

Doctor of Philosophy
Hydrology & Water Resources
Program Guide

Effective Fall 2019

Doctor of Philosophy

Hydrology

36 units Coursework

21 Primary Faculty Courses

03 Field Methods/Field Synthesis

12 Other/Transfer Elective Courses

+18 units Dissertation, HWRS 920

54 units Major

plus

~12 units Minor*

*Varies, from 9-15 units

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 3 of 25 Effective Fall 2019

Contents

WELCOME	4
INTRODUCTION.....	5
TRANSFER COURSEWORK.....	6
DOCTORAL MINOR.....	7
DOCTORAL MAJOR IN HYDROLOGY.....	8
<i>Fundamental Core Courses</i>	8
<i>Primary Faculty Courses = 21 Units</i>	8
<i>Field Methods/Field Synthesis = 3 Units</i>	10
<i>Other Advanced Elective Courses = 12 Units</i>	10
<i>Dissertation 920 Units = 18 Units</i>	11
PROFESSIONAL DEVELOPMENT	12
GRAD PATH FORMS	12
<i>Responsible Conduct of Research, Transfer Credit</i>	13
<i>Doctoral Plan of Study</i>	14
<i>Comprehensive Exam Process</i>	14
<i>Committee Appointment Form</i>	15
<i>Final Oral Exam/Dissertation Defense Process</i>	15
FORMAL EXAM TIMETABLE	17
GRADUATION	17
ACADEMIC PROGRESS: TIME-TO-DEGREE COMPLETION	18
GRADUATE PETITIONS	20
APPENDIX A: EXCLUSIONS - NOT ALL HWRS COURSES ARE PRE-APPROVED.....	21
APPENDIX B: HAS GRADUATE EXAMINATION PROCEDURES.....	22
<i>Doctoral Qualifying Examination</i>	22
<i>Qualifying Exam Waiver for UA HAS Master's Students</i>	22
<i>Doctoral Comprehensive Examination</i>	23

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 4 of 25 Effective Fall 2019

WELCOME

Welcome to the Department of Hydrology and Atmospheric Sciences! Throughout your academic residency, these staff and faculty members will provide student services that support your academic life. Learn more about what staff do at the HAS website [Contact page](#).

Graduate students typically have **assigned office space** (see Corley), **computer lab room access** (see Santander and Phelan), and **key/card access to the building** (see Santander). Students supported through **graduate assistant or hourly wage positions** are hired through the business office (see Alvarez and Varin). Students receiving departmental- or college-sponsored **financial aid** should work with the graduate program coordinator (see Romero).

Name & Contact @email.arizona.edu	Telephone	Student Service & Location
Dr. Eric Betterton better@	520-621-7121	Department Administration Chair, JWH Room 122
Dr. Tom Meixner tmexiner@	520-626-1532	Department Administration Co-Chair, JWH Room 202C
Dr. Martha P.L. Whitaker marthaw@	520-621-9715	Director, Graduate Studies-Hydrology JWH Room 226A
Thomas Alvarez alvarezt@	520-626-3241	Business Office JWH Room 122
Kathy Varin kvarin@	520-621-6834	Business Office JWH Room 122
Tom Phelan phelante@	520-621-4187	IT + Computer Labs JWH Room 324H
Lupe Romero romerog@	520-621-6831	Graduate Program Coordinator-ATMO JWH Room 226
Terrie Thompson tht@	520-621-3131	Graduate Program Coordinator-HWR JWH Room 226
Erma Santander ermasan@	520-621-7120	Office Administration JWH Room 122
Sarah Warren sdotwarren@	520-621-0275	Office Administration JWH Room 122
Tim Corley tcorley@	520-626-5893	Space Management & Director, Analytical & Research Support JWH Room 324E
HAS Student Association uahassa@gmail.com	HASSA & HASSA Calendar	

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 5 of 25 Effective Fall 2019

INTRODUCTION

The Doctor of Philosophy degree in Hydrology and Water Resources requires a combination of 1) approved coursework for the Major area of study—Hydrology—and the Minor area of study—a complementary area of study that you will choose, 2) professional development experience, and 3) significant independent research and scholarship.

Enrollment: Once matriculated, you must maintain **continuous enrollment** during all major semesters (fall and spring) until all degree requirements are met.

If you complete degree requirements (e.g. take final exam and/or submit your dissertation manuscript) *during the summer or winter session*, you do not need to enroll for credit.

Degree requirements must be completed within 10 years, beginning with the *earliest coursework*, to ensure currency of knowledge. The **10-year clock** for time-to-degree begins with the first course, including transfer credit from another institution.

Coursework: The Doctoral Major Plan of Study in Hydrology requires 36 semester units of coursework and 18 dissertation units (minimum of 54 units for the Major). The Minor Plan of Study typically requires 12 units but varies, ranging from 9 to 15 units. Typically, students complete ~66 units.

- **TRANSFER** – A maximum of **12** graduate semester units, if deemed appropriate, may be transferred for use in the Major. See the Director of Graduate Studies-Hydrology for advice about courses that may be applied to the Major. Contact the Minor department's Director of Graduate Studies for advice about Minor coursework. No more than 12 graduate semester units taken in **non-degree status** may be used.
- **CUM GPA** – A minimum cumulative GPA of 3.0 or B average is required to remain in Good Academic Standing with the Department, Graduate College, and University.
- **QUALITY POINT GRADES** – At least half of the coursework listed on the Plan of Study (Major+Minor) must be graded with quality-point grades (A, B).
- **PASSING GRADES** –A course with a grade of D or lower cannot be included in any graduate degree program. A grade of C is acceptable only if you maintain a *cumulative GPA* of 3.0 or higher.
- **UNIVERSITY OF ARIZONA UNITS** – At least 30 graduate-level semester units must be completed at the University of Arizona.
- **NO GRO** – The department does *not* permit use of the GRO Grade Replacement Opportunity.
- **AVERAGE TIME-TO-DEGREE COMPLETION** – Depending on several factors—undergraduate preparation, the use of transfer coursework (or lack of), the specific topic and scope of research, and the research method used—most PHD students complete requirements in 3.5 to 4 years.

