Self-Study Report
2021
EXECUTIVE SUMMARY

The Department of Watershed Sciences is focused on the science and education of ‘wet’ ecosystems, including rivers, lakes, wetlands, reservoirs, and the watersheds that feed them. We are deeply committed to making our science useful for wise planning, management, and restoration of aquatic ecosystems. Our cadre of ecologists, fisheries scientists, hydrologists, geomorphologists, biogeochemists, and limnologists are well positioned to study and solve complex, interdisciplinary problems. We are a medium-sized department, with 17 faculty members, 15 research staff, 4 administrative staff, 50 graduate students and 70 undergraduate majors. We enjoy a long history of excellence in research and teaching, but we are not ones to rest on our laurels and are re-shaping our vision to meet the pressing needs of students and society.

Every one of our faculty members has established a successful and impactful research program. On a per capita basis, the Department of Watershed Sciences is among the most productive research units at USU by any metric. Many have won national or international awards for excellence in research, are funded by the National Science Foundation and other top-tier, highly competitive funding agencies, and publish in the highest impact journals in their field. Most faculty garner funding from a combination of local and state agencies, federal partners, and non-profit organizations. Long-standing relationships with many of these policy and management-oriented entities help to ensure that our research is relevant and actionable. Several of our faculty have been inducted as fellows in their disciplinary society and some have had opportunities to serve in leadership roles outside Utah State University that have greatly enhanced the quality and impact of their careers, enabled them to put science to work for society, and brought valuable perspective and skillsets back to USU.

We offer two undergraduate degrees in Fisheries and Aquatic Sciences and Management and Restoration of Aquatic Ecosystems, and we offer graduate degrees in Ecology (MS, PhD), Fisheries Biology (MS), and Watershed Sciences, (MS, PhD). The size of our undergraduate and graduate programs has remained relatively constant over the past five years. Recently, we have developed several certification programs for matriculated students and we have been working to increase educational offerings for non-matriculated working professionals. We are constantly updating and adapting our teaching modes and practices, modifying our programs to train students for a broader range of careers, placing new emphasis on outreach and science communication, and continually working to ensure that we have the most inclusive, supportive, and inspiring community possible.

The department has been fortunate to have retained faculty lines vacated due to the few departures and retirements we have experienced over the past decade, and we have gained two new faculty lines in recent years. We currently have a healthy spread of faculty spanning early to late career stages.

Watershed Sciences is known throughout USU as having an exceptionally amicable and collegial community. While we acknowledge ongoing deficiencies in cultural and ethnic diversity, due in part to factors beyond our control, we have a very supportive and inclusive culture. Under-represented students who have chosen to join our community have had very positive experiences within our department and have achieved excellent outcomes in terms of their future careers. In typical pre-covid years, the entire department has convened for at least three to four evening socials throughout the year, as well as a faculty vs grad student football game in the Fall and a softball game in the Spring. We have typically enjoyed high participation in our department seminar series and social events associated with faculty and prospective graduate student interviews. Throughout the Fall 2020 semester we maintained semi-weekly department socials via zoom and had approximately 90 participants for our
annual Thanksgiving party, which was conducted online and included a catered-and-delivered meal, a lively three rounds of trivia, and an inclusive No-shave November contest.

Watershed Sciences maintains a culture of inclusive decision-making and shared governance. We host two annual faculty retreats, in May and August, to discuss our curriculum, the status and potential changes to our degree and graduate programs, seminars, new hires and other relevant topics. Throughout the academic year we convene for 8-10 faculty meetings to discuss a variety of timely issues. The meetings can be characterized as substantive, yet succinct, amicable, and open for all to contribute. The Department Head maintains an open-door policy for meetings with faculty, staff, or students at any time, but also has established regular meeting schedules with members of the department. The Department Head and administrative staff meet semi-weekly. The Department Head conducts annual performance reviews for each faculty member and meets individually with new faculty members on a semi-weekly basis for at least the first year. And, the Department Head meets with the Graduate Student Representative at least monthly.
DEPARTMENT PROFILE

UNIVERSITY AND DEPARTMENT MISSION STATEMENTS

The mission of Utah State University is to be one of the nation’s premier student-centered land-grant and space-grant universities by fostering the principle that academics come first, by cultivating diversity of thought and culture, and by serving the public through learning, discovery, and engagement.

The mission of the Department of Watershed Sciences is to foster the discovery, learning and application of knowledge about aquatic and earth resources and their related ecosystems to promote stewardship of the environment.

GOALS

We strive to deeply integrate our research, education and outreach activities. At the same time, we recognize that each of these three components of our department mission requires well-defined, distinct, and assessable goals.

