The University of Minnesota shall provide equal access to and opportunity in its programs, facilities, and employment without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression.

Inquiries regarding compliance may be directed to the Director, Office of Equal Opportunity and Affirmative Action, University of Minnesota, 274 McNamara Alumni Center, 200 Oak Street S.E., Minneapolis, MN 55455, (612) 624-9547, eoaa@umn.edu. Website at: diversity.umn.edu/eoaa.

This publication/material is available in alternative formats upon request. Please contact the WRS office at 612-624-7456 or wrs@umn.edu.
Welcome to the Water Resources Science Program

Information in this handbook applies to all students admitted for study in the Water Resources Science Program. This manual supplements information provided online. Additional useful information can be found in the online University of Minnesota Graduate School Catalog (http://www.catalogs.umn.edu/grad/index.html) and the Graduate Assistants Employment website (http://www1.umn.edu/ohr/gae/). The Graduate Assistant Employment office also offers information, help, and troubleshooting for matters pertaining to research and teaching assistants. You should be familiar with these sources of information and use this manual for subjects specific to Water Resources Science.

During your residence in our program, you should remain in contact with the Program Office about all of their deadlines. In addition, the Graduate School should be consulted regarding such matters as transfer of credits, tuition, fees, residency requirements, thesis credit requirements, and taxes on assistantships.

This handbook was updated June 2015.

The information in this handbook and other University catalogs, publications, or announcements is subject to change without notice. University offices can provide current information about possible changes.
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WRS Administration

WRS Program Office
The Water Resources Science (WRS) Graduate Program office in the Twin Cities is located on the St. Paul campus, within the University of Minnesota’s Water Resources Center, 193 McNeal Hall, 1985 Buford Avenue. Office hours are 8:00am-4:30pm. The program administrators are:

John Nieber
Co-Director of Graduate Studies (Twin Cities)
173 McNeal Hall
1985 Buford Avenue
U of MN, St Paul, MN 55108
Phone: (612) 625-6724
E-mail: nieber@umn.edu

Randall Hicks
Co-Director of Graduate Studies (Duluth)
207 SSB
1035 Kirby Drive
U of MN, Duluth, MN 55812
Phone: (218) 726-8438
E-mail: rhicks@d.umn.edu

Ali Frank-Quick
Graduate Program Coordinator
173 McNeal Hall
1985 Buford Avenue
St Paul, MN 55108
Phone: (612) 624-7456
E-mail: wrs@umn.edu

The WRS program office is located on the St Paul campus (see address above).

Co-Directors of Graduate Studies
The Graduate School recognizes two Co-Directors of Graduate Studies (DGS) and requires that all forms be signed by either the Twin Cities co-DGS (John Nieber) or the Duluth co-DGS (Randall Hicks). Please contact the DGS on your campus with questions about the program, or for signatures on Graduate School documents. Since the WRS program is administered out of the Twin Cities, all official documentation should be routed through the program office in St Paul. The co-DGS’s will also oversee ethics requirements, course availability, and seminars and other WRS activities on their campus.
Student Records
Records for all WRS students are maintained in the WRS office on the St. Paul campus. All of the forms (electronic and paper) used for degree progress are available on the Graduate School website link, “Forms for Current Students” (http://www.grad.umn.edu/current-students/forms). These include:

Masters Students
- Graduate Degree Plan Form (GDP)
- Petition Form
- Time Extension Request Form
- Assign Examination Committee
- Thesis Reviewers Report (Plan A only – part of Graduation Packet)
- Thesis Formatting and Submission Instructions (Plan A only)

Doctoral Students
- Graduate Degree Plan Form (GDP)
- Petition Form
- Time Extension Request Form
- Assign Preliminary and Final Exam Committees
- Thesis Formatting and Submission Instructions
- Preliminary and Final Oral Exam Scheduling

If you have questions about these forms, please contact the WRS office.

WRS Administrative Committees
Two primary committees administer the Water Resources Science program. These are appointed by the Twin Cities and Duluth DGS’s.

1) Executive Committee: Randall Hicks, chair
   The Executive committee sets policy, determines the direction of the program, and approves updates and changes to the WRS curriculum.

2) Admissions and Recruitment Committee: John Nieber, chair
   The Admissions and Recruitment committee reviews student applications, determines fellowship recipients, and develops recruitment plans.

The Executive committee includes graduate student representatives from both campuses. In addition, the program has a Twin Cities seminar committee, co-chaired by John Nieber and David Mulla.
**Grievance Policy**
Any grievance arising during graduate study should be resolved through consultation with your adviser or the Students’ Advisory Committee. Should a matter not be resolved at this point, or should the issue be inappropriate for discussion with your adviser, you should consult with the DGS. For employment and departmental issues, consulting the head of the department in which you are housed may be more appropriate. If the DGS or department head is not able to resolve the grievance, they may direct you to the Student Conflict Resolution Center (http://www.sos.umn.edu/).

**Council of Graduate Students**
The Council of Graduate Students (COGS) is the official governing body representing graduate students at the University. They provide opportunities for graduate students to participate in University administrative and policy decisions. Graduate students in each degree-granting program are entitled to one representative to serve on COGS, the University Senate, and many College of Liberal Arts and University-wide committees. In addition, COGS provides ombudsman services for graduate students and disseminates information, primarily through the Gradletter and through their general meetings held several times per semester. COGS also publishes two valuable guides: The Graduate Student Survival Guide, and Staying on Course: Mutual Roles and Responsibilities in the Graduate School Experience. They are available at: http://www.cogs.umn.edu/publications.html. Information on University governance and grievance procedures is available from the COGS office. The COGS office is located at: 303 Johnston Hall, 101 Pleasant Street SE, Minneapolis, MN 55455, 612-626-1612, cogs@umn.edu.

**Safety and Training Requirements**
Safety requirements, training, and rights and responsibilities for a safe workplace should be covered by your adviser or home department. Be advised that the University requires training for laboratory safety and hazardous waste, research involving human and animal subjects, and other topics. Check with your adviser or department for further details.
Activities

Graduate Program Seminar Series (WRS 8100)

Twin Cities
The WRS program in the Twin Cities organizes seminars throughout the academic year. Seminars are generally offered once a week on the St. Paul Campus. Speakers come from a variety of backgrounds and present information on water-related subjects. A Seminar Committee consisting of faculty and students selected by the Water Resources Students in Action (WRSIA) plans seminars and invites speakers. All WRS graduate students are expected to attend the seminars, unless they have course or work-related conflicts, and all Ph.D. students are expected to participate in the series by giving at least one seminar during their tenure.

All incoming students are required during their first semester to enroll in WRS 8100 (0.5 credit) and to attend all seminars that semester. In other semesters, students may enroll for 1 credit of WRS 8100. If enrolling for credit, attendance at all seminars and additional work will be required. Consult the Chair of the Seminar committee for further information. The calendar for Twin Cities Seminars is available on the seminar web page: [http://wrs.umn.edu/seminar/tc-seminar](http://wrs.umn.edu/seminar/tc-seminar).

Duluth
The WRS program in Duluth organizes seminars every fall semester. Speakers come from a variety of backgrounds and present information on water-related subjects. The WRS co-Director of Graduate Studies (DGS), Randall Hicks, plans the seminars and invites speakers. All WRS graduate students are expected to attend the seminars, unless they have course or work-related conflicts, and all Ph.D. students are expected to participate in the series by giving at least one seminar during their tenure.

All incoming students are required during their first semester to enroll in WRS 8100 (0.5 credit) and to attend all seminars that semester. In other semesters, students may enroll for 1 credit WRS 8100. If enrolling for credit, attendance at all seminars and additional work will be required. Consult the Duluth co-DGS for further information. The calendar for Duluth Seminars is available on the seminar web page: [http://wrs.umn.edu/seminar/duluth-seminar](http://wrs.umn.edu/seminar/duluth-seminar).

Water Resources Students in Action
Water Resources Students in Action (WRSIA) is a student group in the Twin Cities, started by graduate students in the Water Resources Science program. The group was created as a means for graduate students from all disciplines interested in water-related issues to extend their education outside of the classroom. WRSIA meets regularly and provides a formal network within which you can share ideas and experiences with your peers. Some of the group’s activities include seminars, field trips, outreach and campus events, community service projects, and social gatherings. At the beginning of each semester, WRSIA invites new students to join and take an active role in its activities. Visit the WRSIA web page for more information: [http://wrs.umn.edu/wrs-students/wrsia](http://wrs.umn.edu/wrs-students/wrsia).

The Duluth campus is still in the process of officially establishing a WRSIA chapter. More information regarding this group will be posted to the website as it becomes available. Interested students should contact the co-DGS, Randall Hicks, for more information.
Facilities

Research Facilities
You may pursue graduate work in WRS on the Twin Cities campus (Minneapolis and St. Paul) or the Duluth campus or, under special circumstances, at both campuses.

Several research facilities are potentially available to you as a WRS student, such as the Limnological Research Center and Core Laboratory in Minneapolis; the Large Lakes Observatory in Duluth, which includes an 87-foot research vessel on Lake Superior; the St. Anthony Falls Laboratory in Minneapolis; and the Natural Resources Research Institute (NRRI) in Duluth. Arrangements to use these facilities may be facilitated by your adviser and by approaching staff directly.

Desk Space
Full-time graduate students usually are assigned desk and research space in the parent departments of their advisers. Twin Cities students without assigned desk space should contact the Water Resources Center in McNeal Hall to see if they have available space for a student.

Keys
As a full-time graduate student, you may be assigned keys to your office and to the building in which the office is located. The department that controls your office space will issue the keys, and may require you to sign a form or pay a deposit.

Computer Facilities
Computer facilities vary according to departments. The WRS Program does not maintain student computer facilities but views this as the responsibility of the faculty advisers. The CFANS Office of Information Technology in the Twin Cities allows students to check out Dell laptops with ArcGIS and other software for up to one week at no charge. See the website for more details and pickup locations: http://oit.cfans.umn.edu/student-resources/laptop-checkout. Both the Twin Cities and Duluth campuses also have student computer labs. Computer resources for the Twin Cities can be located at this site: http://it.umn.edu/computer-labs-learning-spaces-testing and campus resources for Duluth can be found here: http://www.d.umn.edu/itss/labs/.

E-Mail
All University faculty, staff, and registered students receive an e-mail account, internet access, and 20 MB of server space. You may access your account through the University’s website or through one of the many communications kiosks on campus. A student e-mail address will automatically be assigned to you when you register. To activate your account, visit http://www.umn.edu/initiate/. The site requires you to enter your social security number, your birth date, and your student ID number. The site also describes how to change your password and customize your account. Another useful site for Internet access information is the Academic Computing and Distribution Services site: http://www.oit.umn.edu/accounts/.

E-mail is widely used for individual, program, University, and professional communications, including financial transactions. For this reason, you must access your University account regularly. Many WRS program updates are sent via e-mail. The WRS uses a listserv to notify students of seminars, job opportunities, student group meetings, and other items of interest. Additionally, many job postings, calls for papers for conferences around the country, and other nationwide professional messages are distributed via e-mail.

If you decide to forward your University mail to another provider, be aware that other providers may not allow large attachments. Remember, your University email is your official address for University
correspondence. Check your email frequently.