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 6 of 25 Effective Fall 2019

- **GOOD STANDING STATUS** – To maintain Good Academic Standing, you must complete degree requirements in a reasonable timeframe as described in the Academic Progress: Time-To-Degree Completion section (p. 18). Degree requirements include completion of required undergraduate prerequisite courses by the end of year 1, completion of fundamental and advanced graduate coursework in the major and minor, satisfactory progress on dissertation research, satisfactory completion of professional development requirements, and timely submission of administrative forms (see Grad Path section below).

Professional Development Experience: You must develop a very high level of oral presentation skills (professional level) by observing student research- and invited speaker-presentation techniques and later demonstrate these skills by presenting your own doctoral research. You will be required to enroll in **HWRS 595A *Current Topics in Hydrology and Atmospheric Sciences***, the Weekly Invited Speaker Colloquium, for one at least one semester during academic residency (1-unit maximum per semester). (Units not included in Plan of Study.) During the final semesters of residency when your doctoral research is nearing completion, you will be required to **present your research at two approved conferences (minimum of one oral presentation)**. See the Professional Development section of this guide (p. 11) for details.

Independent Research and Scholarship: As a doctoral student, you are required to undertake significant and independent research which culminates in a work that makes a unique and important contribution to the field of hydrology and water resources. Completion and publication of a research-based Doctoral Dissertation, and successfully defending the research, is a hallmark of the doctoral degree program. The Graduate College recognizes this activity by inclusion of 18 dissertation units on the Major Plan of Study, equivalent to 2 full-time semesters (or one Academic Year) for time spent while engaged in research and writing the dissertation.

Computer Programming: All graduate students are expected to have or to acquire capability for basic coding/computer programming (e.g. Python, MATLAB, Fortran, C++). Semester courses or short courses offered by various departments (e.g. Systems and Industrial Engineering, Civil Engineering, Electrical and Computer Engineering, and Computer Science) and the University Information Technology center are available. No graduate credit is granted for this work.

TRANSFER COURSEWORK

If you have some prior graduate-level coursework completed with grades of A or B from another institution, you may request a transfer of coursework to be applied to the doctoral program. You should also consider the **doctoral 10-year clock** when making these decisions. Discuss this with the Director of Graduate Studies-Hydrology and your Faculty Advisor to determine which courses might be appropriate for your Major Plan of Study. Also, you may be able to transfer coursework for the Minor Plan of Study, a complementary field of study that you will choose. The Minor department will determine which courses, if any, may be appropriate for inclusion.

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 7 of 25 Effective Fall 2019

You should submit the **Transfer Evaluation Form** in Grad Path by the end of the second semester in residence. Some restrictions apply:

- Unless you completed a Master's degree **in HWRS** at the University of Arizona, a maximum of **12** graduate semester units may be transferred for use in the Hydrology Major
- Transfer course grades must be quality-point grades (e.g. A or B or their equivalents); courses with grades of S (satisfactory or superior) or P (pass) may not be used
- List courses *as they appear on the official transcript*; do not convert course units or grades
- The Graduate College will make calculations based on the grading scale/legend on the official transcript, the WES scale, or other official reference material
- Courses used to satisfy an undergraduate degree program, regardless of actual course level, are not transferrable
- Correspondence courses and extension courses are not transferrable

DOCTORAL MINOR

You must choose a Minor area of study to complement your academic areas of expertise. Both the Minor Faculty Advisor and the Minor coursework should support your research and scholarship efforts. For Hydrology Majors, some common Minors and their course prefixes are:

- Applied Mathematics (APPL & MATH)
- Arid Lands Resource Science (ARL)
- Biosystems Engineering (ABE)
- Civil Engineering (CE)
- Computer Science (CS)
- Geography and Development (GEOG)
- Geological Engineering (GEN)
- Geosciences (GEOS)
- Global Change (GC)
- Mining Engineering (MNE)
- Remote Sensing and Spatial Analysis (REM)
- Soil, Water, and Environmental Science (ENVS/SWES)

Consult with your Minor department for details, including the number of units required. Some departments require two faculty advisors, others may require only one. Some may require specific courses and allow you to choose the remaining courses from a list of electives. Some may allow you to transfer one or more courses from a prior graduate degree.

DOCTORAL MAJOR IN HYDROLOGY

Fundamental Core Courses

You are not required to take fundamental core courses—commonly known as Master’s Core Courses—although you may find them useful, particularly if your prior education emphasized just one area of hydrology and water resources. In principle, doctoral students are expected to have academic *breadth* in all areas of hydrology and water resources, as well as *depth* in their individual areas of expertise. Your breadth of knowledge will be examined during the Doctoral Qualifying Examination near the middle/end of Year 1, so taking one or more core courses may be very beneficial (see Appendix B, p. 22).

The fundamental core courses are not sequential and may be started in either the fall or spring semesters. Core courses are included in the **first series of electives**, **Primary Faculty Courses** (p. 9). Undergraduate prerequisite and co-requisite courses must be completed prior to, or concurrent with, the graduate-level course that requires them, and all must be completed by the end of Year 1. Core courses are 3-unit lecture format, unless noted otherwise.

