

Duluth Campus

Water Resources Science Ph.D.

Swenson College of Science & Engineering

University of Minnesota Duluth

Link to a [list of faculty](#) for this program.

Contact Information:

Water Resources Science, 173 McNeal Hall, 1985 Buford Avenue, St. Paul MN 55108 (612-624-7456; fax: 612-625-1263)

Email: wrs@umn.edu

Website: <http://wrs.umn.edu/degrees-courses/degree-requirements>

- Program Type: Doctorate
- Requirements for this program are current for Fall 2017
- Length of program in credits: 48
- This program does not require summer semesters for timely completion.
- The Water Resource Science Ph.D. is an All-University program delivered on the Twin Cities and Duluth Campuses. The University of Minnesota Twin Cities is the degree granting authority for the Water Resources Science Ph.D. program in Duluth.
- Degree: Doctor of Philosophy

Along with the program-specific requirements listed below, please read the [General Information](#) section of the catalog website for requirements that apply to all major fields.

This cross-campus interdisciplinary program provides comprehensive training in water resources science, with integration across scientific disciplines. A structured interdisciplinary graduate curriculum is offered. The program includes a set of core courses plus electives in the following areas of emphasis at the PhD level: aquatic biology, environmental chemistry, hydrologic science, limnology, water management technology, water policy, water quality, and watershed science and management. Approximately 50 courses offered within 15 other graduate programs are available to students majoring in water resources science.

The goal of the program is to produce scientists with strong technical skills in disciplines relevant to water resources and a broad understanding of 1) the hydrologic cycle and associated ecosystems, 2) the interconnectedness of the sciences involved in managing aquatic resources, and 3) the interplay between the biophysical sciences and social sciences in developing and implementing public policies related to water. Students in the program develop the breadth of scientific knowledge appropriate to understand the complicated aquatic ecosystems and watersheds on which they will work, as well as social dimensions of the topic, including the public policy and legal frameworks in which water resources are protected and managed.

The program involves faculty from the following departments on the Twin Cities campus: Applied Economics; Bioproducts and Biosystems Engineering; Chemistry; Civil Engineering; Earth Sciences; Ecology, Evolution, and Behavior; Entomology; Environmental and Occupational Health; Fisheries, Wildlife, and Conservation Biology; Forest Resources; Horticultural Science; Landscape Architecture; Soil, Water, and Climate; and the Humphrey Institute of Public Affairs. It also involves faculty from the following departments on the Duluth campus: Biology; Chemical Engineering; Chemistry; Civil Engineering; Geological Sciences; Physics; as well as the Large Lakes Observatory and the Natural Resources Research Institute in Duluth.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Prerequisites for Admission

The preferred undergraduate GPA for admittance to the program is 3.00.

The program is flexible enough to accommodate students from a variety of backgrounds. Normally students have a bachelor's or master's degree in physical or biological science or engineering.

Other requirements to be completed before admission:

Recommended academic preparation includes one year (or two semesters) each of calculus, physics, and chemistry, and one biology course at the undergraduate level.

Availability of funding and willingness of a member of the graduate faculty to serve as an adviser are important criteria for admission to the PhD program.

Special Application Requirements:

Applicants must submit three letters of recommendation via the Graduate School ApplyYourself website. These letters should be from

professors qualified to estimate applicant's class rank and evaluate their ability to complete a program of graduate study, or from persons who can assess their professional or research potential.

Applicants must also submit a résumé of their academic history and professional experience and a statement of purpose, including the proposed area of emphasis. Applicants should submit results of the GRE. Students may be admitted any semester but are strongly encouraged to submit their application by December 15 for fall semester admission. More specific application instruction can be found on the program website: wrs.umn.edu/prospectivestudents/apply/index.htm.

Applicants must submit their test score(s) from the following:

- GRE

International applicants must submit score(s) from one of the following tests:

- TOEFL
 - Internet Based - Total Score: 79
 - Internet Based - Writing Score: 21
 - Internet Based - Reading Score: 19
 - Paper Based - Total Score: 550
- IELTS
 - Total Score: 6.5
- MELAB
 - Final score: 80

Key to [test abbreviations](#) (GRE, TOEFL, IELTS, MELAB).

For an online application or for more information about graduate education admissions, see the [General Information](#) section of the catalog website.

Program Requirements

24 credits are required in the major.

0 credits are required outside the major.

24 thesis credits are required.

This program may be completed with a minor.

Use of 4xxx courses toward program requirements is permitted under certain conditions with adviser approval.

A minimum GPA of 3.00 is required for students to remain in good standing.

At least 2 semesters must be completed before filing a Degree Program Form.

Coursework is tailored to student interests, and many areas of emphasis are possible. Core courses are offered on both the Twin Cities and Duluth campuses.