As a research-oriented department within a land-grant university, our research goals are to:

1. Conduct rigorous and replicable research that advances fundamental and applied understanding of ecological, physical, and integrated watershed systems;
2. Focus on research questions, observations, or problems that are valuable to the scientific community and society;
3. Maintain integrity and transparency in our data, methods, and interpretations.

In our undergraduate degree programs we have three main educational goals:

1. To educate students in the methods and skills of watershed sciences;
2. To train and provide professional development opportunities for the next generation of aquatic ecosystem scientists to succeed in a broad range of careers;
3. To instill the interdisciplinary knowledge necessary for students to work effectively with a variety of interest groups to inform about water and natural resources in Utah and throughout the United States.

In our graduate degree programs, we augment these three educational goals above with a fourth goal:

4. To address relevant scientific and societal questions by conducting original research using state-of-the-art analytical tools and methods.

Outreach is an important part of our mission as an interdisciplinary department within the Quinney College of Natural Resources. Our outreach goals are as follows:

1. Consider a wide range of potential audiences for communication and outreach activities, including policymakers and managers, members of communities directly affected by the issues we study, and people that are underserved or disadvantaged;
2. Develop and maintain trust with external partners and stakeholders, and when appropriate, engage them in co-production of knowledge;
3. Provide information to target audiences in a relevant and accessible manner;
4. Be responsive to questions and concerns articulated by external partners and stakeholders.
DEGREES AND CERTIFICATIONS OFFERED

Undergraduate Degrees
Fisheries and Aquatic Sciences, BS
Management and Restoration of Aquatic Ecosystems, BS

Graduate Degrees
Ecology, MS, PhD
Fisheries Biology, MS
Watershed Science, MS, PhD

Certificate Programs
Graduate Certificate in Geographic Information Systems
Graduate Certificate in Aquatic Ecosystem Restoration
Undergraduate Certified Ecological Restoration Practitioner In Training

DEGREE PROGRAM DESCRIPTIONS

Undergraduate Programs

We strive for excellence in our undergraduate academic programs by motivating students to develop perspective and a set of skills needed to start a successful career in watershed sciences and natural resource management. We accomplish this by providing relevant context for the myriad environmental problems facing society, thoroughly exploring relevant concepts and watershed processes, introducing students to a variety of effective monitoring, analytical, and modeling tools, and discussing a range of potential solutions. We have established specific learning objectives for each of the required courses in the curricula, and have integrated these learning objectives in the series of courses leading to student capstone experiences. The overall learning objectives for our degree programs are presented below.

B.S. in Fisheries and Aquatic Sciences
Students of Fisheries and Aquatic Sciences learn the concepts and skills necessary to understand and manage freshwater fish populations. This study also includes an understanding of the relationships among physical, chemical and biological components of aquatic ecosystems.

Graduates of this program may go on to graduate school or to work as scientists and managers for state and federal natural resource agencies, researchers, or as professionals for environmental consulting firms, nonprofit environmental firms, and water-based industries. The curriculum has been designed to meet the USA Federal Government’s Office of Personnel Management requirements for the Fish Biologist Series.
# Fisheries and Aquatic Sciences Major

Effective for students beginning Spring Semester 2021

<table>
<thead>
<tr>
<th>Competency Req.</th>
<th>Breadth Requirements* (1000 or 2000 level course)</th>
<th>Depth Education Requirements (3000 or 4000 level course)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ CL1: ENGL 1010</td>
<td>□ Physical Science (BPS)</td>
<td>□ Humanities and Arts (DHA)</td>
</tr>
<tr>
<td>□ CL2: ENGL 2010</td>
<td>□ Life Science (BLS): BIOL 1620</td>
<td>□ Social Science (DSS): ENVS 4000</td>
</tr>
<tr>
<td>□ QL: MATH 1050 or MATH 1100 or AP, CLEP, IBO, ACT, or SAT score</td>
<td>□ American Institutions (BAI)</td>
<td>□ Communications Intensive (CI): WATS 3100</td>
</tr>
<tr>
<td></td>
<td>□ Humanities (BHU)</td>
<td>□ Communications Intensive (CI): WATS 3700</td>
</tr>
<tr>
<td></td>
<td>□ Creative Arts (BCA)</td>
<td>□ Quantitative Intensive (QI): STAT 3000</td>
</tr>
<tr>
<td></td>
<td>□ Social Science (BSS)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Exploration: Since MATH 1050 and 1100 are both required for the Fisheries and Aquatic Sciences major, one of these courses will fulfill the QI requirement and the other will fulfill the Exploration requirement.</td>
<td></td>
</tr>
</tbody>
</table>

## FISHERIES AND AQUATIC SCIENCES MAJOR REQUIREMENTS (92 credits)

All courses required for the major must be taken on an A-B-C-D-F basis. A grade of C- or better is required for all WATS courses used to meet requirements for a major in Fisheries and Aquatic Sciences. The grade point average for all courses taught by the College of Natural Resources must be 2.5 or higher.

