

REVIEW OF THE M.S. IN HYDROGEOLOGY

Classification of Instructional Programs (CIP) Code: 40.0699
Geological and Earth Sciences/Geosciences, Other

OVERVIEW

The M.S. in Hydrogeology program at Illinois State University is housed in the Department of Geography, Geology, and the Environment within the College of Arts and Sciences. The department also offers minors in environmental studies, geography, and geology; a B.A., B.S. in Geography; a B.S. in Geology; and a Hydrogeology Geographic Information Systems (GIS) Graduate Certificate.

Illinois State University is the only university in the state and one of only four universities in the country to offer an advanced degree in hydrogeology. The program contributes new knowledge in the discipline through collaborative research and scholarship among students, faculty, and external scientists employed with state and federal agencies, including the Illinois State Geological Survey, the Illinois State Water Survey, and the United States Geological Survey.

Nearly 97 percent of recent graduates of the M.S. in Hydrogeology program took their first career step in hydrogeology or geology, either as a professional or as a student pursuing an advanced degree. Graduates have taken positions with industry, governmental agencies, and non-profit organizations. Approximately 40 percent of program graduates find employment in the environmental consulting field.

Enrollment, Fall Census Day, 2009-2016 M.S. in Hydrogeology, Illinois State University

2009	2010	2011	2012	2013	2014	2015	2016
17	19	19	16	20	17	18	18

Degrees Conferred, Graduating Fiscal Year, 2010-2016 M.S. in Hydrogeology, Illinois State University

2010	2011	2012	2013	2014	2015	2016
4	11	9	9	7	6	9

EXECUTIVE SUMMARY PROGRAM REVIEW SELF-STUDY REPORT

Self-study process. Self-study is an ongoing process for the geology and hydrogeology faculty at Illinois State University, either as part of departmental retreats, scheduled meetings, or informal conversations. Having program review scheduled for the geology and hydrogeology programs made little difference in the operation of the department during the last few years with respect to curriculum, assessment, budgeting, and planning. Geology faculty held meetings in January 2016 to discuss the program review process for both the undergraduate geology program and the graduate hydrogeology program. Data from the Office of Planning, Research, and Policy Analysis, Alumni Relations, and the Department of Geography, Geology, and the Environment were gathered and compiled. Four surveys were administered to program graduates and current students. A hydrogeology faculty member who was designated as the program review facilitator compiled the data and wrote the first draft of the program review self-study report. The facilitator shared the draft with program faculty and the department chairperson and then sought feedback at faculty meetings prior to preparation and submission of the final draft.

Program curriculum. The M.S. in Hydrogeology program delivers a curriculum that provides a foundation in theoretical hydrogeology coupled with field courses that provide active, hands-on application of theoretical knowledge to real-world scenarios. The curriculum provides specialized training for students who wish to pursue

employment immediately following completion of the program while simultaneously ensuring the breadth of academic background for students intending to pursue a doctorate. This dual goal is accomplished by offering a rigorous curriculum that consists of 32 credit hours. Students choose between a thesis option and a comprehensive examination option. The thesis option includes 18 credit hours of core courses, 8-10 credit hours of electives, and 4-6 credit hours of thesis. The comprehensive examination option includes the same 18 credit hours of core courses, 14 credit hours of electives, and the comprehensive examination. In selecting electives, students may choose to complete the three-course sequence required to earn the Hydrogeology Geographic Information Systems (GIS) Graduate Certificate offered by the department.

Program or academic unit faculty. The geology faculty headcount fluctuated between five and seven during the program review period. Seven faculty members were in residence during fall 2016. Every geology faculty member has a doctorate from a leading research institution and is recognized university-wide, state-wide, nationally, and internationally as a subject-matter expert and for contributions to teaching, scholarship, and service in their specialization. Among geology programs at Illinois universities, public or private, the geology faculty at Illinois State University graduates the most students per faculty full-time-equivalency than geology faculty at any other institution. From 2008 to 2015 a geology faculty member also served as chairperson of the Department of Geography, Geology, and the Environment.

Program goals and quality indices. Hydrogeology is a field of science that encompasses the geologic and hydrologic aspects of water, both surface and subsurface. The goal of the hydrogeology master's program at Illinois State University is to graduate students with advanced knowledge of applied environmental and resource hydrogeology.