All UMN-Twin Cities student and staff email addresses are available online in the Student-Staff Directory at: http://onestop.umn.edu/, and most staff and students on the Duluth campus are searchable through http://www.d.umn.edu.

WRS Website
The WRS Program website at http://wrs.umn.edu/ has a wealth of information about the program, including pages for current faculty and students, degree and course descriptions, and information about graduates (alumni) of the program. The alumni page is useful to students looking for career and employment information.

Mail
Campus mail is another method of communication with students. Graduate students receive both campus and U.S. mail in the building where they have their office. Check with your adviser about your mailbox arrangements. Boxes for outgoing campus mail and U.S. mail are located in most department offices. Be sure to regularly check your campus mail.

Telephones
Most graduate student offices have telephones or telephone access. Your adviser will provide details. The Student-Staff Directory, available at http://onestop.umn.edu/ (or http://www.d.umn.edu for Duluth) lists phone numbers, addresses, and e-mail addresses for University staff, students, colleges, departments, and services.

Conference Room
A conference room in the Water Resources Center (WRC) is available for WRS activities. It can be reserved for meetings and other appropriate gatherings. Reservations must be made through the WRS program office. Many students with assistantships in other departments will also have access to departmental conference rooms.

Fax Machine
A fax machine is available in the Water Resources Center. To use the fax machine, please ask for assistance. You also may have access to a fax machine in your home department.

Copying Facilities
Copying privileges are assigned at the discretion of your adviser in the building where your office is located. Copying accounts are usually related to faculty research projects.
Program Information

Program Goals
The Water Resources Science (WRS) graduate program is committed to the education goals of:

- producing scientists with strong technical skills,
- developing a holistic understanding of the hydrologic cycle and associated ecosystems, and
- generating an understanding of the interplay between the bio-physical sciences and the 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 draws on numerous water-related courses from departments on the Saint Paul, Minneapolis, and Duluth campuses and is administered by the University of Minnesota’s Water Resources Center.

Registration
Registration is completed online at http://onestop.umn.edu (Twin Cities) or http://www.d.umn.edu/onestop/registration/ (Duluth). You must supply the Graduate School with an official final transcript from your undergraduate college before you will be allowed to register.

You should meet with your faculty adviser to discuss your schedule for your first semester. If you do not have a permanent adviser yet, the DGS on your campus will serve that role until one is assigned. If difficulties arise, consult your adviser or the WRS office.

If you are taking six or more credits (three or more in summer) and are a degree-seeking student, you are required to have hospitalization insurance. The University-sponsored hospitalization insurance will automatically be charged to your student account unless you provide the name of your insurance company and policy number. You will need your insurance information at the time of registration. To find out more information about available student health insurance plans, visit: http://www.shb.umn.edu/student-health-benefit-plan.htm.

Graduate School registration policy requires all students to register every fall and spring term to maintain active status.

For students who have completed all coursework and thesis credit requirements and do not have to be registered to meet any other internal/external agency registration requirement (e.g., students who do not hold RA or TA positions with the University), the Graduate School offers Grad 0999 – a zero-credit, zero-tuition non-graded registration mechanism. There is a four semester limit for graduate enrollment in Grad 0999. For more information, visit: http://www.cfans.umn.edu/sites/cfans.umn.edu/files/Grad%20999%20and%20Time%20Limits.pdf.

Students who have completed all coursework and thesis credit requirements and must maintain active status and full-time status (e.g., students who hold RA or TA positions or international students who need to maintain their visas), should see the Full Time Status with One Credit section on page 16.

Degree Options
Both M.S. and Ph.D. degrees are available through the WRS program. WRS students may also follow the
Limnology and Oceanography Track. Graduate students seeking a M.S. degree in WRS may choose from two plans:

- Plan A, which requires a thesis. Students with funded research projects typically complete a Plan A thesis, or
- Plan B, which requires additional coursework and a major project rather than a thesis. Plan B programs are best suited for students without funded research projects.

Degree requirements are determined by the WRS graduate faculty and the Graduate School.

**WRS Minor**

M.S. minor students must complete:

- 9 credits total, including:
  - WRS 5101 (3 credits), and
  - Two other courses from the WRS program’s core courses.

Ph.D. minor students must complete:

- 12 credits total, including:
  - WRS 5101 (3 credits),
  - One course from the WRS program’s core courses, and
  - Two electives within one area of emphasis.

**Coursework**

Course work must include credits in your chosen major field (WRS), and courses in either a minor field or another related area. Declaring a minor requires the approval of your faculty adviser and the DGS of the program administering the minor. Both must approve the courses selected to satisfy the minor. The supporting program arrangement is more flexible in that you may choose courses outside the WRS major in consultation with your adviser to build a related field/supporting program.

**Transferring Credits**

The Graduate School limits transfer credits to 40% of total course credits (up to 12) in Master’s programs, and transfer credits require approval from the DGS and Graduate School. For the Doctoral program, there are restrictions on transfer credits from non-degree graduate credit coursework. However, credits may be transferred from other graduate programs at recognized institutions or from a M.S. program at the University of Minnesota. The transfer of such credits requires the approval of the adviser and the DGS. The transfer of credits is completed by including the courses on your Graduate Degree Plan (GDP). For further details see the Graduate School website and/or the GDP instructions. Credits appearing on your undergraduate transcript cannot be transferred into the graduate program, even if those credits were taken in excess of the B.S. degree requirements.

**Graduate Faculty**

The WRS graduate faculty members are listed on the WRS website. All faculty members may serve on student committees as a representative of WRS (the major), and most may serve as advisers of WRS students. Almost all WRS faculty members also are members of other graduate programs and in that role could serve as a related field/supporting program or minor member of an examining committee; however, one person can only represent one program in a given committee. Advisers (and co-advisers) must represent WRS. Faculty who are not on the WRS graduate faculty cannot advise or co-advise WRS graduate students and cannot represent WRS on examining committees. Faculty may be nominated for membership in the WRS program, subject to approval by the voting WRS graduate faculty. A complete and up-to-date list of all University of Minnesota graduate faculty is available on the WRS website.
Selecting an Adviser
Most incoming M.S. Plan A students and all Ph.D. students will have an adviser and project funding.

Graduate students have a much closer working relationship with their advisers than undergraduate students. Regularly scheduled meetings to discuss your program and progress are recommended, and all students must complete an annual review with their adviser during the spring semester. Most students meet with their advisers weekly or bi-weekly, especially if they receive support as research assistants.

Situations occasionally arise in which a change of adviser is appropriate and desirable. You may find that your research interests match more closely with another faculty member, or personality conflicts may arise. You should not feel locked into your initial choice. At the same time, you should recognize that changing advisers is a major decision that should not be taken lightly, especially if you have been in the program for several semesters. In some cases, your adviser may have invested substantial time and research support into your development. Before requesting a change, you must consider whether another faculty member is available to supervise your thesis and whether assistantship funds will be available. Except in rare circumstances, you should discuss the proposed change with your adviser. If that is not possible, you should meet with your DGS for advice and approval. When a change has been approved, you should write to your former adviser, your new adviser, the DGS, and the WRS program office to notify them of the change. The Graduate Program Coordinator in the WRS program office will complete the necessary online form to make the change.

Student Advisory Committee
The WRS Executive Committee requires all students to establish and meet with a student advisory committee (SAC) before the end of their first year (recommended at the end of the first semester) and once per year thereafter. The SAC should meet before the Graduate Degree Plan Form is filed. The SAC is an informal committee consisting, at minimum, of the student’s adviser(s) plus one additional WRS faculty member. Additional members, including a representative of the minor or related field/supporting program, may be included. Generally, the SAC will become the examining (supervisory) committee, but the main role of the SAC is to provide early guidance in course selection, degree program development, and research direction. Thus, students should establish a SAC early even if they anticipate assembling a different examining committee. Once an examining committee is established, they should perform the role of the SAC.

Ethics Requirement
All graduate students in the WRS program must complete an ethics requirement to graduate; this is mandated by the Graduate School. Both M.S and Ph.D. students are expected to attend an ethics class.

The ethics requirement is fulfilled by a half semester (0.5 cr) ethics course (WRS 8581 Research and Professional Ethics in Water Resources and Environmental Science). Students must register for the course, which will generally be offered during spring in the Twin Cities. The course is often offered in Duluth under the same course designator (or alternatively, students may take a 1 credit ethics seminar offered in Duluth by other graduate programs). You must register at least once for this course in order to graduate.

Student Evaluations
The Graduate School requires annual evaluations of all graduate students. Students will complete the electronic WRS Annual Student Review form, which provides a brief self-evaluation and report of accomplishments, and discuss this form with their adviser(s).

- After submitting the review form online, your adviser(s) will review the form and provide a brief summary assessment either on the form or in a separate e-mail to the DGS.
• The information you provide will allow us to assess support of students and also enable us to highlight your accomplishments in graduate school reports and in other efforts to promote the program. These evaluations should also serve to provide feedback on milestones and help ensure timely completion of your degree.
• Failure to complete the annual review will result in a hold on your registration.
• You should be sure to keep a copy of your annual review, as it will facilitate completing the form for the next year and may also be useful in resume and job application assembly.

**Travel Grants**
The WRS graduate program can provide travel grants in any amount up to $1000, to help defray expenses for WRS students to attend regional, national, or international meetings. These grants are reserved for full-time students presenting papers or posters at these meetings. Applications for funding must be received prior to attending your conference or meeting, and can be submitted prior to your abstract being approved. Should your abstract be denied after submission, please contact the WRS program office to withdraw your application for funding.

Students are required to match the amount requested with other sources of funding such as departmental or research project funds. Requests for funding are reviewed three times each year, with deadlines for application on February 1st, June 1st, and October 1st. The co-DGS’s will assess each request and notify you of the funding decision within 2 weeks. No more than $1000 will be provided to a student in any fiscal year. For more information, or to submit a Travel Grant application, visit: [http://wrs.umn.edu/admissions/funding-opportunities](http://wrs.umn.edu/admissions/funding-opportunities).

**Graduate Degree Plan Form (GDP)**
The GDP documents your coursework and other details of your graduate program. It is the coursework contract between you and the University.
• M.S. candidates must submit a GDP to the WRS office before the end of the second semester, or after completion of 15 credits, whichever comes first.
• Ph.D. students need to submit a GDP during the third semester of study.
• The Graduate Degree Plan Form is available online at: [http://policy.umn.edu/forms/otr/otr198.pdf](http://policy.umn.edu/forms/otr/otr198.pdf). You should fill out the form as completely as possible in consultation with your adviser, who must approve and sign it.