### A. Scientific Foundation (31 credits)

<table>
<thead>
<tr>
<th>Must complete all of the following:</th>
<th>Sem.</th>
<th>Cr.</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ BIOL 1610</td>
<td>Biology I</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>□ BIOL 1615</td>
<td>Biology I Laboratory</td>
<td>F</td>
<td>1 □BIOL 1610 (may be concurrent)</td>
</tr>
<tr>
<td>□ BIOL 1620 (BLS)</td>
<td>Biology II</td>
<td>Sp</td>
<td>3 □BIOL 1610</td>
</tr>
<tr>
<td>□ BIOL 1625</td>
<td>Biology II Laboratory</td>
<td>Sp</td>
<td>1 □BIOL 1620 (may be concurrent)</td>
</tr>
<tr>
<td>□ CHEM 1210</td>
<td>Principles of Chemistry I</td>
<td>F, Sp</td>
<td>4 □Math ACT score of at least 25 or MATH 1050 corequisite</td>
</tr>
<tr>
<td>□ CHEM 1215</td>
<td>Chemical Principles Laboratory I</td>
<td>F, Sp</td>
<td>1 □CHEM 1210 (may be concurrent)</td>
</tr>
<tr>
<td>□ CHEM 1220</td>
<td>Principles of Chemistry II</td>
<td>F, Sp</td>
<td>4 □CHEM 1220</td>
</tr>
<tr>
<td>□ CHEM 1225</td>
<td>Chemical Principles Laboratory II</td>
<td>F, Sp</td>
<td>1 □CHEM 1220 (may be concurrent)</td>
</tr>
<tr>
<td>□ MATH 1050 (QL)</td>
<td>College Algebra</td>
<td>F, Sp, Su</td>
<td>4 □C or better in MATH 0995, or Math ACT score of at least 23</td>
</tr>
<tr>
<td>□ MATH 1100</td>
<td>Calculus Techniques</td>
<td>F, Sp, Su</td>
<td>3 □C- or better in MATH 1050 or Math ACT score of at least 25</td>
</tr>
<tr>
<td>□ WATS/BIOL 2220</td>
<td>General Ecology</td>
<td>F, Sp</td>
<td>3 □BIOL 1620 (may be concurrent)</td>
</tr>
<tr>
<td>□ STAT 3000 (QI)</td>
<td>Statistics for Scientists</td>
<td>F, Sp, Su</td>
<td>3 □C- or better in MATH 1100 or MATH 1210</td>
</tr>
</tbody>
</table>

### B. Common Departmental Core (21 credits)

<table>
<thead>
<tr>
<th>Must complete all of the following:</th>
<th>Sem.</th>
<th>Cr.</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ WATS/ENVS/WILD 2000</td>
<td>Natural Resources Professional Orientation</td>
<td>F, Sp</td>
<td>1</td>
</tr>
<tr>
<td>□ ENVS 4000 (DSS)</td>
<td>Human Dimensions of NR Management</td>
<td>F</td>
<td>3</td>
</tr>
<tr>
<td>□ GEOG 1800</td>
<td>Intro to Geographic Information Sciences</td>
<td>F, Sp</td>
<td>3</td>
</tr>
<tr>
<td>□ WATS 3700 (CI)</td>
<td>Fundamentals of Watershed Science</td>
<td>Sp</td>
<td>3</td>
</tr>
<tr>
<td>□ WATS 4490 (QI)</td>
<td>Small Watershed Hydrology</td>
<td>Sp</td>
<td>4 □MATH 1100 □WATS 3700</td>
</tr>
<tr>
<td>□ WATS 4500</td>
<td>Limnology: Ecology of Inland Waters</td>
<td>F</td>
<td>3 □CHEM 1220</td>
</tr>
<tr>
<td>□ WATS 4930</td>
<td>Advanced GIS and Spatial Analyses</td>
<td>Sp</td>
<td>3 □GEOG 1800</td>
</tr>
<tr>
<td>□ WATS 4980</td>
<td>Watershed Sciences Departmental Seminar</td>
<td>F, Sp</td>
<td>1</td>
</tr>
</tbody>
</table>