- **HWRS 517A** Fundamentals of Water Quality (Fall)
- **HWRS 518** Fundamentals of Subsurface Hydrology (Fall)
- **HWRS 519** Fundamentals of Surface Hydrology (Spring)
- **HWRS 528** Fundamentals: Systems Approach to Hydrologic Modeling (Fall)

Fundamental water policy courses dealing with economic, social, and legal issues may also be included in the Doctoral Plan of Study in the **second series of electives**. The following are pre-approved non-primary faculty courses (see complete list in Other Advanced Electives, p. 10-11).

- **AREC/HWRS 575** Economics Water+Envir Markets/Incentive-Based Policies (Fall)
- **AREC/HWRS 576** Natural Resource Law and Economics (Spring)
- **LAW/HWRS 641** Water Law (Spring)

Primary Faculty Courses = 21 Units

Primary Faculty Courses are the **first series of electives** you will take to satisfy degree requirements. Primary Faculty members in Hydrology include:

Victor Baker	Tom Meixner
Ali Behrangi (HWRS 555 only)	Guo-Yue Niu
Laura Condon	Peter Troch
P.A. Ty Ferré	T.C. Jim Yeh
Bo Guo	Larry Winter
Hoshin Gupta	Marek Zreda
Jennifer McIntosh	

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 9 of 25 Effective Fall 2019

A Primary Course is one in which the Primary Faculty teaching load is 50% or more. Courses with multiple instructors where less than 50% is taught by a Primary Faculty member are not included in this category. **You must complete a minimum of 21 units (seven 3-unit courses) in this category.**

All Primary Faculty courses use the prefix HWRS (where HWRS is the Home Department) and are **3-unit/lecture-format courses** unless noted*. Some Non-Primary Faculty courses also use the HWRS prefix; if they're not listed here, they are not Primary Faculty courses.

- **503** Subsurface Fluid Dynamics (Fall)
- **504** Numerical Methods Subsurface Hydrology (Spring)
- **505** Vadose Zone Hydrology (Fall)
- **516** Hydrologic Transport Processes (Fall)
- **517A** Fundamentals of Water Quality (*Master's Core—Fall*)
- **518** Fundamentals of Subsurface Hydrology (*Master's Core—Fall*)
- **519** Fundamentals of Surface Hydrology (*Master's Core—Spring*)
- **521** Water Resources Systems Planning and Management (Fall)
- **524** Hydroclimatology (Spring)
- **528** Fundamentals: Systems Approach to Hydrologic Modeling (*Master's Core—Fall*)
- **531** Hydrogeology *3 units LEC & 1 unit LAB (Fall)
- **532** Environmental Hydrogeology *3 units LAB (Spring)
- **535** Advanced Subsurface Hydrology (Spring)
- **543A** Risk Assessment for Environmental Systems (Fall)
- **549** Statistical Hydrology (Fall)
- **553** Glacial and Quaternary Geology (Baker) **Exception to cross-listed rule; GEOS is home*
- **555** Introduction to Remote Sensing in Atmospheric and Hydrologic Sciences (Behrangi) (Spring) **Exception to cross-listed rule; ATMO is home*
- **570** Computer Simulation Water Quality Processes (Spring)
- **573** Hydrology for Water Resources Management (Fall)
- **580** Isotope Tracers in Hydrogeology (Spring)
- **582** Applied Groundwater Modeling (Spring)
- **596G** Water-Rock-Microbial Interactions (Spring)
- **603A** Well Hydraulics & Pumping Test Analysis (*taught as needed*)
- **630** Advanced Catchment Hydrology (Fall)
- **642** Analysis of Hydrologic Systems (Spring)
- **645** Stochastic Methods Subsurface Hydrology (Spring)
- **655** Stochastic Methods Surface Hydrology (Fall)
- **696H** Advanced Topics in Geochemistry of Crustal Fluids (*taught as needed*)
- **696T** Cosmogenic Isotopes and Other Environmental Tracers (*taught as needed*)

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 10 of 25 Effective Fall 2019

Independent Study enrollment (e.g. HWRS 599, 699) is not included here and **may not be used to replace a 3-unit lecture course**. *Exception:* These units may be used when a course is canceled due to low enrollment (less than 5 students) as a means to continue the course with a smaller number of students. Approval by the Director of Graduate Studies-Hydrology is required to include these units in the Plan of Study. Be aware, however, that independent study units will not receive quality-point grades (e.g. A, B) and will not impact the cumulative GPA.

Field Methods/Field Synthesis = 3 Units

The HWRS field methods/synthesis two-course sequence is required for all students and should be completed in the same calendar year:

- HWRS 513A (2) Field Methods (Spring)
- HWRS 513B (1) Field Synthesis (Summer Pre-Session)

A field camp experience in Geology does not routinely satisfy this requirement; however, prior employment or experience may warrant a waiver. The waiver process is used primarily by individuals who were formerly (or are currently) employed by government agencies (e.g. USGS, AZGS, and USDA ARS), private consulting firms, or national laboratories. To request a waiver,

- Submit a letter requesting waiver of the requirement to the Director of Graduate Studies-Hydrology (DGS-H)
- Include a resume with details of your prior employment or experience that support your request, such as a description of job duties, relevant skills or certifications required, tools or equipment used, and, if appropriate, contact information for a former supervisor of field work
- **No academic credit** (units, grade, etc.) can be awarded when this requirement is waived, so you must **replace field methods/synthesis units with an HWRS Primary Faculty course** to meet degree requirements (see the DGS-H for advice)

Other Advanced Elective Courses = 12 Units

The **second series of electives** allows some flexibility in choice of remaining coursework and may include:

- Additional HWRS Primary Faculty courses
- Pre-Approved Non-Primary Faculty courses
- Approved Transfer Coursework (12 units maximum)
- One or more courses from outside the Hydrology course list 1) if relevant to your academic and research goals and 2) if approved by the Director of Graduate Studies-Hydrology and your faculty advisor

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 11 of 25 Effective Fall 2019

Courses in the second series of electives should be sufficiently advanced to warrant inclusion in the Doctoral Plan of Study. In some cases, a **co-convened course** (i.e. course numbered 4xx-5xx) taught as a combined undergraduate-graduate course **does not** meet this requirement. Discuss your choice of courses with the Director of Graduate Studies-Hydrology.