On the Graduate Degree Plan form:
• Include the academic term, course number and title, number of credits, and grade (if known) for each course. Also check whether the course is considered a major program or ‘other’ course in your related field/supporting program or minor.
• Be sure to include WRS core courses, water quality electives, electives in your area of emphasis, and other courses taken in minor fields, supporting programs, or related fields. Calculate the total number of major and ‘other’ credits at the bottom of the page.
• Courses taken for graduate credit elsewhere that are to be officially transferred should be listed on the first page of the GDP. Indicate the school where the courses were taken and attach a copy of appropriate transcripts.
• Do not list any courses you took as an undergraduate. If you wish to fulfill core course requirements with undergraduate courses, discuss this with the DGS. These courses taken as an undergraduate may fulfill a WRS core requirement, however, you will still need to take enough WRS elective courses to meet the degree credit requirements.
• Indicate any required thesis credits (10 credits of WRS 8777 for an M.S. Plan A and 24 credits of WRS 8888 for a Ph.D.) on the first page, rather than listing these in the coursework section.
The DGS reviews all degree plans to ensure compliance with Graduate School and program requirements, and to provide a quality control check for the program. Duluth students can have their plan previewed by the co-DGS. It is not unusual for the DGS to contact you or your adviser for clarification of information on the Graduate Degree Plan form. The DGS may make technical corrections to the plan without consulting the student. After the form is reviewed and approved by the DGS, a copy is retained for your file, and the form is transmitted to the Graduate School. Once students receive the approved plan from the Graduate School, they should supply a copy to their adviser. After approval by the Graduate School, the form becomes your official program, and all items listed must be fulfilled before your degree will be awarded. However, your GDP may be revised by submitting a petition, if your proposed change is considered desirable. Petition forms may be found online at: http://policy.umn.edu/forms/otr/otr190.pdf.

- Changes to the Graduate Degree Plan are currently being reviewed by the Graduate School, and it is possible that there could be a transition to an entirely online submission process within the next year. If this occurs within the 2015-16 academic year, you will receive an email notification from the WRS program office to alert you to this change.

Master’s Final (Examining) Committee

The Master’s final committee, which serves as the examining committee for the final oral exam, is established by an online process at: http://www.grad.umn.edu/current-students-graduate-student-services-progress-masters/assignmasterscommittee. Final committees are established formally by the CFANS Dean’s Office upon recommendation by the DGS. You and your adviser suggest committee members to the DGS based on the topic of research for your thesis.

- A GDP must be approved and on file before the M.S. final committee can be requested using the online process.
- Examining committees for master’s degrees must have at least three members: two from your major field, including your adviser(s), and one representing your supporting program or minor.
- Committee members must be members of the appropriate graduate faculty of the University. Prior to submitting names to the DGS, you must visit the faculty you would like to have serve on your committee. Most students have taken a course from each of their committee members, but there is no requirement that you do so.

Doctoral Preliminary Oral (Examining) Committee

The Doctoral preliminary oral exam committee is submitted online at: http://www.grad.umn.edu/current-students-graduate-student-services-progress-doctoral/assign-prelim-committee, after the GDP is approved.

- This committee serves as the examining committee for the preliminary oral exam and usually, but not necessarily, the final oral exam (dissertation defense).
- A separate but related committee is formed for the Ph.D. written preliminary exam (see pg. 29 for more information about the preliminary written exam).
- The WRS program requires that Ph.D. preliminary and final oral exam committees have at least five members: three members from your major field (one outside of your immediate research area) and two from your supporting program or minor.
  - Supporting program or minor members may have graduate appointments in WRS, but must also have an appointment in the minor or supporting program; they should clearly represent an area of expertise beyond WRS and your major area of emphasis. Ph.D. committees are chosen in the same way as Master’s committees (see above).
- The student’s adviser is generally chair of the preliminary oral exam committee.

Doctoral Final Oral (Examining) Committee

The Doctoral final oral (defense) exam committee will be established after you successfully complete
your program requirements and preliminary exams.

- Doctoral Final Committees can be assigned here: http://www.grad.umn.edu/current-students-graduate-student-services-progress-doctoral/assign-doc-final-committee, and must be completed at least one month before your proposed exam date.
- For the final oral exam, the adviser (or co-adviser) cannot serve as the committee chair.
- Your committee must sign a Reviewer’s Report (included in the downloadable graduation packet), and this must be submitted to the Graduate School prior to your defense.

**Full-Time Status with One Credit**
The Office of the Registrar and the Graduate School have developed procedures that permit eligible Advanced Master’s and Doctoral candidates to be certified as “full-time” students when registered for only one credit. Master’s students register for WRS 8333 and doctoral students for WRS 8444. Faculty advisers and the DGS on your campus will affirm that each student is working full time on the thesis or dissertation. These courses are intended only for advanced master’s and doctoral students who have completed all their program coursework and required thesis credits, but are still working full-time on the research or writing of their thesis or dissertation. Master’s students who plan to register for WRS 8333 need to apply for advanced status well in advance of the term they plan to register. More information on this procedure is available at the Graduate School website: http://policy.umn.edu/forms/otr/otr194.pdf.

**Graduation**
You must be a student with active status to graduate. You can maintain active status by registering each fall and spring semester. Graduation procedures are available on the Graduate School website: http://www.grad.umn.edu/current-students/gssp (select your degree level). Follow these instructions carefully; everything must be completed, including payment of copyright and abstract fees, before you can graduate. As indicated in the following M.S. and Ph.D. sections, you should notify the WRS office at least two weeks in advance of your defense with the time, location, and title of your defense presentation; you should also provide an abstract.

**Time Limit for Degree Completion**
Master’s degree candidates must complete all graduate work within five years of enrollment, and doctoral candidates must finish all requirements within eight years of initial enrollment. Petitions for a one-year time extension may be submitted to the Graduate School (via the program office). No more than two, one-year petitions will be considered.

**Exit Interview**
You will also be asked to submit your updated employment and contact information to the WRS program office. This will be used to maintain our alumni web page.

**Thesis Copies**
Follow Graduate School requirements for electronic submission, found at: http://www.grad.umn.edu/students/ThesisSubmission/index.html.
Ph.D. and M.S. students also must submit an electronic copy of their dissertation, thesis, or Plan B project to the WRS program office.
Master of Science (M.S.)

The Master of Science (M.S.) in Water Resources Science consists of:

- Four required core courses (hydrology, environmental chemistry, limnology, and water policy),
- One elective in the area of water quality,
- Two or more WRS elective courses in an area of emphasis,
- At least 6 semester credits from a minor outside WRS or in a related field (minor not required),
- Registration for the WRS 8100 seminar during the first semester in residence,
- Research and Professional Ethics in Water Resources and Environmental Science (WRS 8581),
- A Plan A thesis or Plan B paper (Plan A students will complete 10 additional research credits).
  - For more information about these requirements, see page 26.

This section explains your options for each course requirement. **Students in Duluth should check with the co-DGS in Duluth for minor variations on program requirements.** The guidelines for how to satisfy the Graduate School requirement for training in professional ethics and responsible conduct of research are covered in the previous ‘Program Information’ section. Generally, WRS 8581- Research and Professional Ethics in Water Resources and Environmental Science (0.5 credit) should be used to fulfill this requirement. Read more about the M.S. degree on the Graduate School website: [http://www.grad.umn.edu/current-students-graduate-student-services-progress/masters](http://www.grad.umn.edu/current-students-graduate-student-services-progress/masters).

**Please note that the course offerings listed below do not include courses now considered to be inactive. If you have taken a course which you believe should be recognized as a part of the WRS curriculum, please verify this with the WRS program office.**

**Core courses**

Course work is required in four core areas of water resources science: 1) hydrology (surface and/or hydrogeology); 2) environmental/water chemistry; 3) limnology; and 4) water resources policy, economics, and management. A list of approved core courses on the Twin Cities and Duluth campuses are shown below. A course can fulfill only one core or elective requirement (no double counting). If you want to take a course for which you lack a prerequisite, consult with your adviser, the DGS’s, or the instructor to determine if you may register.

<table>
<thead>
<tr>
<th>Core Courses- Hydrology</th>
<th>TWIN CITIES CAMPUS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Number</strong></td>
<td><strong>Title &amp; Credits</strong></td>
</tr>
<tr>
<td>BBE 8513*</td>
<td>Hydrologic Modeling of Small Watersheds (3 crd)</td>
</tr>
<tr>
<td>CE 4501</td>
<td>Hydrologic Design (4 crd)</td>
</tr>
<tr>
<td>ESCI 4702</td>
<td>General Hydrogeology (3 crd)</td>
</tr>
<tr>
<td>FR 5114*</td>
<td>Hydrology and Watershed Management (3 crd)</td>
</tr>
<tr>
<td>FR 5153</td>
<td>Forest and Wetland Hydrology (3 crd)</td>
</tr>
<tr>
<td>GEOG 5446</td>
<td>Water Processes and Management (3 crd)</td>
</tr>
<tr>
<td>GEOL 4240</td>
<td>Physical Hydrogeology (4 crd)</td>
</tr>
<tr>
<td>GEOL 4250</td>
<td>Environmental Hydrogeology (4 crd)</td>
</tr>
<tr>
<td>LIM 5101*</td>
<td>Physical Limnology (3 crd)</td>
</tr>
</tbody>
</table>

*Core Course Options for the Limnology & Oceanography Track.

Courses scheduled for future semesters are subject to change.*
### Core Courses- Environmental Chemistry

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title &amp; Credits</th>
<th>Typically Offered</th>
<th>Recently Scheduled</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 5541*</td>
<td>Environmental Water Chemistry (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2014</td>
</tr>
<tr>
<td>ESCI 4401*</td>
<td>Aqueous Environmental Geochemistry (3 crd)</td>
<td>Odd Years (Sp)</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>LAAS 5311*</td>
<td>Soil Chemistry and Mineralogy (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>PUBH 6190*</td>
<td>Environmental Chemistry (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title &amp; Credits</th>
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<th>Recently Scheduled</th>
</tr>
</thead>
<tbody>
<tr>
<td>DULUTH CAMPUS</td>
<td>GEOL 4710* Aqueous Geochemistry/ Chemical Hydrogeology (4 crd)</td>
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<td>Fall 2014</td>
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<tr>
<td></td>
<td>LIM 5102* Chemical Limnology (3 crd)</td>
<td>Odd Years (F)</td>
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### Core Courses- Limnology

<table>
<thead>
<tr>
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<th>Title &amp; Credits</th>
<th>Typically Offered</th>
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</tr>
</thead>
<tbody>
<tr>
<td>TWIN CITIES CAMPUS</td>
<td>EEB 5601* Limnology (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>DULUTH CAMPUS</td>
<td>BIOL 5833* Stream Ecology (3 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2014</td>
</tr>
<tr>
<td></td>
<td>BIOL 5861* Lake Ecology (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2014</td>
</tr>
<tr>
<td></td>
<td>LIM 5101 Physical Limnology (3 crd)</td>
<td>Odd Years (F)</td>
<td>Fall 2015</td>
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<td>LIM 5102 Chemical Limnology (3 crd)</td>
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<td></td>
<td>LIM 5103 Geological Limnology (3 crd)</td>
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### Core Courses- Water Policy

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<th>Title &amp; Credits</th>
<th>Typically Offered</th>
<th>Recently Scheduled</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOTH CAMPUSES</td>
<td>WRS 5101* Water Policy (3 crd)- TC Campus and Duluth via ITV</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
</tr>
</tbody>
</table>

*Core Course Options for the Limnology & Oceanography Track.*

Courses scheduled for future semesters are subject to change.