1 March 2020 pmw
### C. Fisheries Courses (21 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Type</th>
<th>Credits</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATS 3100</td>
<td>Fish Diversity and Conservation</td>
<td>F</td>
<td>3</td>
<td>BIOL 1010 or BIOL 1610 or BIOL 1620</td>
</tr>
<tr>
<td>WATS 3110</td>
<td>Fish Diversity Laboratory</td>
<td>F</td>
<td>1</td>
<td>WATS 3100 (may be taken concurrently)</td>
</tr>
<tr>
<td>WATS 5310</td>
<td>Ecology and Restoration of Wetland and Riparian</td>
<td>Sp (Odd yrs)</td>
<td>3</td>
<td>WATS/BIOL 2220</td>
</tr>
<tr>
<td>WATS 4510</td>
<td>Aquatic Ecology Practicum I: Lab Methods</td>
<td>F</td>
<td>2</td>
<td>CHEM 1225, STAT 3000, WATS 3700, WATS 4500</td>
</tr>
<tr>
<td>WATS 4520</td>
<td>Aquatic Ecology Practicum II: Analysis</td>
<td>F</td>
<td>2</td>
<td>WATS 4510</td>
</tr>
<tr>
<td>WATS 4650</td>
<td>Principles in Fishery Management</td>
<td>Sp</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>WATS 5200</td>
<td>Fish Habitats</td>
<td>F</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>WATS 5300</td>
<td>Principles of Aquatic Ecosystem Restoration</td>
<td>F</td>
<td>2</td>
<td>WATS/BIOL 2220</td>
</tr>
<tr>
<td>WATS/BIOL 5550</td>
<td>Freshwater Invertebrates</td>
<td>Sp</td>
<td>3</td>
<td>One year of general biology or zoology, or permission of instructor.</td>
</tr>
</tbody>
</table>

### D. Capstone Experience (4 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Type</th>
<th>Credits</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATS 5340</td>
<td>Capstone I - Management and Restoration of Aquatic Ecosystems</td>
<td>F</td>
<td>2</td>
<td>GEOG 1800 or WILD 1800 AND WATS 5300 or WATS 5200</td>
</tr>
<tr>
<td>WATS 5350</td>
<td>Capstone II - Management and Restoration of Aquatic Ecosystems</td>
<td>Sp</td>
<td>2</td>
<td>WATS 5340</td>
</tr>
</tbody>
</table>

### E. Directed Elective Courses (15 credits)

Students must choose a minimum of 15 elective credits to complete the Fisheries and Aquatic Sciences degree requirements. The majority of these elective credits must come from courses directly related to the degree program. All elective courses must be approved by the student’s faculty advisor before enrollment. The following is a list of recommended courses that could be used to satisfy this requirement. Courses listed in Section D that were not used to meet the Capstone Course requirement may be taken as part of the suggested electives.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Type</th>
<th>Credits</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENVS 3010</td>
<td>Fundamentals of NR and Env Policy</td>
<td>F</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ENVS 4020</td>
<td>Foundations of Environmental Studies</td>
<td>S</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ENVS 6320</td>
<td>Water Law and Policy in the United States</td>
<td>Sp</td>
<td>3</td>
<td>Instructor permission</td>
</tr>
<tr>
<td>ENGL 3080</td>
<td>Introduction to Technical Communication</td>
<td>F,Sp</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ENGL 3490</td>
<td>Professional Writing</td>
<td>F,Sp</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HIST 3950</td>
<td>Environmental History</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>NR 6920</td>
<td>Python Programming for GIS</td>
<td>F</td>
<td>3</td>
<td>GEOG/WILD 1800, permission</td>
</tr>
<tr>
<td>POLS 4820</td>
<td>NR and Environmental Policy: Political Economy of Environmental Quality</td>
<td>Sp</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHYS 2110</td>
<td>General Physics - Life Sciences I</td>
<td>F</td>
<td>4</td>
<td>MATH 1100</td>
</tr>
<tr>
<td>WATS 3000</td>
<td>Oceanography</td>
<td>Sp</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>WATS 3450</td>
<td>Introduction to Coral Reefs - Field Course</td>
<td>Sp</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>WATS 3600</td>
<td>Geomorphology</td>
<td>F</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>WATS 3910</td>
<td>Climatology &amp; Hydrology for Western Watersheds</td>
<td>F</td>
<td>3</td>
<td>MATH 1050</td>
</tr>
<tr>
<td>WATS 4110</td>
<td>Biogeochemistry: Tracking Environmental Processes and Change</td>
<td>F</td>
<td>3</td>
<td>MATH 1050 OR CHEM 1110 or 1210</td>
</tr>
<tr>
<td>WATS 4530</td>
<td>Water Quality and Pollution</td>
<td>F</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>WATS 5150</td>
<td>Fluvial Geomorphology</td>
<td>F</td>
<td>3</td>
<td>Undergraduates: NR advisor permission</td>
</tr>
<tr>
<td>WATS 5300</td>
<td>Principles of Aquatic Ecosystem Restoration</td>
<td>Sp</td>
<td>3</td>
<td>GEO 1115 OR GEO 1005; WATS/BIOL 2220</td>
</tr>
<tr>
<td>WATS 5330</td>
<td>Large River Management</td>
<td>S</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>WILD 3810</td>
<td>Plant and Animal Populations</td>
<td>Sp</td>
<td>3</td>
<td>WATS/BIOL 2220 MATH 1100</td>
</tr>
<tr>
<td>WILD 4880</td>
<td>Genetics and Conservation in Management</td>
<td>Sp</td>
<td>3</td>
<td>BIOL 1610 CHEM 1110 or 1210</td>
</tr>
</tbody>
</table>

