueous Geochemistry</td>
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<td>GEOL 8230</td>
<td>Groundwater and Subsurface Geomicrobiology</td>
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<td>GEOL 8240</td>
<td>Hydrogeologic Processes</td>
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<td>GEOL 8400</td>
<td>Ancient Greenhouse Climate</td>
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<td>GEOL 8550</td>
<td>Stable Isotope Geochemistry</td>
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<tr>
<td>PLNT_S 7720</td>
<td>Aquatic Entomology</td>
<td>3</td>
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**Qualifying Process**

The qualifying examination determines whether the student's background is adequate to enter the Ph.D. program, as a candidate. It also is intended to ascertain if there are areas of weakness in which a candidate will be required to gain background through appropriate course work. Therefore, it is advisable that the student work with their advisor to select a committee and complete the qualifying exam within the first 2 semesters of matriculation.

**Comprehensive Examination Process**

The comprehensive examination is taken following the completion of most if not all, the course work requirements established by the graduate committee.

The objectives of the comprehensive examination are twofold:

1. To determine if a student has acquired sufficient depth and breadth of knowledge in selected areas of concentration; and
2. To evaluate the candidate's capacity to apply that knowledge in solving applied or theoretical problems.

**Dissertation Requirements**

Every candidate should review the Dissertation & Thesis Guidelines (http://gradschool.missouri.edu/academics/thesis-dissertation/diss-thesis-guideline) from the Graduate School and should consult the Director of Graduate Studies for academic program style requirements.

**Dissertation Defense Seminar**

The DGS must be informed of the dissertation defense seminar at least two weeks in advance of the seminar. It must be well advertised and open to the public.

**Ph.D. Committee Meeting Minimum Requirements**

Ph.D. Students must meet with their committee at least three times during their degree seeking program.

- First Meeting: Present a written research proposal, provide a proposal presentation to the committee and present the D1 and D2 for approval and signing.
- Second Meeting: Comprehensive exam committee meeting.

**Admissions**

**Admission Contact Information**

School of Natural Resources  
Water Resources Emphasis Area  
203-Q Anheuser-Busch Natural Resources Building  
(573) 884-7732  

Dr. Jason A. Hubbard  
203-Q ABNR Building  
(573) 884-7732  
HubbartJ@missouri.edu

Applicants are required to meet two sets of minimum qualifications for admission: the requirements of the PhD in Natural Resources with emphasis in Water Resources (http://gradstudies.missouri.edu/academics/programs/natural-resources/phd-water-resources-emphasis.php) program and the minimum requirements of the Office of Graduate Studies (http://gradstudies.missouri.edu/admissions/eligibility-process/minimum-requirements). Because requirements vary, you must refer to a degree program's graduate admission page to learn about specific admission criteria, application deadlines, eligibility and application process. Your application materials will be reviewed by both the Office of Graduate Studies and the degree program to which you've applied before official admission to the University of Missouri.