**Water quality elective**

A minimum of one course is required that deals with some aspect of water quality, not dealing strictly with quantity (e.g., flow/hydrodynamics). Possible courses include water chemistry, aquatic microbiology, water quality modeling; various limnology, ecology, and biology courses on lakes, streams and wetlands; and engineering courses that deal with water quality remediation. A list of such courses is shown below. Plan A students may count their water quality elective as an area of emphasis course. If you are interested in taking a course not on the list, you may (informally) petition the DGS in the Twin Cities or Duluth to have it approved.
### Water Quality Electives

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title &amp; Credits</th>
<th>Typically Offered</th>
<th>Recently Scheduled</th>
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<tbody>
<tr>
<td>BBE 4523/5523</td>
<td>Ecological Engineering Design (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>BBE 5513</td>
<td>Watershed Engineering (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>BBE 5535*</td>
<td>Assessment and Diagnosis of Impaired Waters (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>BIOL 4121*</td>
<td>Microbial Ecology and Applied Microbiology (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>CE 4502</td>
<td>Water and Wastewater Treatment (3 crd)</td>
<td>Every Semester</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>CE 4562</td>
<td>Environmental Remediation Technology (3 crd)</td>
<td>Periodically</td>
<td>Spring 2015</td>
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<tr>
<td>CE 5551</td>
<td>Environmental Microbiology (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2014</td>
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<tr>
<td>CE 8504</td>
<td>Theory of Unit Operations (4 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2015</td>
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<tr>
<td>CE 8505*</td>
<td>Biological Processes (3 crd)</td>
<td>Periodically</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>CE/ESCI 8511*</td>
<td>Mechanics of Sediment Transport (3 crd)</td>
<td>Periodically</td>
<td>Fall 2014</td>
</tr>
<tr>
<td>CE 8542</td>
<td>Chemistry of Organic Pollutants in Environmental Systems (3 crd)</td>
<td>Periodically</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>ENT 5081*</td>
<td>Insects, Aquatic Habitats, and Pollution (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>ESCI 4401*</td>
<td>Aqueous Environmental Geochemistry (3 crd)</td>
<td>Odd Years (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>ESCI 5713</td>
<td>Tracers and Karst Hydrogeology (3 crd)</td>
<td>Periodically</td>
<td>Fall 2012</td>
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<tr>
<td>ESPM 5061*</td>
<td>Water Quality and Natural Resources (3 crd)</td>
<td>Every Semester</td>
<td>Fall 2015</td>
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<tr>
<td>ESPM 5111</td>
<td>Hydrology and Water Quality Field Methods (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>ESPM 5575*</td>
<td>Wetlands (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>ESPM 5703</td>
<td>Agroforestry in Watershed Management (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>FW 8459*</td>
<td>Stream and River Ecology (3 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2012</td>
</tr>
<tr>
<td>FW 8465*</td>
<td>Fish Habitats and Restoration (3 crd)</td>
<td>Odd Years (F)</td>
<td>Fall 2011</td>
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</table>

### DULUTH CAMPUS

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title &amp; Credits</th>
<th>Typically Offered</th>
<th>Recently Scheduled</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 5801*</td>
<td>Microbial Ecology (2 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2014</td>
</tr>
<tr>
<td>BIOL 5833*</td>
<td>Stream Ecology (3 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2014</td>
</tr>
<tr>
<td>BIOL 5861*</td>
<td>Lake Ecology (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2014</td>
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<tr>
<td>BIOL 5868*</td>
<td>Ecotoxicology (3 crd)</td>
<td>Periodically</td>
<td>Spring 2013</td>
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<tr>
<td>BIOL 5870*</td>
<td>Wetland Ecology (3 crd)</td>
<td>Odd Years (F)</td>
<td>Fall 2015</td>
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<tr>
<td>CE 4237/5237</td>
<td>Water Quality Engineering (3 crd)</td>
<td>Periodically (F)</td>
<td>Fall 2015</td>
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<tr>
<td>CE 5216</td>
<td>Environmental Modeling (3 crd)</td>
<td>Periodically (Sp)</td>
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<td>CE 5233</td>
<td>Environmental Sampling/Analysis</td>
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<td>GEOL 4710*</td>
<td>Aqueous Geochemistry/ Chemical Hydrogeology (4 crd)</td>
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<td>Fall 2014</td>
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<tr>
<td>LIM 5004*</td>
<td>Field Limnology (2 crd)</td>
<td>Periodically</td>
<td>Spring 2016</td>
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</tbody>
</table>

*Water Quality Electives for the Limnology & Oceanography Track.

Courses scheduled for future semesters are subject to change.

**WRS electives by area of emphasis**

Two or more elective courses must be completed to provide depth in an area of emphasis. For Plan A students, the water quality elective may also be counted toward the area of emphasis requirement. See the tables below for a complete list of approved courses within each area of emphasis. In general, the two elective courses should be from the same area of emphasis, however, you may “mix and match” if you can demonstrate that your selection represents a coherent body of knowledge. This may be required if there are not enough courses offered in an area of emphasis that you wish to pursue.
If any core course requirements have been waived for you by the DGS, you may need to take additional electives to meet the WRS minimum credit requirements for Plan A (22 credits, plus 10 thesis credits) or Plan B (30 credits). If you are interested in a course that is not yet approved as a WRS elective, you may (informally) petition the DGS in the Twin Cities or Duluth to have it approved. If you lack a prerequisite, consult with your adviser, the DGS’s, or the instructor.

### Aquatic Biology Area of Emphasis

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title &amp; Credits</th>
<th>Typically Offered</th>
<th>Recently Scheduled</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 4121</td>
<td>Microbial Ecology and Applied Microbiology (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>CE 5551</td>
<td>Environmental Microbiology (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2014</td>
</tr>
<tr>
<td>EEB 5601</td>
<td>Limnology (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>ENT 5081</td>
<td>Insects, Aquatic Habitats, and Pollution (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>ENT 5361</td>
<td>Aquatic Insects (4 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>ESPM 5575</td>
<td>Wetlands (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>FW 4136</td>
<td>Ichthyology (4 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>FW 5604W</td>
<td>Fisheries Ecology and Management (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>FW 8459</td>
<td>Stream and River Ecology (3 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2012</td>
</tr>
<tr>
<td>FW 8465</td>
<td>Fish Habitats and Restoration (3 crd)</td>
<td>Odd Years (F)</td>
<td>Fall 2011</td>
</tr>
<tr>
<td>HORT 5071</td>
<td>Ecological Restoration (4 crd)</td>
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### Environmental Chemistry Area of Emphasis

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</tr>
</thead>
<tbody>
<tr>
<td>CE 5541</td>
<td>Environmental Water Chemistry (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2014</td>
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<tr>
<td>CE 5542</td>
<td>Experimental Methods in Environmental Engineering (3 crd)</td>
<td>Periodically (Sp)</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>CE 8542</td>
<td>Chemistry of Organic Pollutants in Environmental Systems (3 crd)</td>
<td>Periodically</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>ESCI 4401</td>
<td>Aqueous Environmental Geochemistry (3 crd)</td>
<td>Odd Years (Sp)</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>ESCI 4402</td>
<td>Biogeochemical Cycles in the Ocean (3 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2014</td>
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<tr>
<td>ESPM 4216</td>
<td>Contaminant Hydrology (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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<td>LAAS 5311</td>
<td>Soil Chemistry and Mineralogy (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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<tr>
<td>PUBH 6190</td>
<td>Environmental Chemistry (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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</table>

Courses scheduled for future semesters are subject to change.
### Hydrology Area of Emphasis (Climatology)

<table>
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</thead>
<tbody>
<tr>
<td>ESPM 5402</td>
<td>Biometeorology (3 crd)</td>
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<td>Climatic Variations (3 crd)</td>
<td>Periodically (F/Sp)</td>
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<td>GEOL 5220</td>
<td>Advances in Paleoclimatology (3 crd)</td>
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### Hydrology Area of Emphasis (Groundwater)

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<tbody>
<tr>
<td>CE 4351</td>
<td>Groundwater Mechanics (3 crd)</td>
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<td>CE 4352</td>
<td>Groundwater Modeling (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2015</td>
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<tr>
<td>ESCI 4702</td>
<td>General Hydrogeology (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>ESCI 5971</td>
<td>Field Hydrogeology (2 crd)</td>
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<td>Summer 2015</td>
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<td>GEOL 4240</td>
<td>Physical Hydrogeology (4 crd)</td>
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<td>GEOL 4250</td>
<td>Environmental Hydrogeology (4 crd)</td>
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### Hydrology Area of Emphasis (Surface Water)

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<th>Typically Offered</th>
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<tr>
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<td>Watershed Engineering (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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<tr>
<td>BBE 8513</td>
<td>Hydrologic Modeling of Small Watersheds (3 crd)</td>
<td>Odd Years (Sp)</td>
<td>Spring 2015</td>
</tr>
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<td>CE 4501</td>
<td>Hydrologic Design (4 crd)</td>
<td>Every Semester</td>
<td>Spring 2015</td>
</tr>
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<td>CE 8506</td>
<td>Stochastic Hydrology (4 crd)</td>
<td>Periodically</td>
<td>Fall 2013</td>
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<td>CE 8507</td>
<td>Advanced Methods in Hydrology (4 crd)</td>
<td>Periodically</td>
<td>Spring 2014</td>
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<tr>
<td>CE 8572</td>
<td>Computational Environmental Fluid Dynamics (4 crd)</td>
<td>Periodically (Sp)</td>
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<td>ESCI/CE/EEB 8601</td>
<td>Introduction to Stream Restoration (3 crd)</td>
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<td>Stream Restoration Practice (2 crd)</td>
<td>Annual (Sum/F)</td>
<td>Summer 2015</td>
</tr>
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<td>ESPM 5111</td>
<td>Hydrology and Water Quality Field Methods (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<td>ESPM/SOIL 5555</td>
<td>Wetland Soils (3 crd)</td>
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<td>Fall 2015</td>
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<td>FNRM 5153</td>
<td>Forest Hydrology and Watershed Biogeochemistry</td>
<td>Annual (Sp)</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>FR 5114</td>
<td>Hydrology and Watershed Management (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2013</td>
</tr>
<tr>
<td>FR 5153</td>
<td>Forest and Wetland Hydrology (3 crd)</td>
<td>Odd Years (Sp)</td>
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<td>SOIL 5232</td>
<td>Vadose Zone Hydrology (3 crd)</td>
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<td>Fall 2015</td>
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<td>GEOG 5446</td>
<td>Water Processes and Management (3 crd)</td>
<td>Periodically (F)</td>
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<td>Glacial and Quaternary Geology (4 crd)</td>
<td>Periodically</td>
<td>Fall 2014</td>
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<tr>
<td>GEOL 5260</td>
<td>Fluvial Geomorphology (4 crd)</td>
<td>Every Years (F)</td>
<td>Fall 2014</td>
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<tr>
<td>GEOL 5601</td>
<td>Introduction to Stream Restoration (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2014</td>
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<tr>
<td>LIM 5101</td>
<td>Physical Limnology (3 crd)</td>
<td>Odd Years (F)</td>
<td>Fall 2015</td>
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Courses scheduled for future semesters are subject to change.
# Limnology Area of Emphasis *

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title &amp; Credits</th>
<th>Typically Offered</th>
<th>Recently Scheduled</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEB 4611*</td>
<td>Biogeochemical Processes (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>EEB 5601*</td>
<td>Limnology (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>ESCI 4402*</td>
<td>Biogeochemical Cycles in the Ocean (3 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2014</td>
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<tr>
<td>ESCI 5705*</td>
<td>Limnogeology and Paleoenvironment (3 crd) - New Course</td>
<td>Periodically</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>FW 5604W*</td>
<td>Fisheries Ecology and Management (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>FW 8459*</td>
<td>Stream and River Ecology (3 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2012</td>
</tr>
<tr>
<td>FW 8465*</td>
<td>Fish Habitats and Restoration (3 crd)</td>
<td>Odd Years (F)</td>
<td>Fall 2011</td>
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<tr>
<td>PUBH 6190*</td>
<td>Environmental Chemistry (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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## DULUTH CAMPUS