1 March 2020 prw
Management and Restoration of Aquatic Ecosystems is the study of water-related physical processes, including climate, surface and ground water, river formation, soil sciences, and water chemistry. The discipline focuses on protecting and restoring aquatic systems, includes courses in stream restoration, water pollution, climate change, aquatic habitat, and managing uplands.

Students of Management and Restoration of Aquatic Ecosystems study the relationships among physical, chemical and biological components of the earth’s ecosystems. Specific areas of interest may include hydrology, geomorphology, biogeochemistry, water quality, conservation, or restoration and management of aquatic and riparian ecosystems. With appropriate selection of elective courses, graduates of the MRAE degree meet OPM requirements for positions of Hydrologist, Hydrologic Technician, and Environmental Protection Specialist. Graduates of this program may go on to graduate school or work as scientists and managers for natural resource agencies, professionals with consulting and nonprofit environmental firms, or university teachers and researchers.
## Management and Restoration of Aquatic Ecosystems Major

Effective for students beginning Spring Semester 2021

### GENERAL EDUCATION and UNIVERSITY STUDIES

<table>
<thead>
<tr>
<th>Competency Req.</th>
<th>Breadth Requirements* (1000 or 2000 level course)</th>
<th>Depth Education Requirements (3000 or 4000 level course)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL1: ENGL 1010</td>
<td>□ Phys. Science (BPS): GEO 1110/GEOG 1000</td>
<td>□ Humanities and Arts (DHA)</td>
</tr>
<tr>
<td>CL2: ENGL 2010</td>
<td>□ Life Science (BLS) BIOL 1620</td>
<td>□ Social Science (DSS): ENV 4000</td>
</tr>
<tr>
<td>QL: MATH 1050 or MATH 1210 or AP, CLEP, IB, ACT, or SAT score</td>
<td>□ American Institutions (BAI)</td>
<td>□ Communications Intensive (C): WATS 3700</td>
</tr>
<tr>
<td></td>
<td>□ Humanities (BHS)</td>
<td>□ Communications Intensive (C)</td>
</tr>
<tr>
<td></td>
<td>□ Creative Arts (BCA)</td>
<td>□ Quantitative Intensive (Q): STAT 3000</td>
</tr>
<tr>
<td></td>
<td>□ Social Science (BSS)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>□ Exploration: CHEM 1220 (BPS), MATH 1220 (QL), or PHYS 2220 (BPS/QL) if chosen as a Directed Elective course will fulfill this requirement for students in the Mgt &amp; Restoration of Aquatic Ecosystems major.</td>
<td></td>
</tr>
</tbody>
</table>

### MANAGEMENT & RESTORATION AQUATIC ECOSYSTEMS MAJOR REQUIREMENTS (91-92 credits)

All courses required for the major must be taken on an A-B-C-D-F basis. A grade of C- or better is required for all WATS courses used to meet requirements for a major in Management and Restoration of Aquatic Ecosystems. The grade point average for all courses taught by the College of Natural Resources must be 2.5 or higher.