Student learning outcomes assessment plan and process. Students who complete the M.S. in Hydrogeology program are expected to understand and display proficiency in physical and chemical hydrogeology, to be able to develop new groundwater resources and manage existing ones and to perform field and laboratory techniques for collection of physical and chemical hydrogeologic data, and to understand the theories and mathematical solutions underlying numerical models used to solve hydrogeologic problems. Graduates are also expected to be proficient in the use of software to manipulate, display, and interpret hydrogeologic data; to be familiar with and able to discuss current research and techniques in water resources; and to have oral and written skills appropriate to the discipline.

Annual assessment of student learning outcomes in the hydrogeology program has three parts. The first involves evaluation of the hydrogeology and geochemistry sections of the final report required in the introductory groundwater modeling course. The second involves application of rubrics to the research project in the required aqueous geochemistry course. The third involves application of rubrics to the final project in the capstone fieldwork course, which requires students to create a conceptual model by drawing on content from all other core courses in the program. In addition to these three annual assessment activities, all hydrogeology students are interviewed once they have completed their thesis or comprehensive examination. Historically, the exit interview has been conducted face-to-face. However, as more students have been completing the program while off campus, exit interviews have begun to be administered electronically. The exit interview also provides an opportunity for faculty to monitor the first career steps of graduates.

Specialized accreditation. Hydrogeology, as a discipline, does not have an accreditation or certification process. Thus, the M.S. in Hydrogeology program is not affiliated with or recognized by a specialized accreditation association.

Responses to recommendations resulting from the previous program review. At the conclusion of the 2008-2009 review of the M.S. in Hydrogeology program, the Academic Planning Committee asked faculty to consider three recommendations during the subsequent program review cycle: 1) continue efforts to ensure a diverse faculty, 2) develop and implement a recruitment plan for a diverse student population, and 3) increase student and faculty participation in the research symposium at the University. The Department of Geography, Geology, and the Environment has since made significant progress advancing demographic diversity of its faculty. All four recent faculty hires, in addition to being the top candidate in their respective search pool, are either female or self-identify with a racial or ethnic group traditionally underrepresented in geology faculty ranks nationwide. Two of the four hires are hydrogeologists. The level of cultural diversity among students in the hydrogeology program remained

stable during the program review period, closely mirroring the level of cultural diversity across the hydrogeology discipline nationwide. Hydrogeology faculty members have strongly encouraged their students to participate in the annual University Research Symposium. Faculty has instituted a policy whereby students must present at the symposium to qualify for research awards conferred by the department.

Changes in the academic discipline, field, societal need, and program demand. The field of hydrogeology has experienced a slow shift toward greater use of computational analyses to evaluate spatial and temporal data. Academic programs in the discipline are being modified accordingly. Increasing pressure from society and from governmental units to protect the environment, specifically water, should ensure the need for hydrogeologists in the foreseeable future. Over the next decade, a 14 percent increase in geoscience jobs is predicted, which is three percentage points higher than projected growth of the entire United States workforce. Among geoscience positions, employment of environmental scientists and environmental engineers is expected to grow the most. In Illinois the locus of many new geoscience positions will be the greater Chicago metropolitan area. Physical development in the Chicago area requires the preparation of environmental impact statements, which geologists will have a hand in preparing. As opportunities for employment in the field increase, demand for admission to the M.S. in Hydrogeology program at Illinois State is expected to grow. With the recent hiring of new faculty members, the program has the capacity to support that growth.

Major findings of this program review self-study. With its focus on a single sub-discipline of geology, the M.S. in Hydrogeology program at Illinois State University is unique in the state, region, and nation. Despite its narrow content focus, the program ranks third with respect to enrollment in master's-level geology programs in Illinois and second with respect to degrees conferred. Contributions by hydrogeology faculty and students at Illinois State to scholarship in the discipline have been numerous since the 2008-2009 program review. Students in the program have generated 24 peer-reviewed manuscripts, 10 geologic maps, and 62 presentations since that review.

Initiatives and plans for the next program review cycle.

- Revise and strengthen the student learning outcomes assessment plan for the program
- Recruit a more diversified student body
- Explore ways to increase graduate assistantship stipends to amounts more competitive with those offered by other universities
- Continue to expand the research profile of hydrogeology faculty
- Increase funding for faculty research from external, indirect-cost generating sources
- Maintain the ability to offer field experiences in existing courses and in new courses
- Renovate and upgrade research facilities
- Renovate and upgrade teaching facilities, including traditional classrooms and the computer laboratory
- Identify new and stable revenue streams to supplement state-appropriated funds, to enable the department to address its fiscal challenges
- Explore developing metrics for including student research mentoring in an individual faculty member's teaching load
- Explore the creation of an accelerated hydrogeology master's program that would make it possible for high achieving students to complete the B.S. in Geology program and the M.S. in Hydrogeology program in five years
- Explore collaboration with the Career Center at the University to enhance career guidance for students in the program
- Increase start-up funding for newly-hired faculty

PROGRAM REVIEW OUTCOME AND RECOMMENDATIONS FROM THE ACADEMIC PLANNING COMMITTEE

Review Outcome. The Academic Planning Committee, as a result of this review process, finds the M.S. in Hydrogeology program to be in Good Standing.