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title &amp; Credits</th>
<th>Typically Offered</th>
<th>Recently Scheduled</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 5801*</td>
<td>Microbial Ecology (2 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2014</td>
</tr>
<tr>
<td>BIOL 5833*</td>
<td>Stream Ecology (3 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2014</td>
</tr>
<tr>
<td>BIOL 5861*</td>
<td>Lake Ecology (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2014</td>
</tr>
<tr>
<td>BIOL 5863*</td>
<td>Ecosystems Ecology (3 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2011</td>
</tr>
<tr>
<td>BIOL 5870*</td>
<td>Wetland Ecology (3 crd)</td>
<td>Odd Years (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>LIM 5004*</td>
<td>Field Limnology (2 crd)</td>
<td>Periodically</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>LIM 5101*</td>
<td>Physical Limnology (3 crd)</td>
<td>Odd Years (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>LIM 5102*</td>
<td>Chemical Limnology (3 crd)</td>
<td>Odd Years (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>LIM 5103*</td>
<td>Geological Limnology (3 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2014</td>
</tr>
<tr>
<td>LIM 5104*</td>
<td>Geochemical, Physical, and Biological Processes in Aquatic Sediments (2 crd)</td>
<td>Odd Years (Sp)</td>
<td>Spring 2015</td>
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</table>

# Water Management Tech Area of Emphasis

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title &amp; Credits</th>
<th>Typically Offered</th>
<th>Recently Scheduled</th>
</tr>
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<tbody>
<tr>
<td>BBE 4523/5523</td>
<td>Ecological Engineering Design (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>BBE 4533</td>
<td>Sustainable Waste Management Engineering (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>CE 4502</td>
<td>Water and Wastewater Treatment (3 crd)</td>
<td>Every Semester</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>CE 4511</td>
<td>Hydraulic Structures (3 crd)</td>
<td>Periodically</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>CE 4512</td>
<td>Open Channel Hydraulics (4 crd)</td>
<td>Periodically</td>
<td>Fall 2014</td>
</tr>
<tr>
<td>CE 4562</td>
<td>Environmental Remediation Technology (3 crd)</td>
<td>Periodically</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>CE 8504</td>
<td>Theory of Unit Operations (4 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>CE 8505</td>
<td>Biological Processes (3 crd)</td>
<td>Periodically</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>CE/ESCI 8511</td>
<td>Mechanics of Sediment Transport (3 crd)</td>
<td>Periodically</td>
<td>Fall 2014</td>
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## DULUTH CAMPUS

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title &amp; Credits</th>
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<tbody>
<tr>
<td>CE 4215</td>
<td>Hydraulic Design (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
</tr>
</tbody>
</table>

*Elective Course Options for the Limnology & Oceanography Track.

Courses scheduled for future semesters are subject to change.
<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title &amp; Credits</th>
<th>Typically Offered</th>
<th>Recently Scheduled</th>
</tr>
</thead>
<tbody>
<tr>
<td>APEC 5611</td>
<td>Economic Aspects of Environmental Management (3 crd)</td>
<td>Periodically (Sp)</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>APEC 5651</td>
<td>Economics of Natural Resource and Environmental Policy (3 crd)</td>
<td>Annual (F/Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>CBIO 8004</td>
<td>Economic and Social Aspects of Conservation Biology (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>ESPM 5256</td>
<td>Natural Resource Law &amp; the Management of Public Lands &amp; Waters (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>CE 5201</td>
<td>Water Policy (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>BBE 5535</td>
<td>Assessment and Diagnosis of Impaired Waters (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>CE 4502</td>
<td>Water and Wastewater Treatment (3 crd)</td>
<td>Every Semester</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>CE 8542</td>
<td>Chemistry of Organic Pollutants in Environmental Systems (3 crd)</td>
<td>Periodically</td>
<td>Spring 2015</td>
</tr>
<tr>
<td>ENT 5081</td>
<td>Insects, Aquatic Habitats, and Pollution (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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<tr>
<td>ESPM 5061</td>
<td>Water Quality and Natural Resources (3 crd)</td>
<td>Every Semester</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>ESPM 5111</td>
<td>Hydrology and Water Quality Field Methods (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
</tr>
<tr>
<td>ESPM 5575</td>
<td>Wetlands (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<td>BIOL 5801</td>
<td>Microbial Ecology (2 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2014</td>
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<tr>
<td>BIOL 5833</td>
<td>Stream Ecology (3 crd)</td>
<td>Even Years (F)</td>
<td>Fall 2014</td>
</tr>
<tr>
<td>BIOL 5861</td>
<td>Lake Ecology (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2014</td>
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<td>BIOL 5868</td>
<td>Ecotoxicology (3 crd)</td>
<td>Periodically</td>
<td>Spring 2013</td>
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<tr>
<td>BIOL 5869</td>
<td>Great Lakes Ecology and Management (3 crd)</td>
<td>Periodically</td>
<td>Spring 2013</td>
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<tr>
<td>BIOL 5870</td>
<td>Wetland Ecology (3 crd)</td>
<td>Odd Years (F)</td>
<td>Fall 2015</td>
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<tr>
<td>BBE 5513</td>
<td>Watershed Engineering (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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<tr>
<td>BBE 8513</td>
<td>Hydrologic Modeling of Small Watersheds (3 crd)</td>
<td>Odd Years (Sp)</td>
<td>Spring 2015</td>
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<tr>
<td>CE 4501</td>
<td>Hydrologic Design (4 crd)</td>
<td>Every Semester</td>
<td>Spring 2015</td>
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<tr>
<td>ESCI/CE/EEB 8601</td>
<td>Introduction to Stream Restoration (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2014</td>
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<tr>
<td>ESCI/CE/EEB 8602</td>
<td>Stream Restoration Practice (2 crd)</td>
<td>Annual (Sum/F)</td>
<td>Summer 2015</td>
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<tr>
<td>ESPM 5111</td>
<td>Hydrology and Water Quality Field Methods (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>ESPM 5575</td>
<td>Wetlands (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>ESPM 5703</td>
<td>Agroforestry in Watershed Management (3 crd)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>ESPM/SOIL 5555</td>
<td>Wetland Soils (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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<tr>
<td>FNRM 5153</td>
<td>Forest Hydrology and Watershed Biogeochemistry</td>
<td>Annual (Sp)</td>
<td>Spring 2015</td>
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<tr>
<td>FR 5114</td>
<td>Hydrology and Watershed Management (3 crd)</td>
<td>Annual (F)</td>
<td>Fall 2013</td>
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<tr>
<td>HORT 5071</td>
<td>Ecological Restoration (4 crd)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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<tr>
<td>WRS 5050</td>
<td>Topics Course: Watershed Specialist Training (2 crd)</td>
<td>Every Semester</td>
<td>Fall 2015</td>
</tr>
</tbody>
</table>

Courses scheduled for future semesters are subject to change.
WRS Graduate Student Handbook 2015

### BIOL 5808
**Landscape Ecology**
- Periodically
- Spring 2014

### BIOL 5870
**Wetland Ecology (3 crd)**
- Odd Years (F)
- Fall 2015

### CE 5226
**Water Resources Engineering (3 crd)**
- Annual (Sp)
- Spring 2015

### GEOL 5601
**Introduction to Stream Restoration (3 crd)**
- Annual (F)
- Fall 2014

### GEOL 8602
**Stream Restoration Practice (2 crd)**
- Periodically
- Spring 2015

### WRS 5050
**Topics Course: Watershed Specialist Training (2 crd)**
- Every Semester
- Fall 2014

Courses scheduled for future semesters are subject to change.

**WRS 8100 Seminar**
All incoming students are required to register for WRS 8100 (0.5 credit) during their first semester and attend at least 80% of the seminars. In the Twin Cities, students are required to attend the WRS Seminar Series (Friday afternoons). In Duluth, students register for WRS 8100 and attend 10 seminars, or attend the weekly seminar in their department.

**Related Field**
You must take at least 6 semester credits of coursework outside the WRS major. We prefer that courses not be from the list of approved WRS elective courses and that they be “non-water” courses. Examples include courses in statistics, GIS, remote sensing, economics, soils, microbiology, chemistry, geology, and policy and management (see the table below). Many other possibilities exist. In some cases, it is desirable to have a related field course from the WRS elective list, but the course must represent a distinctly different area than the area of emphasis.

### Related Field Courses (Examples)

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title &amp; Credits</th>
<th>Typically Offered</th>
<th>Recently Scheduled</th>
</tr>
</thead>
<tbody>
<tr>
<td>APEC 5032</td>
<td>Econ Data Analysis for Managerial &amp; Policy Decisions (3 cr)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>APE5 5711</td>
<td>U.S. Agricultural and Environmental Policy (3 cr)</td>
<td>Periodically</td>
<td>Fall 2015</td>
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<tr>
<td>CBIO 8004</td>
<td>Economics and Social Aspects of ConsBio (3 cr)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<tr>
<td>EEB 4609W</td>
<td>Ecosystem Ecology (3 cr)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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<tr>
<td>EEB 5053</td>
<td>Ecology: Theory and Concepts (4 cr)</td>
<td>Odd Yrs (F)</td>
<td>Fall 2015</td>
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<tr>
<td>ENT 5021</td>
<td>Insect Taxonomy and Phylogeny (4 cr)</td>
<td>Periodically</td>
<td>Fall 2015</td>
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<tr>
<td>ESPM 4295W</td>
<td>GIS in Environmental Science and Management (4 cr)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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<tr>
<td>ESPM 4601</td>
<td>Soils and Pollution (3 cr)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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<tr>
<td>ESPM 5020</td>
<td>Environ Conflict Management, Leadership &amp; Planning (3 cr)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<td>ESPM 5601</td>
<td>Principles of Waste Management (3 cr)</td>
<td>Annual (Sp)</td>
<td>Spring 2016</td>
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<td>FR 5131</td>
<td>GIS for Natural Resources (4 cr)</td>
<td>Annual (F)</td>
<td>Fall 2013</td>
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<tr>
<td>FR 5262</td>
<td>Remote Sensing of Natural Resources &amp; Environ (3 cr)</td>
<td>Periodically</td>
<td>Fall 2013</td>
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<tr>
<td>FR 5412</td>
<td>Digital Remote Sensing (3 cr)</td>
<td>Periodically</td>
<td>Spring 2013</td>
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<td>FW 5003</td>
<td>Human Dimensions of Biological Conservation (3 cr)</td>
<td>Periodically</td>
<td>Fall 2015</td>
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<td>Frequency</td>
<td>Semester</td>
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<tr>
<td>GEOG 5561</td>
<td>Principles of Geographic Information Science (3 cr)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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<tr>
<td>GEOG 5565</td>
<td>Geo Analysis of Environmental Systems &amp; Global Change (3 cr)</td>
<td>Periodically</td>
<td>Fall 2013</td>
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<td>GIS 5571</td>
<td>Introduction to Arc/Info (3 cr)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
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<td>PA 5701</td>
<td>Science and State (3 cr)</td>
<td>Periodically</td>
<td>Spring 2013</td>
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<tr>
<td>PA 5721</td>
<td>Energy and Environmental Policy (3 cr)</td>
<td>Annual (F)</td>
<td>Fall 2015</td>
</tr>
<tr>
<td>PA 5722</td>
<td>Environmental and Resource Economics Policy (3 cr)</td>
<td>Periodically (F)</td>
<td>Fall 2011</td>
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<td>PA 8201</td>
<td>Environment and Infrastructure Planning (4 cr)</td>
<td>Annual (F)</td>
<td>Fall 2013</td>
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<td>PUBH 6104</td>
<td>Environmental Health Effects: Intro to Toxicology (2 cr)</td>
<td>Annual (F &amp; Sum)</td>
<td>Fall 2015</td>
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<tr>
<td>STAT 5021</td>
<td>Statistical Analysis (4 cr)</td>
<td>Every Semester</td>
<td>Fall 2015</td>
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<tr>
<td>STAT 5303</td>
<td>Designing Experiments (4 cr)</td>
<td>Every Semester</td>
<td>Fall 2015 &amp; Spring 2016</td>
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<tr>
<td>BIOL 5807</td>
<td>Mathematical Ecology (UMD) (3 cr)</td>
<td>Even Yrs (F)</td>
<td>Fall 2014</td>
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<tr>
<td>BIOL 5863</td>
<td>Ecosystems Ecology (UMD) (3 cr)</td>
<td>Periodically</td>
<td>Fall 2011</td>
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<tr>
<td>PHYS 5053</td>
<td>Data Analysis Methods in Physics (UMD) (3 cr)</td>
<td>Even Yrs (F)</td>
<td>Fall 2014</td>
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</tbody>
</table>