#### A. Scientific Foundation (33-34 credits)

<table>
<thead>
<tr>
<th>Course</th>
<th>Sem.</th>
<th>Cr.</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 1610 Biology I</td>
<td>F</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>BIOL 1620 (BLS) Biology II</td>
<td>Sp</td>
<td>3</td>
<td>BIOL 1610</td>
</tr>
<tr>
<td>CHEM 1210 Principles of Chemistry I</td>
<td>F, Sp</td>
<td>4</td>
<td>Math ACT score of at least 25 or MATH 1050 prerequisite/corequisite</td>
</tr>
<tr>
<td>CHEM 1215 Chemical Principles Laboratory I</td>
<td>F, Sp</td>
<td>1</td>
<td>CHEM 1210 (may be concurrent)</td>
</tr>
<tr>
<td>CHEM 1220 Principles of Chemistry II</td>
<td>F, Sp</td>
<td>4</td>
<td>CHEM 1220</td>
</tr>
<tr>
<td>CHEM 1225 Chemical Principles Laboratory II</td>
<td>F, Sp</td>
<td>1</td>
<td>CHEM 1220 (may be concurrent)</td>
</tr>
<tr>
<td>GEO 1110 (BPS)</td>
<td>F, Sp</td>
<td>3</td>
<td>GEO 1110 (corequisite)</td>
</tr>
<tr>
<td>GEO 1115 Physical Geology and</td>
<td>F, Sp</td>
<td>1</td>
<td>GEO 1110 (corequisite)</td>
</tr>
<tr>
<td>GEO 1000 (BPS)</td>
<td>F</td>
<td>3</td>
<td>GEO 1000 (concurrent)</td>
</tr>
<tr>
<td>MATH 1050 (QL) College Algebra</td>
<td>F, Sp,Su</td>
<td>4</td>
<td>Calc or better in MATH 0955, or Math ACT score of at least 23</td>
</tr>
<tr>
<td>MATH 1100 Calculus Techniques OR</td>
<td>F, Sp,Su</td>
<td>3</td>
<td>Calc or better in MATH 1050 or Math ACT score of at least 25</td>
</tr>
<tr>
<td>MATH 1210 (QL)</td>
<td>F, Sp,Su</td>
<td>3</td>
<td>Calc or better in MATH 1050 and MATH 1060, or Math ACT score of at least 27 (Math SAT score of at least 620), or AP Calculus score of at least 3 on AP exam or satisfactory score on Math Placement Exam within the Math prerequisite time limit</td>
</tr>
<tr>
<td>STAT 3000 (QL) Statistics for Scientists</td>
<td>F, Sp,Su</td>
<td>3</td>
<td>Calc or better in MATH 1100 or MATH 1210</td>
</tr>
<tr>
<td>WATS/BIOL 2220 General Ecology</td>
<td>F, Sp</td>
<td>3</td>
<td>BIOL 1620 (may be concurrent)</td>
</tr>
</tbody>
</table>

1 March 2020 prov
Graduate Programs

The mission of the WATS graduate program is to provide interdisciplinary education in watershed and aquatic sciences. We target students whose career goals require both the technical depth and interdisciplinary breadth necessary to sustain the water resources and aquatic ecosystem services on which society depends. Pursuing this mission requires a commitment to interdisciplinary education, research, and outreach across the breadth of water sciences.

From its inception in 2003, WATS has worked to build an internationally recognized graduate program in interdisciplinary, natural resources-focused, watershed science. We offer five graduate degrees, MS and PhD in both Watershed Sciences and Ecology, as well as an MS in Fisheries Biology. Each of the three
main degree areas has a unique focus, but our general expectations regarding degree requirements are similar, and we manage our degree options under a central department philosophy, modified as needed, given the specific requirements of each degree (e.g., minimum core requirements for the Ecology degree are set by the Ecology Center).

Sixteen E&G faculty and 3 federal collaborators within the department support our graduate programs. In addition, we take advantage of an extensive campus-wide network of faculty with expertise in a diverse array of water-related disciplines. Many of our faculty advise students in more than one degree option, and all faculty serve on advisory committees of students pursuing any of the three degree options. We believe we have succeeded in building a high-quality, interdisciplinary graduate program in watershed sciences.

Ecology MS and PhD degrees are jointly administered by the Ecology Center at USU. Course and research requirements (Table X) are determined by a committee of Ecology Center faculty, which includes faculty from the College of Natural Resources, College of Science, and College of Agriculture.

Table 1. Ecology Center Degree Requirements
1. Ecology Seminar - enroll twice for MS students, three times for PhD students
2. MS students are required to take three credits each from two of the five topical blocks presented below. PhD students must take three credits each from three of the blocks.

- Block 1 – Biophysical Ecology
- Block 2 – Organismic, Populations, and Evolutionary Ecology
- Block 3 – Community, Ecosystem, and Landscape Ecology
- Block 4 – Quantitative Ecology
- Block 5 – Human Ecology

The MS degree in Fisheries Biology focuses on educating students in the principles of the biology of fishes and the practice of fisheries management. Recent advances in our understanding of genetics, physiology, and evolution have profound implications on how fish taxa are influenced by their environment and how fish populations impact the communities and ecosystems they inhabit. Students graduating with advanced degrees in Fisheries Biology have strong backgrounds in general scientific approaches, statistical rigor, and a deep understanding of the biology of aquatic organisms. Development of new sampling and analysis technologies such as stable isotopes, simulation modeling, organismal tagging, and GIS have allowed our students to better assess the role of aquatic organisms within the context of their ecosystems and have enhanced our ability to embrace the management of biodiversity at large spatial scales.

MS and PhD degrees in Watershed Sciences focus on physical and chemical processes and changes within our environment. Students in these programs learn to assess the current condition of our watershed resources and determine the direction and magnitude of changes to these ecosystems. Students completing these advanced degrees are proficient at measuring the scale of environmental change in atmospheric, hydrologic, and geomorphic arenas. The synergies inherent in the dynamics of these areas coupled with their impact on biologic resources are important components of our graduate education programs.