Non-Primary Faculty Courses (most cross-listed with HWRS) **pre-approved** for use by Hydrology doctoral majors include the following (home department prefix noted first):

- ATMO/HWRS 529 Objective Analysis in Atmospheric and Related Sciences
- ATMO/HWRS 558 Mesoscale Meteorological Modeling
- ATMO/HWRS 595C General Circulation Observations-Modeling (1-3)
- AREC/HWRS 575 Economics of Water & Environmental Markets and Incentive-based Policies
- AREC/HWRS 576 Natural Resource Law and Economics
- AREC/ HWRS 577 Advanced Topics Economic Environmental Regulation
- ENV5/HWRS 566 Soil and Groundwater Remediation
- ENV5/HWRS/LAW 596B Arizona Water Policy *If enrolled as LAW, permission and registration through College of Law*
- ENV5/WSM 696M Using MATLAB for Environmental Data Processing
- LAW 606 Constitutional Law I *Permission and registration through College of Law*
- LAW/HWRS 641 Water Law *Permission and registration through College of Law*
- PA/HWRS 581 Environmental Policy (3)
- WSM/HWRS 696Q Practical and Applied Meteorology (1-3)

Some HWRS courses listed in the Catalog and Schedule of Classes are **not automatically approved** for the Doctoral Plan of Study. Often, these courses have been cross-listed with HWRS to satisfy other departments' curricular requirements and not necessarily for our students. HWRS Primary Faculty members *do not teach these courses*. Nearly all of these courses are **co-convened** at both the undergraduate and graduate levels and may be less rigorous than graduate-only courses. For a list of some of these courses, see **APPENDIX A: EXCLUSIONS** – NOT ALL HWRS ARE PRE-APPROVED (p. 21).

Dissertation 920 Units = 18 Units

After you have passed the Doctoral Qualifying Examination, you will be eligible to enroll for HWRS 920 Dissertation units (enroll in your faculty supervisor's individual section number). Ask the program coordinator to enroll you for these units. Dissertation units receive non-quality grades, Superior/S or Pass/P, and do not impact your cumulative GPA. There is no limit to the number of units you can enroll for during academic residency; however, you should **include only (exactly) 18 units of HWRS 920 Dissertation on the Doctoral Plan of Study.**

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 12 of 25 Effective Fall 2019

PROFESSIONAL DEVELOPMENT

You must develop a very high level of oral presentation skills (professional level) by observing student research- and invited speaker-presentation techniques and later demonstrate these skills by presenting your own doctoral research. There are 2 components of this requirement:

1) You must **enroll in HWRS 595A** Current Topics in Hydrology and Atmospheric Sciences (1-unit maximum per semester), the Weekly Invited Speaker Colloquium, for *at least one semester* during academic residency. **Do not include these units on your Doctoral Plan of Study.** When completing the form, classes you have completed may **automatically fill** the list, so you **may have to *delete these units from your plan***. The Director of Graduate Studies-Hydrology will confirm that you have completed this enrollment requirement during the Plan of Study review process.

2) To **demonstrate competence** in presentation skills, you must present your own doctoral research—minimum one oral presentation—at **two (2) approved conferences**. If the presentation format at an annual meeting (e.g. AGU, AHS, AMS, EGU, GSA) will be a poster (highly likely), you should make an **oral** presentation at the annual student research conference (El Día).

- An oral (preferred) or poster presentation of your Dissertation research at the **department's annual student research symposium, El Día del Agua y la Atmósfera**, satisfies 1 of 2 presentations
- The second presentation (poster preferred) should be made at a professional conference or annual meeting (e.g. AHS, AGU, AMS, EGU, GSA)
- Be sure to make at least one oral presentation at an approved conference
 - If you make two poster presentations—e.g. poster at El Día and poster at AGU—you will be required to attend a *third* conference to make an oral presentation!

See the Director of Graduate Studies-Hydrology to discuss any issues you may have in meeting these requirements.

To satisfy these requirements, **submit a memo** (email) to the Director of Graduate Studies-Hydrology with the **names, dates, and locations of the conferences** you attended and the **titles and formats** (oral or poster) **of your presentations**. Also include a **PDF of the conference program or a URL** that links to an electronic copy of the program **with your presentation (and possibly abstract) listed**.

GRAD PATH FORMS

GradPath is the Graduate College's nearly paperless system that makes tracking and monitoring student progress much easier. Students can fill out and submit forms online through UAccess Student. The forms are routed electronically to everyone who needs to review or approve them.