Courses scheduled for future semesters are subject to change.
M.S. Plan A
The M.S. Plan A option is best suited for students with a funded research project. The Plan A option provides a more research-intensive background.

- Coursework: Plan A requires a minimum of 32 credits (including thesis credits)
  - Major Coursework: four core courses, one water quality elective, and two area of emphasis courses (see above for courses), in addition to WRS 8100 and WRS 8581;
    - M.S. Plan A students may elect to take one water quality elective course that may double for one area of emphasis course. Students must still obtain the minimum number of credits for their degree.
  - 6 credits in a supporting field or a designated minor (please note that the required number of credits to obtain a minor is set by the program in which the minor is taken);
  - 10 credits of thesis work (WRS 8777) (thesis credits can be taken at any time).
- Thesis: Plan A also requires the successful completion and defense of an M.S. thesis.
  - Thesis must be written on a research project that you carry out in consultation with your faculty adviser. Specific formatting guidelines for your thesis are available on the Graduate School’s website: [http://www.grad.umn.edu/current-students-graduate-student-services-progress/thesis-submission](http://www.grad.umn.edu/current-students-graduate-student-services-progress/thesis-submission);
  - You must present an electronic copy to the WRS Program Office. Check with your adviser for their copy requirements.

M.S. Plan B
Plan B is best suited to students who do not have a funded project that will cover research expenses and provide an assistantship. Students accepted without funding should consider the Plan B option, which can generally be completed in less time, or at an individualized part-time pace.

- Coursework: Plan B requires a minimum of 30 credits
  - Major Coursework: four core courses, one water quality elective, and two area of emphasis courses (see above for courses), in addition to WRS 8100 and WRS 8581;
  - 6 semester credits in a supporting field or a designated minor (Note that the number of credits for the minor is set by the program in which the minor is taken);
  - Additional coursework, divided in any appropriate manner between the major field and related field / minor program (subject to approval by your adviser), if 30 credit minimum is not completed through major coursework and supporting field coursework alone;
  - Students are not required to register for any credits of Plan B work. However, students may count three semester credits of WRS 8095 (Plan B research) toward their degree.
- Plan B Project(s): No thesis is required, but each student must demonstrate the ability to work independently by completing one or two project papers.
  - Best suited for students with few previous courses in water resources science and thus need more coursework to gain the combination of depth and breadth needed in this field;
  - Project must be approved and overseen by the faculty adviser;
  - Must utilize field, laboratory, or computer work and the analysis, synthesis, or interpretation of data.
- Course Selection
  - Coherent coursework should be related to your career objectives;
  - Supporting field or minor program should not consist of water-oriented courses (note that the water quality and elective courses are normally not eligible);
    - Supporting field coursework may include a variety of courses (i.e. statistics, computer science, natural resource policy, applied economics, chemistry, chemical engineering, soil science, microbiology, envt health, geography, and geology – see ‘Related Field Courses’ table on pages 24 and 25).
• Plan B students should provide an electronic copy of their Plan B project to the WRS Program Office after a successful final oral exam.

Final Oral Exams for M.S. Degrees
Other than course exams, the final oral examination is the only exam taken by an M.S. candidate. The composition of the examining committee is described in the Master’s Final (Examining) Committee section above. Once your thesis or Plan B papers are nearly ready for review by your committee, request a graduate packet from the Graduate Student Services and Progress Office (GSSP) online at: http://www.grad.umn.edu/students/masters/index.html.

• Oral exam formats for Plan A and Plan B candidates are described in the sections below.
• If possible, final oral exams should not be scheduled for the period between June 15 and the start of the fall semester.
• You should discuss the format of your oral exam with your adviser well in advance of its scheduled date.
• M.S. final oral exams are open to the public. Please inform the WRS office of your defense seminar at least one week in advance, including the date, time, and an abstract from your thesis or project. The office will send out an announcement to faculty and students.

Plan A Final Oral Exams
The final oral exam is primarily a thesis defense. The exam consists of two parts:

1. Public seminar by the student, covering the objectives of the thesis, technical approach, results and conclusions, and

2. Defense of the work to the examining committee in a closed session.

The time and place of the exam are announced in advance. As a minimum, announcements should be distributed to the WRS faculty and students on the campus (Twin Cities or Duluth) at least a week in advance of the exam. In addition to sending this information to the WRS office for distribution, you should also have an announcement posted in the building in which you have done your research.

It is recommended that oral presentations last about 30 – 40 minutes. You and your adviser should decide on the length of your presentation. Consult with your adviser for help in selecting material and for advice on making an effective presentation. It is a good idea to practice the seminar in front of graduate students in your adviser’s group before the exam date. Be sure to start your talk by describing your main objectives and why the work was done, and end by summarizing your important findings and conclusions. Also, be sure to acknowledge assistance you received from other persons in doing the work and funding assistance from granting agencies or fellowships. Although questions of clarification may occur during the presentation, most questions are reserved until the end of the presentation when the general audience is allowed to ask questions about the work. When there are no further questions from the general audience, they are asked to leave and the second part of the thesis defense takes place.

As chair of the examining committee, your adviser will normally ask each committee member in turn to ask his/her questions before moving on to the next questioner. Questions usually arise directly from the thesis or the oral presentation. However, you should be prepared for the possibility that a line of questioning may lead beyond the narrow confines of the thesis material. For example, questions about a statistical method you used or how you performed an analysis may lead to broader questioning to gauge your understanding of the method and other procedures that may have been appropriate to address the issue at hand.

M.S. thesis defenses typically last between two and three hours. Because questioning is open-ended, you should be sure to schedule enough time to allow the committee to complete its questioning. To be on the safe side, you should reserve the exam room for a three-hour period and make sure that committee
members are available for the entire period.

Scheduling the thesis defense is often a difficult and time-consuming process. You should begin preparing as soon as your adviser gives you the “go ahead.” Typically, this will occur when your adviser regards your thesis draft as ready for review by the rest of the committee. Committee members need a reasonable amount of time to read the thesis, and you cannot schedule the thesis defense sooner than two weeks after committee members have received their copies. To allocate sufficient time to read the thesis and decide whether it is ready for defense, students must notify their adviser and other members of the final oral committee at least two weeks before the thesis arrives at their offices that it will be delivered on a particular date. All members of the examining committee must then have at least two weeks to read the thesis after it has been delivered. These are minimum standards set by the Graduate School. Between the time the committee receives the thesis and the date of your exam, you must obtain the signatures of each committee member on a form verifying that the committee has found the thesis ready for defense. You must obtain this Reviewer’s Report form from the GSSP (downloaded with the Graduation Packet online) and return it to the GSSP office so that you can pick up the Final Exam Form (where your committee will indicate if you have passed or failed), which is needed at the oral exam. Occasionally reviewers will determine that substantial revision is required before the thesis is ready to defend, and their concerns must be addressed before the defense can proceed. Finally, it is your responsibility to arrange the exam time with the committee, schedule the exam room, and see that the exam announcements are distributed. Students must contact the WRS office in the Twin Cities before the exam to ensure that the announcement is distributed to the WRS e-mail lists. You may also contact the WRS office if you need assistance with scheduling an exam room.

**Plan B Final Oral Exam**

The basic format for this exam is similar to that for the M.S. Plan A exam.

1. A public seminar is given on the Plan B project, and
2. Questioning from the committee follows in closed session.

The time and place of the exam are announced in advance and arranged to be accessible to interested faculty and students.

Differences in the exam formats reflect the fact that Plan B projects are shorter and less complicated than theses. Consequently, the seminar may be shorter. Because Plan B programs are more course-intensive, the examining committee may spend relatively less time addressing the Plan B project and more time on questions related to course work. Such questions still tend to evolve from the topic of the project and presentation, but you should be ready for general questions in the areas of the WRS core, your area of emphasis within WRS, and your related field or minor program. The student is responsible for arranging the time and place of the exam, contacting their committee members, and providing them with copies of the Plan B report (similar to the responsibilities for the Plan A defense except that there is no GSSP Reviewer’s Report form for the Plan B project report). Because M.S. final oral exams are open to the public, you should plan to attend a few before your own is scheduled so that you will be familiar with the way they are run. If you have any questions about this process, or need assistance with scheduling a room for your defense, contact the WRS program office.
Doctor of Philosophy (Ph.D.)

The Doctor of Philosophy (Ph.D.) in Water Resources Science consists of:

- Coursework equivalent to an M.S. in WRS:
  - Four required core courses (one from each area);
  - One elective in the area of water quality;
  - Two or more WRS elective courses in an area of emphasis;
  - WRS Seminar Series (WRS 8100) during the first semester in residence;
    - Twin Cities students are required to attend the WRS Seminar Series, and are required to attend at least 80% of seminars (held on Friday afternoon).
    - Duluth students must attend 10 seminars of WRS 8100, or attend the weekly seminar in their own department.
  - Research and Professional Ethics (WRS 8581).

- Ph.D. students are also required to enroll in a minor or appropriate supporting program courses.
  - 12 semester credits of course work outside the WRS major. In certain cases, it may be desirable to have a supporting program course from the WRS related field list (Related Field Courses table, page 24), but the course must represent a distinctly different area;
  - Minor coursework must be approved by the DGS from the designated minor.

- Dissertation

The Ph.D. is a research degree that represents the highest level of academic accomplishment in any field. Persons with this degree are expected to have demonstrated the ability to conduct independent research and should also have the level and breadth of knowledge about their field that one could reasonably expect of someone who has attained the highest academic degree in their field. Research performance, evidenced by the preparation of a dissertation on an independently pursued research topic, is the primary requirement for the Ph.D. degree. Each student degree program is designed in consultation with a faculty adviser to meet the special needs of the student, and must be approved by the DGS.