MS students in any of the graduate degree programs are required to complete 30 credits, including 24 credits in residency and a minimum of 6 credits of thesis research. PhD students are required to
complete 30 credits if entering the program with a master’s degree or 60 credits if entering the program with a bachelor’s degree. Currently the only course requirement for Fisheries Biology or Watershed Science graduate students is a 1 credit, 5-day field course that occurs the week prior to each fall semester (WATS 6260 – Watershed Sciences Graduate Student Induction Course).

We expect MS and PhD students in each of the graduate degree programs to make new contributions to the science, management, and restoration of watersheds. All MS and PhD students in the department are required to complete a pre-project research proposal, which should be reviewed and approved by their committee within the first two semesters for MS students and within the first three semesters for PhD students. To complete the MS or PhD degree, students must publish, with the approval of their supervisory committee, a written thesis or dissertation, deliver an oral presentation open to the department and public, and pass an oral defense of their thesis or dissertation in a closed session with their supervisory committee. We encourage the publication of student research projects in peer reviewed literature by having students complete their thesis or dissertation in a format suitable for submission to research and management journals.

Certificate Programs

WATS contributes to several certificate programs that can be obtained by matriculated USU students within or outside one of our degree programs. These certificate programs are intended to complement our degree programs by allowing students to demonstrate proficiency in specific, marketable skillsets. Currently, WATS participates in the following certificate programs:

1. Graduate Certificate in Geographic Information Science (GIS): This certificate is designed for graduate students or professionals wanting skills and experience applying industry standard GIS and remote sensing tools to natural resource issues. Students must complete a total of 12 credits from a select group of courses to complete the certificate. Their USU transcript will list the courses and grades received to complete the program. The certificate is complementary to a wide variety of graduate programs and is available as a standalone certificate.

2. Graduate Certificate in Aquatic Ecosystem Restoration: This certificate provides complimentary training for graduate students wishing to gain depth in techniques and principles for restoration of aquatic ecosystems and to provide background and training in these techniques and principles for professional practitioners and managers working in the field of ecosystem restoration and management. Students must complete a total of 12 credits, including two required core courses and three to five electives from a select group of courses to complete the certificate. Their USU transcript will list the courses and grades received to complete the program. Many courses in this certificate program are offered in the short-course or workshop format, either in-person or as online courses. Most in-person workshops have a field component. The certificate is complementary to a wide variety of graduate programs and is available as a standalone certificate.

3. Undergraduate Certified Ecological Restoration Practitioner In Training (CERPIT): This certification is available from the Society of Ecological Restoration (SER) for all MRAE graduates because we have aligned that degree program with SER’s curricular requirements. SER encourages a high professional standard for those who are designing, implementing, overseeing, and monitoring restoration projects. The certification identifies practitioners who have achieved SER’s knowledge requirements. After five years of restoration experience, CERPITs can apply to
become Certified Ecological Restoration Practitioners (CERPs), which identify senior level practitioners.

RESEARCH-EDUCATION-OUTREACH CENTERS

The Department of Watershed Sciences supports several centers, each of which integrates research, education, and outreach in various ways. These centers facilitate collaboration among faculty, provide a platform for the exchange of ideas, and support graduate and undergraduate student research. Below are brief descriptions of these centers.

USU Restoration Consortium

The USU Restoration Consortium is a new and emerging center intended to promote restoration-related activities and train students to assist the recovery of stream, wetland, or lake ecosystems that have been degraded. The mission of the Restoration Consortium is to facilitate restoration-related research, publicize accomplishments of restoration-related efforts at USU, and offer courses, professional workshops, hands-on trainings, and degree programs that prepare students for careers in aquatic ecosystem restoration. These offerings are targeted to working environmental management professionals, active stream, wetland and watershed restoration practitioners, as well as matriculated USU undergraduate and graduate students.

Both WATS undergraduate majors in the department are expected to benefit from interactions with the Restoration Consortium as it provides context for restoration-related research and educational offerings, hosts restoration-related literature and analytical tools, and connects students with internships, projects, and job opportunities. The Restoration Consortium also facilitates the post-baccalaureate Certificate in Aquatic Ecosystem Restoration, which allows matriculated MS and PhD students at USU to add a professional certificate to their postgraduate academic studies. The certificate program provides training for graduate students wishing to gain depth in techniques and principles for restoration of riverine habitats and environments and provides a background and training in these techniques and principles for professional practitioners and managers working in the field of ecosystem restoration and management.