No more than 9 credits at the 4xxx level may apply.

Core Courses (13 cr)

Hydrology

Take 1 or more course(s) from the following:

- [CE 4228](#) - Watershed Engineering (3.0 cr)
- [GEOG 4446](#) - Water Processes and Management (3.0 cr)
- [EES 4201](#) - Watershed Hydrology (3.0 cr)
- [EES 5250](#) - Hydrogeology (4.0 cr)
- [LIM 5101](#) - Physical Limnology (3.0 cr)

Environmental/Water Chemistry

Take 1 or more course(s) from the following:

- [CE 5241](#) - Water Chemistry (3.0 cr)
- [CHEM 5150](#) - Organic and Stable Isotope Biogeochemistry (3.0 cr)
- [LIM 5102](#) - Chemical Limnology (3.0 cr)



Limnology

Take 1 or more course(s) from the following:

- BIOL 5833 - Stream Ecology (3.0 cr)
- BIOL 5861 - Lake Ecology (3.0 cr)
- EES 5103 - Geological Paleolimnology (3.0 cr)
- LIM 5101 - Physical Limnology (3.0 cr)
- LIM 5102 - Chemical Limnology (3.0 cr)
- LIM 5103 - Geological Paleolimnology (3.0 cr)

Water Resources Policy

Take 1 or more course(s) from the following:

- WRS 5101 - Water Policy (3.0 cr)

Ethics

- WRS 8581 - Research and Professional Ethics in Water Resources and Environmental Science (0.5 cr)

Seminar

- WRS 8100 - Interdisciplinary Seminar in Water Resources (0.5 - 3.0 cr)

Electives (11 cr)

Approved electives to fulfill the required 24 course credits.

Take 11 or more credit(s) from the following:

- BIOL 4761 - Ichthyology (3.0 cr)
- BIOL 5777 *{Inactive}*(2.0 cr)
- BIOL 5801 - Microbial Ecology (2.0 cr)
- BIOL 5805 - Fisheries Ecology and Management (3.0 cr)
- BIOL 5808 *{Inactive}*(3.0 cr)
- BIOL 5833 - Stream Ecology (3.0 cr)
- BIOL 5861 - Lake Ecology (3.0 cr)
- BIOL 5863 - Ecosystems Ecology (3.0 cr)
- BIOL 5870 - Wetland Ecology (3.0 cr)
- CE 4213 - Open Channel Hydraulics (3.0 cr)
- CE 4215 - Hydraulic Design (3.0 cr)
- CE 4228 - Watershed Engineering (3.0 cr)
- CE 5216 - Applications in Environmental Modeling (3.0 cr)
- CE 5237 - Water Quality Engineering (3.0 cr)
- CE 5241 - Water Chemistry (3.0 cr)
- CE 5246 - Environmental Remediation Technologies (3.0 cr)
- CHEM 5150 - Organic and Stable Isotope Biogeochemistry (3.0 cr)
- GEOG 4446 - Water Processes and Management (3.0 cr)
- EES 4201 - Watershed Hydrology (3.0 cr)
- EES 5103 - Geological Paleolimnology (3.0 cr)
- EES 5210 - Glacial and Quaternary Geology (4.0 cr)
- EES 5220 *{Inactive}*(3.0 cr)
- EES 5250 - Hydrogeology (4.0 cr)
- EES 5260 - Fluvial Geomorphology (3.0 cr)
- EES 5601 - Introduction to Stream Restoration (3.0 cr)
- EES 8602 - Stream Restoration Practice (2.0 cr)
- LIM 5010 - Integrated Approaches to the Study of Inland Waters (3.0 cr)
- LIM 5011 - Laboratory and Discussion in Integrated Approaches to the Study of Inland Waters (2.0 cr)
- LIM 5012 - Integrated Approaches to the Study of Inland Waters II (3.0 cr)
- LIM 5013 - Laboratory and Discussion in Integrated Approaches to the Study of Inland Waters II (2.0 cr)
- LIM 5101 - Physical Limnology (3.0 cr)
- LIM 5102 - Chemical Limnology (3.0 cr)
- LIM 5103 - Geological Paleolimnology (3.0 cr)
- LIM 5104 *{Inactive}*(2.0 cr)
- LIM 5105 - Research Frontiers and New Directions in Limnology and Environmental Science (1.0 cr)
- PHYS 5541 - Fluid Dynamics (3.0 cr)
- WRS 5050 *{Inactive}*(1.0 - 3.0 cr)

Thesis (24 cr)

Take 24 credits

- WRS 8888 - Thesis Credits: Doctoral (1.0 - 24.0 cr)

Program Sub-plans

A sub-plan is not required for this program.

Students may not complete the program with more than one sub-plan.