The Graduate School does not set a minimum number of graduate course credits for the Ph.D., but the WRS program has established the guideline that a Ph.D. program should include at least 40 coursework credits and 24 thesis credits. Relevant course credits from a student’s previous M.S. degree are included in the 40 credit minimum.

The WRS program does not have a rigid criterion regarding the number of 8000-level coursework credits that are appropriate for Ph.D. programs because the availability of such courses varies widely among academic areas. Nonetheless, students should be aware that the Ph.D. represents the highest level of scholarly achievement; Ph.D. programs should thus include a strong representation of advanced-level courses in your major field.

**Ph.D. Preliminary Exams**

The written and oral preliminary exams usually are taken during the second year or at the beginning of the third year of study. The written exam must be passed before the oral is scheduled. Only after passing both exams are you admitted to “Ph.D. candidacy.” You can then begin to register for dissertation credits (WRS 8888); as such it is to your advantage to pass these exams as soon as possible. You do not need to complete all of your course requirements before the preliminary exams. It is fairly common for examining committees to recommend additional coursework as a result of your oral preliminary exam. Therefore, it is in your best interests to proceed with the oral preliminary once you think you are nearing the end of your program coursework.

**Preliminary Written Exam:** The structure of the written preliminary is the development of a research
proposal on a topic closely related to your proposed dissertation. The proposal must follow the format of the National Institutes for Water Resources (NIWR): https://niwr.net/public/Migration/niwr.net.

Proposal guidelines can be obtained from the above website. Each completed proposal must include the budget, a resume, and other such materials. However, it need not include affidavits and forms that would be attached to a proposal by the University Sponsored Projects Administration if it were actually submitted to the granting agency.

The five-person examining committee for the written preliminary must include the three faculty members from the WRS program who serve on your advisory committee and two additional WRS faculty members. Your adviser and the DGS will approve the composition of your committee. All committee members must be contacted and agree to serve within the proposed timeline.

- You should hold an initial meeting with your committee at which time the precise topic for the proposal is discussed and ground rules and expectations are clarified.
- You will be allowed four weeks following that meeting to develop and complete the proposal. During that four-week writing period, you may approach your adviser or other members for clarification, but the proposal must represent your work only. In some cases, your committee may hold a mid-term progress review with you to refine direction and give clarification.
- After you have completed the proposal, send one complete copy to each committee member. The committee will have a minimum of two weeks to review the proposal.
- The committee will rate the written exam (proposal) and relay their ratings to the adviser and the rest of the committee as (1) pass, (2) pass with reservations (meaning that some rewriting is necessary), (3) fail but can retake, or (4) fail without the possibility of retaking the exam.
  - If the proposal is rated unanimously as a pass, the reviewers should provide their reviews and comments to the adviser who will relay this to the student; the adviser will report the outcome of the exam to the DGS (see below).
  - If the vote is not unanimous, the committee will deliberate by e-mail, phone, or a face-to-face meeting. A conference call or face-to-face meeting of the committee can be requested by any of the committee members. The committee may decide that it wishes to meet with the student to seek clarification of certain aspects of the proposal before deciding the outcome of the exam.
  - Four (out of five) passing votes are required to pass; if two or more committee members vote to pass with reservations, the pass will carry reservations. For a pass with reservations, the examining committee will provide further instructions to the student regarding what needs to be done, time allowed to do this, and in the case of option 3, fail but can retake, the extent to which the initial proposal should be used as the basis for a new proposal.
  - If the recommendation is “pass with reservations” the student must satisfy the committee’s reservations before proceeding to the oral preliminary stage. Normally, this involves revising the proposal (or portions thereof) to meet specific concerns raised by the committee and resubmitting a corrected proposal to the review committee. The precise procedure may vary slightly at the discretion of the committee.
  - In the event that a student fails their exam, they should contact the WRS program office immediately for further instructions.

Committee members usually offer comments on the proposal. Those comments should be incorporated into the proposal and a final copy of the proposal must be submitted to the WRS program office for your file. The results of the examination are reported on the Preliminary Written Examination Report form, signed by your adviser and the DGS. It is then the student’s responsibility to schedule
the preliminary oral examination. The preliminary oral exam cannot be scheduled before the results of
the written examination report form is reported to GSSP by the WRS program office. Please contact the
WRS program office to receive a Preliminary Written Examination Report form.

Preliminary Oral Exam: The oral preliminary exam and its accompanying dossier is the last major
milestone before Ph.D. candidacy. The oral exam consists of two parts:

1. Seminar-like presentation to your committee on your proposed dissertation research, and
2. Committee questions, which pertain to the presentation but also extend across your areas of
   expertise.

The exam must be scheduled with GSSP (http://www.grad.umn.edu/students/prelimschedule/index.html)
at least one week in advance. The seminar presentation should include a description of the proposed
work, the scientific basis and need for the work, and the progress made to date. The presentation should
be scheduled to last about 30 minutes or less, but because the committee may ask questions during the
presentation, it may last longer. The question-answer phase may last for several additional hours. A
minimum of three hours should be reserved for the preliminary oral exam.

The written “preliminary dossier” must be prepared and provided to the Ph.D. Preliminary Examination
Committee and to the WRS program office at least two weeks before the oral preliminary exam. Your
dossier should include the following components:

1. Copies of your graduate and undergraduate transcripts and approved GDP,
2. Statement describing the areas of Water Resources Science and related fields in which you have
   specialized and thus are prepared to demonstrate expertise,
3. Examples of scholarly work (e.g., reprints of published papers, an abstract of your M.S. thesis,
   summaries or abstracts of technical reports you have written),
4. Research prospectus that describes the scope, objectives, and basis for the proposed dissertation
   research and summarizes progress to date, and
5. Description or outline of the proposed dissertation.

Item 5 may be included as part of item 4. The proposal prepared for the written preliminary should serve
as the basis for the research prospectus, but in many cases, some additions and changes will be needed
(e.g., because the dissertation research will include aspects not covered in the proposal). The research
prospectus should be no longer than 20 pages. You may ask your adviser or the DGS for examples of
previously prepared dossiers to gain a better understanding of how this should be assembled.

Committees and advisers vary somewhat in the way they conduct the question-answer part of oral
preliminary exam, and in the amount of information they are willing to provide the student in advance on
the range and nature of the questions they are likely to ask. It generally is a good idea to meet with each
member of your committee before the exam date to obtain their perspectives on what you will be
expected to know. You might ask each person ‘How do you suggest I prepare for the oral exam?’

You should be prepared to:

1. Explain your research plan and the scientific principles behind any methods you will be using, and
2. Demonstrate knowledge of the fundamental concepts in the core areas of water resources
   science, as well as in your areas of expertise.

At the same time, you should realize that while examining committees are established to protect the
academic standards of the program, their goal is to see that students succeed. No committee wishes to see
a student fail. While committee members may test the limits of your knowledge, they do not do so with
the intention of finding a question that you cannot answer so that they can fail you.

It is your responsibility to find a time at which the committee can meet for the exam, to arrange an
appropriate exam room, and to see that the necessary audio-visual facilities are available. Exams are usually held in the building where the student and adviser’s office and lab are located; the WRC conference room is available for preliminary exams on the Twin Cities campus.

At the conclusion of the examination, the committee votes, discusses, and votes again, following the rules prescribed by the Graduate School on the exam form (sent directly to the committee chair).

- Possible outcomes are: pass, pass with reservations, or fail.
- The committee may decide to allow a person who fails the preliminary oral exam to retake it one time.
- Pass with reservation indicates that the committee was not satisfied with some aspect(s) of the student’s knowledge or preparation; the specific deficiencies and requirements for rectifying those deficiencies (e.g., additional coursework, writing a review paper, etc.) must be explained to the student immediately after the exam, and a written explanation provided within one week of the exam. The reservation must be lifted before the student can proceed to the final defense.

When a student has successfully completed the preliminary written and oral exams, they become official “Ph.D. candidates.”

**Ph.D. Dissertation**

**Assigning Doctoral Final Examination Committee:** The Doctoral Final Examination Committee must have at least four members including:

- Three WRS graduate faculty members, including your adviser(s),
- At least one member representing a field outside of WRS,
- One member from your minor field, if you have declared a minor.

Members cannot represent both WRS and an outside field or minor during your defense, however, all WRS graduate faculty also hold appointments in other fields, and could therefore serve as the ‘outside’ member on your committee. Your committee is not required to include the same members who served on the preliminary oral exam committee. Your finalized committee selections must be submitted a minimum of one month prior to your defense, and will be approved by your adviser, the DGS, and the College of Food, Agricultural and Natural Resource Sciences. You can submit your final exam committee online ([http://www.grad.umn.edu/current-students-graduate-student-services-progress-doctoral/assign-doc-final-committee](http://www.grad.umn.edu/current-students-graduate-student-services-progress-doctoral/assign-doc-final-committee)).

**Preparation for Dissertation:** Specific formatting guidelines for your thesis are available on the Graduate School website- [http://www.grad.umn.edu/current-students-graduate-student-services-progress/thesis-submission](http://www.grad.umn.edu/current-students-graduate-student-services-progress/thesis-submission).

You should download your Graduation Packet from the Graduate School’s website ([http://www.grad.umn.edu/students/doctoral/index.html](http://www.grad.umn.edu/students/doctoral/index.html)) by no later than the first day of the month in which you would like to defend your dissertation.

**Your graduation packet will include your Reviewer’s Report Form, which you must distribute to your Thesis Reviewers.** At least three members of your committee, including your adviser(s) must review your thesis and sign a Reviewer’s Report to verify that you are ready to defend. Once this form is submitted to the Graduate School, you will receive your Final Exam Form for your defense (which will record the votes of pass or fail).
Final Oral Examination for the Ph.D. (Dissertation Defense): The final oral exam is a defense of your dissertation.

- After your adviser has approved your dissertation, provide copies to all committee members, including your Thesis Reviewers (see above).
- Allow a minimum of two weeks for the reviewers to read your dissertation.
- The Reviewers Report form must be on file with GSSP before the examination. Students may schedule their exam with GSSP before submitting the Reviewers Report form.
- Doctoral students are expected to schedule their defense at least one week in advance. Schedule your final oral exam with GSSP online - http://www.grad.umn.edu/graduate-student-services-progress/final-schedule.

It is preferred (but not required) that the final oral exam not be scheduled for the period between June 15 and the start of the fall semester. Your Final Oral Examination will include:

- A seminar (approximately 45 minutes) which is open to the public, where you will present your major findings,
- A question and answer session (reserved for after your presentation) with your audience, and
- A closed-door meeting with your committee, consisting of questions focused on your dissertation.

At the conclusion of the examination, your committee discusses and votes to pass or fail. A failing grade on the dissertation defense ends the person’s Ph.D. program. A grade of pass may still involve a need to make changes to the dissertation before it is acceptable. All committee members must sign the original Final Exam Report form, indicating their decisions. New Graduate School policy indicates that committee members may delay signing the form until all appropriate revisions are made.