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 13 of 25 Effective Fall 2019

Forms are sequential and each one must be approved before proceeding to the next form. Most are self-explanatory, but **more details about some of these forms follow this section.**

- Responsible Conduct of Research
- Evaluation of Transfer Credit
 - Use only if you include external transfer courses in the Plan of Study
- Doctoral Plan of Study
- Comprehensive Exam Committee Appointment
- Announcement of Doctoral Comprehensive Exam
- Results of Comprehensive Exam
 - Submitted electronically by your faculty advisor and committee chair
 - [Candidacy fees](#) are charged to your student Bursar Account upon advancement to doctoral candidacy
- Verification of Prospectus/Proposal Confirmation
 - Send a copy of your dissertation abstract to the program coordinator when you initiate the Comprehensive Exam process
 - The verification form is submitted by the program coordinator
- Doctoral Dissertation Committee Appointment
- Announcement of Final Oral Exam/Defense
 - Must be submitted and approved at least 10 business days before the exam date
- Final Oral Exam (Defense) Instructions (Instructions for committee members)
 - Students: See the Final Oral Exam Process section in this guide for details (p. 15)
- Results of Final Oral Exam/Defense
 - Submitted electronically by your faculty advisor (dissertation director)
- [Dissertation Checklist](#) (use after the final defense has been completed)
 - Includes Distribution Rights Form and Survey of Earned Doctorates links
- [Submission of Final \(Approved\) Dissertation for Archiving](#)
- Exit Survey for Graduate College

Refer to the [GradPath website](#) for FAQs related to preparing these forms.

Responsible Conduct of Research, Transfer Credit

Responsible Conduct of Research: “Fostering a culture and expectation of responsible and ethical conduct of research is a critical component in the advancement of knowledge through research and scholarship. It is a key element in the maintenance of public trust in the research enterprise.” *Source: UA Office of [Research, Discovery, and Innovation](#)*

All students must complete the Responsible Conduct of Research (RCR) Statement form. Additionally, an [RCR Workshop](#) is required for any student who is financially supported by an NSF, NIH, or NIFA grant.

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 14 of 25 Effective Fall 2019

Transfer Credit: Submit this form during the first or second semester in residence to obtain approval for *any potential Transfer Credit* (graduate-level coursework already completed) for later use in the Doctoral Plan of Study. Discuss details with the Director of Graduate Studies-Hydrology.

Doctoral Plan of Study

You should submit the Doctoral Plan of Study form in GradPath by the end of the second semester or early in the third semester in residence. Early submission will give you a concrete and clear path to completing degree program requirements in a reasonable time. You can adjust your Plan of Study in later semesters if circumstances require a change.

You should **first arrange an appointment with the Director of Graduate Studies-Hydrology** to discuss the Plan and confirm that all degree requirements have been understood and will be satisfied. After that meeting, you can submit the Plan of Study form which should include the graduate units approved by the Director of Graduate Studies-Hydrology and exactly 18 units of HWRS 920 Dissertation.

You may need to **delete some entries** that autofill on the form:

- *Delete* your enrollment for HWRS 595A (we will confirm this so you don't need to list it)
- *Delete* excess 920 Dissertation units (any number greater than 18)
- *Delete* 599, 699, or 900 independent study/research units you may have taken to meet enrollment requirements for financial aid or an international visa

Comprehensive Exam Process

The Doctoral Comprehensive Examination Process is described in **Appendix B** (p. 22) of this guide and includes important instructions about:

- When to initiate the exam process
- Understanding the Written and the Oral components
- How to form a committee and prepare for the exam
- Scheduling a room for the exam
- What happens after the exam

Prior to the exam date, the Graduate College will send a link to the Results form directly to your Faculty Advisor (dissertation director), so he or she may report the results of the exam electronically to the Graduate College. Paper forms are not used for this exam.

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 15 of 25 Effective Fall 2019

Committee Appointment Form

After you have passed the Oral Comprehensive Examination and your faculty member has reported the results to the Graduate College, you may submit the **Committee Appointment Form**. Under normal circumstances, this submission is expected at least 6 months prior to scheduling the Final Oral Examination. This informs the Graduate College 1) which faculty members will serve on your final oral exam (dissertation defense), 2) the working/tentative title of your dissertation, and 3) what term (semester and year) you expect to complete all degree requirements.

The dissertation committee may or may not be the same as the one you created for the Comprehensive Exam process. (Often it is smaller if the minor chooses not to participate in the defense, but sometimes it's exactly the same.) You must have a minimum of 3 tenured or tenure-track University of Arizona faculty members, and at least 2 of the 3 must be primary Hydrology faculty members.

A fourth member may be a UA tenured or tenure-track faculty member or an approved **Special Member**. A special member could be a UA non-tenured research scientist, a non-UA faculty member from another university, or an approved scientist from an external agency or laboratory. See the program coordinator for advice about obtaining Special Member approval.

Final Oral Exam/Dissertation Defense Process

Timing: Only you and your faculty advisor can determine when you are ready to defend your dissertation research. Typically, this comes about 1 to 1.5 years after you have completed all coursework for the Major and Minor. When the penultimate draft of your dissertation manuscript has been accepted by your faculty advisors (Major, Minor), you can initiate the final exam process.

Preparation: It is *essential* that you practice your presentation and learn to navigate the impromptu Q&A process which will surely happen during your final oral exam. The "research presentation" component of the Professional Development requirement helps prepare you for formal exams. Every time you present your work at a meeting or conference, you will become more and more comfortable with extemporaneous speaking. Practice at every opportunity until you can talk with confidence about the work you have done. Prior to any formal examination (Comprehensive or Final), you can reserve a conference room in the department to practice presenting to students and faculty members. The more you practice, the better prepared you will be on the day of your formal exam.

Identify committee: Following the Oral Comprehensive Examination, you submitted a Committee Appointment form. Unless members listed on that form have changed, you do not need to submit additional information to the Graduate College. If you wish to revise membership, contact the Graduate College's student services degree auditor and ask him or

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 16 of 25 Effective Fall 2019

her to return the Committee Appointment form to you so that you may submit the new information.

Schedule the exam: After members of your committee have approved the penultimate draft, you should propose several dates/times to hold the exam. When a date and time has been agreed upon, contact a HASSA staff member (Romero, Santander, Warren) to reserve a room for the exam. You will need a 2.5- to 3-hour block of time for the exam (e.g. set up, initial public presentation, closed-door examination by the committee, and deliberation and voting by committee).