Limnology and Oceanography

The science of inland waters, or "limnology," includes the study of streams, lakes, ponds, and wetlands. While Lake Superior falls into this category, the style of research, particularly the nature of sampling and the scale of the processes investigated, makes study of Lake Superior and other Great Lakes more akin to oceanography than to classical limnology. A program that focuses on the study of both limnology and oceanography strengthens understanding of both systems, through comparative studies and by fostering interaction between groups that focus more strongly on one or the other system. Limnology and oceanography are by necessity interdisciplinary fields, with major components contributed by biological, geological, physical, and chemical sciences.

This track within the cross-campus interdisciplinary WRS program provides comprehensive training in limnology and oceanography. As is the case for the WRS graduate program as a whole, the limnology and oceanography program includes a set of core courses plus electives in the subfield of limnology and oceanography.

The goal of the program is to produce scientists with strong technical skills in aquatic science and a broad understanding of limnology and oceanography. Faculty on both Twin Cities and Duluth campuses participate in the limnology and oceanography track.

PhD students pursuing this track must have at least two members of the limnology and oceanography track faculty on their committee including the adviser.

Core Courses (14 cr)

Limnology

- LIM 5010 - Integrated Approaches to the Study of Inland Waters (3.0 cr)
- LIM 5011 - Laboratory and Discussion in Integrated Approaches to the Study of Inland Waters (2.0 cr)
- LIM 5012 - Integrated Approaches to the Study of Inland Waters II (3.0 cr)
- LIM 5013 - Laboratory and Discussion in Integrated Approaches to the Study of Inland Waters II (2.0 cr)

Water Policy

- CE 5201 - Water Policy (3.0 cr)

Ethics

- WRS 8581 - Research and Professional Ethics in Water Resources and Environmental Science (0.5 cr)

Seminar

- WRS 8100 - Interdisciplinary Seminar in Water Resources (0.5 - 3.0 cr)

Electives (10 cr)

Approved electives to fulfill the required 24 course credits.

Take 10 or more credit(s) from the following:

- BIOL 4761 - Ichthyology (3.0 cr)
- BIOL 5777 *(Inactive)* (2.0 cr)
- BIOL 5801 - Microbial Ecology (2.0 cr)
- BIOL 5805 - Fisheries Ecology and Management (3.0 cr)
- BIOL 5808 *(Inactive)* (3.0 cr)
- BIOL 5833 - Stream Ecology (3.0 cr)
- BIOL 5861 - Lake Ecology (3.0 cr)
- BIOL 5863 - Ecosystems Ecology (3.0 cr)
- BIOL 5870 - Wetland Ecology (3.0 cr)
- CE 4213 - Open Channel Hydraulics (3.0 cr)
- CE 4215 - Hydraulic Design (3.0 cr)
- CE 4228 - Watershed Engineering (3.0 cr)
- CE 5216 - Applications in Environmental Modeling (3.0 cr)
- CE 5237 - Water Quality Engineering (3.0 cr)
- CE 5241 - Water Chemistry (3.0 cr)
- CE 5246 - Environmental Remediation Technologies (3.0 cr)
- CHEM 5150 - Organic and Stable Isotope Biogeochemistry (3.0 cr)
- GEOG 4446 - Water Processes and Management (3.0 cr)
- EES 4201 - Watershed Hydrology (3.0 cr)
- EES 5103 - Geological Paleolimnology (3.0 cr)
- EES 5210 - Glacial and Quaternary Geology (4.0 cr)
- EES 5220 *(Inactive)* (3.0 cr)
- EES 5250 - Hydrogeology (4.0 cr)
- EES 5260 - Fluvial Geomorphology (3.0 cr)
- EES 5601 - Introduction to Stream Restoration (3.0 cr)
- EES 8602 - Stream Restoration Practice (2.0 cr)
- LIM 5010 - Integrated Approaches to the Study of Inland Waters (3.0 cr)
- LIM 5011 - Laboratory and Discussion in Integrated Approaches to the Study of Inland Waters (2.0 cr)
- LIM 5012 - Integrated Approaches to the Study of Inland Waters II (3.0 cr)
- LIM 5013 - Laboratory and Discussion in Integrated Approaches to the Study of Inland Waters II (2.0 cr)
- LIM 5101 - Physical Limnology (3.0 cr)
- LIM 5102 - Chemical Limnology (3.0 cr)



- LIM 5103 - Geological Paleolimnology (3.0 cr)
- LIM 5104 *{Inactive}*(2.0 cr)
- LIM 5105 - Research Frontiers and New Directions in Limnology and Environmental Science (1.0 cr)
- PHYS 5541 - Fluid Dynamics (3.0 cr)
- WRS 5050 *{Inactive}*(1.0 - 3.0 cr)