Once all required changes are made, you may prepare final copies of your dissertation. The Graduate School requires electronic submission of dissertations. You must also submit one electronic copy to the WRS program office, and you may need to submit a copy to your adviser as well. Your adviser must sign the original cover page of each copy.

Be sure to fill out all required forms (dissertation abstracts, student survey, copyright, etc.) and pay all appropriate fees by the end of the month in which you expect to graduate. The Graduate School will not date your graduation until all requirements are met and fees are paid.
Limnology and Oceanography Track

Master of Science
The M.S. in the Water Resources Science Limnology and Oceanography Track consists of:
- Four Limnology and Oceanography Track Core Courses (noted with * in course offerings),
- One Water Quality elective (noted with * in course offerings),
- At least 5 semester credits of Limnology Area of Emphasis electives,
- At least 6 semester credits from a related field or minor outside WRS,
- Registration for the WRS 8100 seminar during the first semester in residence,
- Research and Professional Ethics in Water Resources and Environmental Science (WRS 8581), and
- A thesis (M.S. Plan A) or Plan B paper (M.S. Plan B)

M.S. Plan A
The M.S. Plan A option provides a more research intensive background, and therefore requires 10 credits of thesis work (WRS 8777) and the successful completion and defense of an M.S. thesis. The thesis generally represents original laboratory or field research, or in-depth analysis and synthesis carried out in consultation with the faculty adviser. Plan A course work is individualized to reflect a student’s preparation, degree goals, and research topic. The faculty Adviser must be a member of the Limnology and Oceanography Track Faculty.

M.S. Plan B
The M.S. Plan B requires a minimum of 30 course credits. If students are below the minimum number of credits needed after completing the requirements above, any remaining credits may be divided in an appropriate manner between the major field and related field or minor program. No thesis is required, but each student must demonstrate the ability to work independently by completing one or two project papers in consultation with the faculty adviser, who must be a member of the Limnology and Oceanography Track Faculty. These papers can be in-depth literature reviews in some cases. Students are not required to register for any credits of Plan B work; However, students may count three semester credits of WRS 8095 (Plan B research) toward the M.S. degree. The Plan B is well suited for part time students who do not wish to focus on research, but require a more in depth knowledge of Limnology and Oceanography for their professional goals.

Doctor of Philosophy
A Ph.D. in the Water Resources Science Limnology and Oceanography Track consists of:
- Coursework equivalent to an M.S. in the Water Resources Science Limnology and Oceanography Track:
  - Four Limnology and Oceanography Track Core Courses (noted with *),
  - One Water Quality elective (noted with *),
  - At least 11 semester credits (6 more than the M.S. degree) of Limnology and Oceanography Track electives.
- Minor or appropriate supporting program courses:
  - 12 semester credits of course work outside the WRS major. In certain cases, it may be desirable to have a supporting program course from the WRS related field list (Related Field Courses table, page 24), but the course must represent a distinctly different area;
  - Minor coursework must be approved by the DGS from the designated minor.
- WRS Seminar Series (WRS 8100) during the first semester in residence.
- Research and Professional Ethics in Water Resources and Environmental Science (WRS 8581).
- Dissertation
The Ph.D. is a research degree that represents the highest level of academic accomplishment in any field. Persons with this degree are expected to have demonstrated the ability to conduct independent research and also should have the level and breadth of knowledge about their field that one could reasonably expect of someone who has attained the highest academic degree in their field. Research performance, evidenced by preparation of a dissertation on an independently pursued research topic, is the primary requirement for the Ph.D. degree. Each program is designed in consultation with a faculty adviser to meet the special needs of the student, and must be approved by the DGS.

Ph.D. course programs include a minimum of 40 graduate credits, excluding thesis credits, and including at least 12 credits in a supporting program or minor and completion of the ethics requirement. Relevant course credits from a student’s previous M.S. degree are included in the 40-credit minimum.

Ph.D. students pursuing the Limnology and Oceanography Track must have at least two members of the track faculty on their preliminary exam and final defense committees, including their adviser(s). See the main Doctoral of Philosophy section above for more information on committee requirements.
Definitions and Descriptions

**Graduate Assistants:** Students with appointments that require service in return for financial support, such as Research Assistant (RA) and Teaching Assistant (TA). Titles and compensation vary.

**Graduate Fellows:** Students who hold appointments (i.e., receive monetary stipends) that do not require any services. Titles and stipends of graduate fellows vary. Examples: Graduate School Fellows and Graduate Fellows. It is expected that graduate fellows carry out research toward the completion of a Plan A Master’s thesis or a Ph.D.

**Academic Year:** Two academic terms: fall and spring semesters (early-September to mid-May). The University also offers a summer session.

**Full-Time & Part-Time Graduate Student:** Students registered for six or more course or thesis credits (or a combination thereof) are full-time students. Students registered for fewer than six course or thesis credits are part-time students. Tuition is the same for students registering for 6-14 credits and is calculated per credit for 1-5 credits or credits exceeding 14 in a semester.

**Thesis Research:** Research to satisfy requirements for a Plan A master’s degree or a doctoral degree. Students should be registered for thesis credits during this time (minimum total of 10 for master’s and 24 for doctoral).

**Doctoral Candidate:** Refers to a student who has passed the preliminary written and oral exams for the Ph.D. degree.

**International Student:** Any student who is not a citizen or permanent resident of the United States. International students usually hold a passport bearing a student entry visa to the United States. This definition is the same as that used by the International Student and Scholar Services Office (612-626-7100), which should be consulted for any questions regarding international student status.

**Resident:** Residents of Minnesota pay fees at the in-state rate. Graduate Assistants who have at least 25%-time appointments and their spouses are counted as residents with regard to payment of fees. Minnesota also has reciprocity programs (which allow you to qualify for a lower tuition rate) for Wisconsin, North Dakota, South Dakota, and province of Manitoba, Canada residents. (More information on reciprocity can be found at: [http://onestop.umn.edu/finances/costs_and_tuition/tuition_and_fees/reciprocity/index.html](http://onestop.umn.edu/finances/costs_and_tuition/tuition_and_fees/reciprocity/index.html).)

**Co-Directors of Graduate Studies:** The co-DGS’s on the Twin Cities or Duluth campus provide advice for students and work together to make decisions regarding programs, committees, etc. The co-DGS also oversees WRS activities their campus. Co-DGS’s will alternate chairing the WRS Executive Committee.

**Plan Level Coordinator (PLC):** Provides support and advises the co-DGS’s, faculty, and students. Contact the program coordinator ([wrs@umn.edu](mailto:wrs@umn.edu)) with any WRS-related questions.

**Executive Committee:** General oversight responsibility for academic matters pertaining to WRS graduate programs, as well as issues related to the status and well-being of WRS graduate students.
## Useful Contacts

### Bookstores
- Twin Cities Coffman Memorial Union Store, Minneapolis Campus  
  (612) 625-6000
- St. Paul Store, St. Paul Campus: http://www.bookstores.umn.edu/  
  (612) 624-9200
- UMD Stores, Kirby Student Center  
  http://umdstores.com/  
  (218) 726-7286

### Career Services
- http://career.umn.edu/
- St Paul Career Center  
  http://www.careerhelp.umn.edu/  
  (612) 624-2710
- UMD Career Services  
  http://www.d.umn.edu/careers/  
  (218) 726-7985

### Computer Facilities and Wireless Access
- Twin Cities Computer Labs: http://www.oit.umn.edu/computerlabs/
- Twin Cities Wireless: http://it.umn.edu/wifi-network
- Duluth: http://www.d.umn.edu/itss/  
  (218) 726-8847

### Computer Help Line
- Twin Cities  
  (612) 301-4357 (301-HELP)
- Duluth  
  (218) 726-8847

### Copy Centers
- Coffman Memorial Union Copy Store, G 14, Minneapolis Campus  
  (612) 625-1092
- St. Paul Student Union Copy Store, Rm. 8, St Paul Campus  
  (612) 625-4771
- The Print Shop, 125 Kirby Plaza, UMD  
  http://www.printing.umn.edu/copycenters/index.html
- Duluth: http://www.d.umn.edu/print/  
  (218) 726-7114

### Council of Graduate Students (COGS)
- 405 Johnston Hall, Mpls  
  (612) 626-1612
- http://www.cogs.umn.edu/

### Counseling and Mental Health Services
- Twin Cities - http://www.mentalhealth.umn.edu/
  University Counseling and Consulting Services  
  109 Eddy Hall (East Bank) & 199 Coffey Hall (St Paul Campus)  
  http://www.uccs.umn.edu/index.html
  Boynton Mental Health Clinic  
  http://www.bhs.umn.edu/east-bank-clinic/mental-health-services.htm
- Duluth Health Services - Counseling  
  615 Niagara Court  
  http://www.d.umn.edu/hlthserv/counseling/
  After-hours Birch Tree Center’s Crisis Line (Duluth)  
  (218) 623-1800

### Fee Payments
- Twin Cities-  
  http://onestop.umn.edu/finances/pay/index.html
- Duluth-  
  UMD Cashier’s Office - 1049 University Drive (140 Darland)  

### Financial Aid Information

### General Campus Information
- Twin Cities - http://www1.umn.edu/twincities/  
  (612) 625-5000
Duluth - http://www.d.umn.edu/  
(218) 726-8000

Graduate Assistant Employment Services (Twin Cities)  
545 West Bank Office Building, 1300 South 2nd Street  
http://www1.umn.edu/ohr/gae  
(612) 624-8647

Graduate Assistant Health Insurance Office  
http://www.shb.umn.edu/index.htm (Duluth & TC info)  
(612) 624-0627

Graduate Student Services and Progress (GSSP) Office  
160 Williamson Hall (Minneapolis Campus)  
http://www.grad.umn.edu/current-students/gssp  
(612) 625-3490

Health Services  
Minneapolis – 410 Church St. SE  
St. Paul – 1420 Eckles Ave (109 Coffey Hall)  
http://www.bhs.umn.edu/east-bank-clinic/index.htm  
Duluth – 615 Niagara Court  
http://www.d.umn.edu/hlthserv/  
(612) 625-3222  
(612) 624-7700  
(218) 726-8155

Dental Clinic (Twin Cities)  
Pharmacy (Twin Cities)  
(612) 624-9998  
(612) 624-7655

Housing Services  
Twin Cities-  
http://www.housing.umn.edu/  
(612) 624-2994

Duluth-  
http://www.d.umn.edu/housing/  
(612) 624-7655

International Student and Scholar Services  
Twin Cities – 190 Hubert H. Humphrey School  
Duluth – 237 Kirby Student Center  
(612) 626-7100  
(218) 716-7305

On-Campus Post Office  
Coffman Postal Station, Coffman Memorial Union  
St. Paul Postal Station, St. Paul Student Center  
(612) 624-8602  
(612) 625-9794

Registration, Records & Admissions  
Twin Cities – One Stop Student Services  
http://www.onestop.umn.edu/onestop/registration.html  
(612) 624-1111

Duluth Student Assistance Center, 23 Solon Campus Center  
http://www.d.umn.edu/onestop/registration/index.html  
(218) 726-8000

Student Conflict Resolution Center  
http://www.sos.umn.edu/  
(612) 624-7272

Water Resources Science Program Office  
Saint Paul Campus – 193 McNeal Hall  
http://wrs.umn.edu/  
(612) 624-7456  
wrs@umn.edu