- The public presentation should last no more than 1 hour
- After the presentation, the public should withdraw so that the committee may examine you in private for a more in-depth discussion of research findings, conclusions, and the manuscript as a whole
- There is no minimum time allotted for the exam, although the maximum time (all components) is 3 hours

You must submit the Announcement of Final Oral Exam/Dissertation Defense form in GradPath at least **10 business days in advance** so that the information can be published in the UA Master Calendar. The initial presentation portion of all doctoral final exams is open to the public.

Paper Forms and Signature Page: Notify the program coordinator about your forthcoming exam, and she will send exam instructions to the dissertation director that provide Graduate College guidelines for conduct of the exam, such as the tone and type of questions which may be asked, the focus of the exam (your dissertation research and conclusions, not general knowledge), the voting requirements for Pass or Fail, and the rules for acceptance of the dissertation with or without revision. She may also ask your dissertation director to physically sign a Change of Grade form (hard copy) for 920 Dissertation units if some of these units are not graded on your transcript.

Print out (regular copy paper) and take a signature page (Page 2 of the Dissertation) to the exam in the event that faculty members are prepared to sign it confirming your completion of the dissertation manuscript.

Your dissertation director must report the results of the exam in GradPath using the **Results of Final Oral Exam Dissertation Defense form**. (The Graduate College will send this link to your advisor after you submit the Announcement of Final Exam form.) There are 3 options on the Results form: 1) Pass with No Revision, 2) Pass with Revision, or 3) Fail.

Post-exam: If you Pass the exam and your manuscript is approved with no revision required (i.e. **Pass with No Revisions**), you will be notified by the Graduate College Student Services office and given instructions on how to submit your dissertation manuscript electronically for archiving by ProQuest/UMI.

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 17 of 25 Effective Fall 2019

If your manuscript requires some revision after your exam (i.e. **Pass with Revisions**), your committee will provide guidance on the specific revisions required and an expected date of completion. The Graduate College requires that all revisions be completed within one year.

- Your faculty advisor should notify the program coordinator when your revisions have been accepted and all members have signed your Page 2 signature page.

If you fail the exam (**Fail**), your committee will vote whether or not to recommend a retake (repeat) of the exam. The Graduate College allows no more than two attempts to pass the exam (first attempt, one re-take).

FORMAL EXAM TIMETABLE

- **~Year 1** Doctoral Qualifying Examination – see APPENDIX B: HAS Graduate Examination Procedures
 - Beginning of the second semester: Contact the program coordinator for exam instructions and committee assignment
- **~Year 2.5 to 3** Comprehensive Examination (Written and Oral Components) – see APPENDIX B: HAS Graduate Examination Procedures
 - Initiate after ALL coursework has been completed, about Year 2.5-3
 - After passing the Comprehensive Exam process, you must complete degree requirements (e.g. write dissertation, successfully defend, submit manuscript for digital archive) within 5 years or repeat the Comprehensive Exam process
- **~Year 4** Final Oral Examination (Dissertation Defense) – see Final Oral Exam section (p. 15)
 - See the Graduate College [Degree Dates and Deadlines](#) website for important “last day/due by” dates related to the Final Oral Exam (Defense) process, announcement, and submission of the dissertation for archiving

GRADUATION

Commencement: There are multiple ways to celebrate your graduation with friends and family. Depending on the time of year you complete requirements, you may attend the campus-wide [Commencement Ceremony](#) in May and/or the [College of Science Graduation Convocation](#) (May and December). Students graduating in August or December may attend the campus-wide May commencement ceremony if they wish. You must **RSVP** to attend all ceremonies. Find more information and RSVP links on the HAS website under the **Events** tab (dropdown menu).

Exit Interview and Housekeeping: When you are ready to graduate, please **return** any keys and borrowed manuscripts, books, or equipment to the department (see Santander regarding **return of keys**). It’s also important to clean up and tidy your office space and desk for the next student. If you have mail forwarded to the department address, submit a U.S. postal [Change of Address card](#) (we will *return-to-sender* first class mail and will not forward other postal mail).

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 18 of 25 Effective Fall 2019

Please arrange an appointment with the Director of Graduate Studies-Hydrology (see Whitaker) for a final exit interview to discuss your experiences in the graduate program. You may be able to complete this online.

ACADEMIC PROGRESS: TIME-TO-DEGREE COMPLETION

Students in Good Academic Standing and making good progress meet these benchmarks:

Year 1

Before/Beginning of Year 1

- Meet with Director of Graduate Studies-Hydrology to discuss undergraduate course deficiencies (if any) and potential graduate coursework for first year
- Make a plan to complete specific courses for the first two semesters
- Submit **Responsible Conduct of Research Form** in GradPath
- Take RCR *workshops* if required by your funding agency
- Discuss potential transfer coursework with the Director of Graduate Studies and your faculty advisor and submit the **Transfer Course Form** (optional)

By End of Year 1 (end of second semester in residence)

- Complete all undergraduate course deficiencies, if any (see Director of Graduate Studies-Hydrology)
- Complete all components of the Doctoral Qualifying Exams, Major and Minor (if any)

Year 2

Before/Beginning of Year 2

- Make a plan to complete specific courses for the next two semesters

By End of Year 2

- Make adjustments (add new courses, delete courses not available) to plan to satisfy Major and Minor course requirements
- Submit **Doctoral Plan of Study Form** (Major/Minor) in GradPath

Year 3

Mid to End of Year 3

- Submit **Comprehensive Exam Committee Appointment Form** after all coursework for the Major/Minor has been completed (form should include a list all members serving on the Major and Minor committees)
- Follow instructions for the Doctoral Comprehensive Examination process (see Appendix B, p. 22)

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 19 of 25 Effective Fall 2019

- After completing the Written portion of the Comprehensive exam, submit the **Announcement of Doctoral Comprehensive Exam Form** in GradPath
 - Arrange a time/date/location for the exam with staff (Santander, Romero, Warren) to reserve a room – use this information when submitting the Announcement Form
- Your faculty advisor (dissertation director) will receive a link from the Graduate College to submit the **Report of Comprehensive Exam Form** (the results, Pass or Fail)
- The **5-Year clock** starts: You must complete all doctoral degree requirements within the next 5 years or repeat the Comprehensive Exam process. This clock guarantees “currency of knowledge” in the Major and Minor fields of study.