The Academic Planning Committee thanks faculty and staff of the M.S. in Hydrogeology program for a thorough, insightful, critical, and forward-looking self-study report that evidences meaningful involvement in the program review process by multiple stakeholders including students and alumni. Particularly noteworthy is the summary of program strengths, weaknesses, opportunities, and threats.

The committee recognizes faculty and staff for offering the only master's level hydrogeology major in Illinois and one of only four in the United States. The committee commends the program for providing a supportive academic environment to help students successfully navigate the rigorous curriculum that strongly emphasizes applied research. Faculty members provide individualized attention to students through twice weekly one-on-one meetings and through collaborative research work. Since the last program review in 2008, students have co-authored 24 peer-reviewed articles with faculty members and have published 10 geologic maps. The program provides travel funds for students to attend professional conferences at which they present their research findings; since the 2008 program review, 48 students have presented at the annual meeting of the Geological Society of America. Most full-time students in the program also present at the annual Graduate Research Symposium on campus. The committee recognizes program faculty for their collaboration with Milner Library faculty in teaching information literacy skills needed by students to succeed in their research endeavors.

Success of the M.S. in Hydrogeology program is evidenced by the more than 95 percent of students who either obtain a job in the field or are admitted to a doctoral program upon graduation. Levels of satisfaction with the program among alumni remain high; 100 percent of respondents to the alumni survey conducted especially for this program review indicated being satisfied or very satisfied with the overall quality of the program.

More than half of the students in the M.S. in Hydrogeology program serve as teaching assistants. The committee thanks those assistants who each fall and spring term teach 20 laboratory sections of the undergraduate geology course that meets general education requirements. The course enrolls nearly 1,500 students each academic year.

The committee recognizes faculty and staff for nurturing and maintaining contacts with alumni and with professional organizations, state agencies, and industries associated with the discipline. These relationships continue to benefit the program and the broader community through help recruiting students, employing students as interns or as permanent employees upon their graduation, contributions to the Powell (scholarship) Fund, participation as speakers for the colloquium series sponsored by the department, and support for research or service initiatives undertaken by faculty or students. Examples of the latter include a partnership with the Illinois Petroleum Resources Board and the Illinois Association of Aggregate Producers to offer summer physical sciences workshops for K-12 teachers in Illinois and a research collaboration involving the City of Bloomington and the Nature Conservancy to study agricultural runoff.

The committee commends faculty members for balancing their teaching and mentorship responsibilities with their own scholarship and service activities. In recent years the core faculty members teaching in the program have won the Outstanding College Teacher Award bestowed by the College of Arts and Sciences at Illinois State and the Research Initiative Award conferred by the University. One core faculty member participated in the International Panel on Climate Change, which subsequently was awarded a Nobel Peace Prize. Across all geology faculty members in the department, 52 requests for external funding have been approved since the 2008 program review totaling \$5.4 million (or approximately \$100,000 per faculty member per year). Three geology faculty members have been inducted into the (Illinois State) University Million Dollar Club in recognition of their grant-procurement successes. Faculty members also mentor students in their pursuit of external grant funds to support their own research; since the 2008 program review, 19 students have been successful in that pursuit. The committee expresses appreciation to the program for its efforts to assemble the highly-credentialed yet diverse faculty responsible for these achievements. While the field of geology is predominately white (non-Hispanic) and male, all four recent

geology faculty hires have self-identified as female and/or with a racial or ethnic group traditionally underrepresented among faculty at Illinois State and nationally across the discipline.