Year 4 and beyond

Before/Beginning of Year 4

- Submit a copy of your dissertation abstract (aka Prospectus) to the department’s program coordinator (copy to be retained in your file at department)
- The program coordinator will submit the **Prospectus Confirmation Form** on your behalf

Beginning of ***Final Semester***

- Meet with faculty advisor (dissertation director) to discuss timing of the final exam
- Define committee membership and reserve a room for the exam
- Submit the Doctoral **Dissertation Committee Appointment Form** in GradPath

End of ***Final Semester***

- Complete your work and writing (penultimate draft) and submit to your dissertation director and committee members at least 3 weeks in advance of the exam date
- Submit the **Announcement of Final Oral Exam Form** at least **10 business days in advance** of the exam date
 - The Graduate College will send an electronic link to the dissertation director to submit the **Report of Final Oral Exam/Dissertation Defense Form** (the results, Pass Without Revision, Pass With Revision, Fail)
- Submit your abstract to the program coordinator and ask her to announce the date/time/location of your public presentation for the final exam
- Print out the signature page (Page 2) from your dissertation manuscript on regular printer paper and take to the final exam
 - Members of the committee will sign your form when your dissertation manuscript has been accepted, although the director may withhold signature until any required revisions have been completed
- After the Graduate College receives your exam results, they will send you instructions about archiving your dissertation manuscript with ProQuest UMI
- Arrange an appointment or correspond via email with the Director of Graduate Studies-Hydrology for an **Exit Interview** (you may be able to do this online)
- Return your **KEYS** before leaving campus! (see Santander for details)

GRADUATE PETITIONS

Most students never need to submit a Graduate Petition to the Graduate College; however, you may need to submit a petition for a variety of reasons, such as:

- Petition for a Leave of Absence (e.g. medical leave, non-medical leave, study abroad leave) which temporarily suspends the continuous enrollment requirement for one or two semesters
 - Note: The 10-year time-to-degree CLOCK and the 5-year comprehensive exam CLOCK do not stop during an approved Leave of Absence!
- Petition for extension of time to complete a course
- Petition for a retroactive enrollment change
- Petition for extension of time to complete the degree program

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 21 of 25 Effective Fall 2019

APPENDIX A: EXCLUSIONS - NOT ALL HWRS COURSES ARE PRE-APPROVED

Some HWRS courses listed in the Catalog and Schedule of Classes are **not automatically approved** for the Doctoral Plan of Study. Often, these courses have been cross-listed with HWRS to satisfy other departments' curricular requirements and not necessarily for our students. HWRS Primary Faculty members *do not teach these courses*. These courses are generally **co-convened** at both the undergraduate and graduate levels.

- ATMO/HWRS 436A-536A Fundamentals of Atmospheric Sciences (3)
- CE/HWRS 423-523 Hydrology (3)
- CE/HWRS 427-527 Computer Applications in Hydraulics (3)
- ENVS/HWRS 464-564 Environmental Organic Chemistry (3)
- GEOG 483-583 Geographic Applications of Remote Sensing (3)
- GEOS 439A-539A Introduction to Dendrochronology (4)
- GEOS 450-550 Geomorphology (4)
- GEOS/HWRS 478-578 Global Change (3)
- REM/HWRS 490-590 Remote Sensing for Study of Planet Earth (3)
- RNR 417-517 Geographic Information Systems for Natural and Social Sciences (3)
- RNR/HWRS 473-573 Spatial Analysis and Modeling (3)
- WSM/HWRS 452-552 Dryland Ecohydrology and Vegetation Dynamics (3)
- WSM/HWRS 460A-560A Watershed Hydrology (3)

These courses are *not* automatically approved for inclusion in a Doctoral Plan of Study, regardless of whether they have been approved for another student.

Consult with the Director of Graduate Studies-Hydrology if you wish to include one on the Plan of Study form. If you do, please prepare:

- A letter of petition explaining relevance to your research or project
- Include a copy of the proposed Plan of Study listing all coursework you have completed and plan to take and be specific about which HWRS Primary Faculty courses you have completed or will complete
- Allow 3-4 weeks for review, especially during a priority registration period, the first and last weeks of classes, and when fall or spring classes are not in session

APPENDIX B: HAS GRADUATE EXAMINATION PROCEDURES

Doctoral Qualifying Examination

Year 1

Qual Purpose

- To test a student's basic understanding of their general field of study, their ability to communicate their research interests, and their potential for doing doctoral-level research
- To provide feedback on graduate coursework that may help the student accomplish their career goals
- To increase students' and faculty members' exposure to each other's research interests

Qualifying Exam Waiver for UA HAS Master's Students

The Qualifying Exam will be waived for a UA HAS Master's student continuing in the PHD program if the student:

- Successfully completed a HAS Master's degree at the University of Arizona
- Received at least **2 As** and **2 Bs** in the fundamental core courses
- Received a unanimous endorsement from the MS final oral exam committee and the faculty advisor requests waiver of the exam