The self-study report indicates that the current student learning outcomes assessment plan for the program, adopted in 2013, is a “working document.” The report identifies revision of the plan as a priority for the next program review cycle, specifically adding strategies for obtaining feedback from external stakeholders. The committee concurs. As faculty considers revisions to the assessment plan, the committee suggests a scan of best practices in working with external stakeholders and in other aspects of assessment such as plan implementation strategies and use of rubrics. University Assessment Services staff is available to assist with this scan and with plan revision. The committee asks the department to submit a report to the Office of the Provost by December 1, 2019, that includes the revised plan and a brief update regarding plan implementation, assessment findings, and actions either taken or planned to be taken in response to those findings. Whatever assessment changes are considered by faculty during the next review cycle, the committee encourages ongoing attention to sustainability of those assessment efforts. Strategies such as staggering assessment of learning goals over multiple years and sampling student work rather than assessing the work of every student can help minimize the burden assessment may otherwise have on program faculty.

Recommendations. The Academic Planning Committee makes the following recommendations to be addressed within the next regularly scheduled review cycle. In the next program review self-study, tentatively due October 1, 2024, the committee asks the program to describe actions taken and results achieved for each recommendation.

- Enrollment in the program has been stable from fall 2010 to fall 2014, ranging from 16 to 20 students. Applications to the program averaged 14 during the same period, and the acceptance rate across those five years was approximately 80 percent. The self-study report articulates a goal of maintaining enrollment within or slightly above the range noted above while continuing to attract highly qualified applicants. For the program to do so larger applicant pools may be needed. To guide recruitment of those applicant pools, the committee recommends that the program develop and implement a formal student recruitment plan. Many elements of a recruitment plan are already in place, including contacts with prospective students at the annual Geological Society of America conference, sharing experiences of students in the program on the department website, and subsidizing campus visits for prospective students (a strategy which has had an 80 percent success rate in attracting applicants). Faculty might also consider additional strategies for recruiting students from other undergraduate geology programs in the state or strategies for attracting high-achieving students in the undergraduate geology program in the department, perhaps through a “four plus one” option (see below).
- The committee acknowledges the ongoing challenges the program faces in diversifying its student population. The committee commends the successful efforts of the program to increase female representation among students in the program to levels near or above the average across all geology programs in the country. Maintaining those levels and increasing the percentage of students in the program who self-identify with racial or ethnic groups traditionally underrepresented at Illinois State remain difficult challenges for the program. The committee supports the program in its continuing efforts to address these challenges. The committee recommends that the program compile and implement a plan to do so, either as part of a broader recruitment plan (see above) or as a stand-alone plan.
- The committee commends geology faculty members for their commitment to maintaining a curriculum that is current and relevant and for their collaboration with geography faculty members in their exploration of additional environmental curricula that meets the needs of students while advancing the mission of the program and department. The committee supports faculty review of the curriculum to identify different or additional content areas that could be offered (the self-study report identifies stratigraphy, organic chemistry, biogeochemistry, and civil engineering as areas to consider). The committee also recommends working with the Graduate School to explore offering a “four plus one” program for high-achieving students seeking an undergraduate degree in geology and a master’s degree in hydrogeology.
- Every respondent to the alumni survey conducted especially for this program review expressed satisfaction with the overall quality of the program. When queried about specific aspects of the program, more than 90 percent of survey participants expressed satisfaction with the quality of instruction, field experiences, and intellectual challenges of the program. Receiving slightly lower ratings (75 percent) were career development opportunities

(seemingly inconsistent with the program placement rate of 95 percent) and the effectiveness of academic advisement. Both aspects of the program merit additional investigation to determine whether strategies may be needed to improve them.

- With continued uncertainty regarding public support for higher education in Illinois, it is unlikely that the University will have sufficient funds in the near term to meet all infrastructure needs of its academic units including the Department of Geography, Geology, and the Environment. Accordingly, the committee suggests that the department maintain its plan for infrastructure development and recapitalization needed to support the M.S. in Hydrogeology program while exploring options for funding the highest priority projects identified in it. The committee suggests exploring coordination of equipment purchases with other physical science units at the University and continuing to seek external funds either through single purpose funding requests or as part of requests to fund research initiatives. The committee encourages the department to continue exploring partnerships with business and industry and outreaching to alumni, which could lead to additional private contributions to the program.
- The self-study report notes the importance of graduate assistantships to the program in recruiting students, supporting faculty research, and instructing laboratory sections of the undergraduate geology course taken by students to meet general education requirements. The report further notes the recent reduction in the number of graduate assistantships the program is able to offer, from 10 to nine, due to budget rescissions. The committee recommends that the program work with University Advancement to explore development of endowed fellowships or scholarships to help offset recent losses in general funds for graduate assistantships and, potentially, to increase the monthly stipend that can be offered to graduate assistants. In pursuing external funds for this purpose, the program may be able to draw upon the strong relationships the department has developed with alumni, professional organizations, and industry.