Qual Written Component: Graduate Fellowship Research Application (GFRA)

- You must submit a short research proposal or GFRA in the format of a federally-funded fellowship program, such as NSF, EPA, NASA, or NOAA (an alternative format may be used with prior approval from the HAS Academic Committee)
- You are encouraged, but not required, to submit your proposal to the funding agency whose format you are using
- Proposal length is typically 2-6 pages, single-spaced with 1-inch margins and using a 12-point New Times Roman font (or similar)
- If you started in Fall, submit your proposal by **February 15** of your second semester
- If you started in Spring, submit your proposal by **September 15** of your second semester

Qual Committee Assignment and Oral Component

- Your faculty committee will be assigned by the department, and you will be notified by email about your committee membership by the end of February (for students starting in Fall) or the end of September (for students starting in Spring)

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 23 of 25 Effective Fall 2019

- Committee members will include 4 tenured/tenure-track faculty members (including your faculty advisor), 3 from the HAS major and 1 from another HAS major (e.g. for an ATMO major, 3 ATMO + 1 HWRS or HYMET members **OR** for a Hydrology major, 3 HWRS + 1 ATMO or HYMET members)
- When notified of committee membership, within the subsequent 4-week period, you should schedule individual meetings (20 minutes each) with the 4 members
- Individual meetings should be scheduled within the same week if possible
- Individual committee members will submit their recommendations to the Program Coordinator within 2 business days of the meeting with you
- You will be notified of the results when all members have submitted their recommendations to the Program Coordinator

Qual Evaluation by Faculty Committee

- *Prior to the meetings*, faculty members will evaluate your research application
- *During the Q&A meetings*, faculty members will ask you questions about your research proposal to test your breadth of knowledge in your field of study and provide feedback on coursework that might help you achieve your research and career goals

Qual Grading

- Written and oral exams will be graded Pass/Fail
- You must receive a Passing grade from at least 3 of the 4 members on both the written and oral components to pass the qualifying exam
- If you fail the *written component*, you must submit a revised research proposal within one month of receiving notice of the failure
- If you fail the *oral component*, you must retake the oral exam within one month of receiving notice of the failure
- There are no retakes after two attempts (the first and the retake)

Doctoral Comprehensive Examination

Year 2.5-3

Comp Purpose

- To evaluate a student's breadth of understanding across your major (Hydrology, Atmospheric Science, or Hydrometeorology)
- To evaluate student's depth of understanding in their chosen field of research, writing and presentation ability, and ability to conduct original research
- To enable student's doctoral committee members to provide feedback on research direction

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 24 of 25 Effective Fall 2019

Comp Timing

- The Comprehensive Exam process should be completed **as soon as all coursework** (excluding dissertation units) **for the Major and Minor has been completed**, typically in year 2-2.5 to 3
- To ensure currency of knowledge, once passed, the **Comprehensive Exam Clock** begins and you will have **5 years** to complete all degree requirements, including completion of research, writing the dissertation, successfully passing the Final Oral Examination (Dissertation Defense), and submitting the final approved dissertation manuscript (with any required revision) to the Graduate College for archival by ProQuest/UMI
- If you do not complete all requirements within 5 years, you will be required to repeat the entire Comprehensive Exam process (Written and Oral)

Comp Requirements

- Core Courses: You must have earned at least 2 As and 2 Bs in the core courses required by your doctoral program

Comp Written Component

- **Dissertation Abstract:** To initiate the Comprehensive Exam process, you must submit a 1-page abstract of the Dissertation to your Doctoral Comprehensive Committee (details below) and to the Graduate Program Coordinator
- **Manuscript/Publication or Research Proposal:** At least 2 weeks prior to scheduling your Oral Comprehensive Exam, you must submit either a first-authored research manuscript—"in preparation," "in review," or "published"—**or** a research proposal
- The **Research Manuscript** "in preparation" or "in review" should be formatted to a peer-reviewed scientific journal or, "if published," you can submit the paper to committee members and receive an automatic pass for the written component
- The **Research Proposal** (minimum 10 pages, including figures/tables, but not including references) should be formatted in typical NSF EAR-Directorate style

Comp Oral Component

- This formal Graduate College exam should include a 30-minute (approximate) presentation of your research manuscript/paper or research proposal
- Q&A by committee members will follow the presentation for a minimum of 1 hour but not more than 2 hours

Doctor of Philosophy in Hydrology and Water Resources (PHD HWRS)

PHD Program Guide

Page 25 of 25 Effective Fall 2019

Comp Committee Members (4-5 Members)

- Major Committee: 3 HAS faculty members, including the faculty advisor, who hold tenured/tenure-track positions in your Major and at least 2 of the 3 must be Primary Faculty in the Major (*not* Joint Faculty Members or Research Scientists/Specialists)
- Minor Committee: 1 faculty member who holds a tenured/tenure-track position in your Minor, although some departments require 2 members for the Minor Committee
- External members (Special Members), such as collaborative scientists from agencies or non-UA faculty members, *should not be included in the Comprehensive Exam process* but may be included in the Final Oral Exam/Dissertation Defense committee

Comp Grading

- The Written and Oral components of the Comprehensive Exam process will be graded Pass/Fail
- You must receive a passing grade from at least 3 of the 4+ faculty members on both the Written and Oral components to pass the Comprehensive Exam process
- Your faculty advisor will report the outcomes electronically to the Graduate College for both the Written and Oral components
- If you fail the *written* exam, you must submit a revised manuscript or proposal within 2 months of receiving notice of failure
- If you fail the *oral* exam, you must retake the oral portion of the exam within 2 months of receiving notice of failure
- There are no retakes after two attempts (the first and the retake)