USU’s Restoration Consortium focuses on understanding and restoring natural processes as a mechanism for restoration of rivers, lakes, wetlands and watersheds. This approach addresses the underlying causes of restoration, rather than temporarily addressing symptoms. Researchers at USU predict, model, measure, and explain patterns and processes that are instrumental to restoration success. Professors and students work together to answer fundamental research questions such as: at what spatial and temporal scales should restoration be implemented? How should restoration projects be prioritized? What monitoring and metrics should be used to evaluate success? How do drought and water management affect restoration in Utah? The USU Restoration Consortium also connects research within USU and to applied projects throughout Utah. Professors and students routinely collaborate with restoration practitioners and natural resource agencies to apply restoration approaches developed at USU or developing monitoring tools. These real-world applications are vital to gain a deeper understanding and successful restoration.
understanding of restoration ecology, produce data and findings that feed back into research, and provide the challenge and excitement of working on real-world problems.

Management and Restoration of Aquatic Ecosystems students also benefit from the partnership between the Restoration Consortium and USU’s Water Quality Extension Program, which focuses on identification and mitigation of nonpoint source pollution. The Water Quality Extension Program helps people understand the link between their everyday activities and land uses and the quality of our water, outreach, website, and citizen science. Research within extension has involved innovative approaches to water quality monitoring at a local and watershed scale and seeks to dive deeper into some of the unanswered questions about water quality practices within Utah.

Finally, the USU Restoration Consortium offers popular courses for working professionals such as the Low-Tech Process-Based Restoration of Riverscapes workshop series, short courses in Sediment Transport in Stream Assessment and Design, and semester long courses in Wetland Ecology & Management, and Restoration of Wetland and Riparian Plants. Additional courses are likely to be developed in the future.

**Center for Colorado River Studies**

The Center for Colorado River Studies at Utah State University informs management of the Colorado River and other major rivers through its work in research, teaching, and outreach. Led by Professor John (Jack) C. Schmidt, Janet Quinney Lawson Chair in Colorado River Studies, the Center conducts consequential studies that inform how the Colorado River and its tributaries can sustainably meet the water-supply needs of the American Southwest, while also meeting the diverse expectations of stakeholders regarding recreation, healthy ecosystems, recovery of endangered species, and protection of the values and resources of the National Park system.

Presently, the Center is conducting a major research project – the Future of the Colorado River – funded by private foundations and federal agencies, that seeks to identify sustainable strategies for managing the river system in the face of declining watershed runoff caused by a warming climate. The Center’s white paper series is widely read among Colorado River decisionmakers, and the Center stages regular briefings with key stakeholder groups. The Center manages the Colorado River scholars program that provides partial stipend support to PhD and MS students, and the Center’s research supports two post-doctoral researchers. An outreach coordinator leads the effort to effectively share the work of the Center with Utah’s communities. Prior to the onset of the global pandemic, the Center organized and hosted speakers and events in Moab and Escalante.

**White Papers:**

As part of the Future of the Colorado River project, the Center has published six white papers whose goal is to reshape the framework for discussing the Colorado River’s future, including renegotiation of the 2007 Interim Shortage Guidelines for the Colorado River. These white papers include:

- Alternative Management Paradigms for the Future of the Colorado and Green Rivers (to be released January 2021)
- Stream Flow and Losses of the Colorado River in the Southern Colorado Plateau (released September 2020)
- The Future Hydrology of the Colorado River Basin (released December 2020)
• Managing the Colorado River for an Uncertain Future (released February 2020)
• Fill Mead First – A Technical Assessment (released November 2016)

Outreach:

Colorado River Speaker Series:

The Center organized and obtained financial support for the Colorado River speaker series that was held in Moab in between 2018 and 2020. Each community event was attended by ~100 people. Some of these events were individual speakers (authors, scientists) and other events were panel discussions that involved many speakers and presentations. In addition, one event was held in conjunction with the Escalante Arts Festival and one event was held on the USU campus. These events included:

• **The Future of the Colorado River Community Symposium** (10 national experts gave talks and discussed the future of the river in a half day symposium, October 2018)
• **Politics, Power and Rivers** – a Presentation on Historic Mining in the Rural West (Jonathan Thompson, Author & High Country News journalist, April 2019)
• **Utah River Running Archives** (Roy Webb, River historian, author & archivist, April 2019)
• **History of the Great Floods of the Colorado and Green Rivers** (Vic Baker, Hydrology & Atmospheric Sciences, University of Arizona, July 2019)
• **One River Many Voices**: A Source to Sea Expedition (Mike and Jenny Fiebig, American Rivers, September 2019) Co-sponsored by the Moab Festival of Science.
• **Escalante Summer Festival**, CCRS teamed with the Escalante Canyon Art Festival, NEHMA Museum, and Mark Lee Koven (USU Extension) to bring river science to the towns of Escalante and Boulder, Utah, September 26-28, 2019. This included a school outreach program and a science speaker:
  • **Heather Hansman** (Downriver: Into the Future of Water in the West)
  • **James M. Aton**, (The Crimson Cowboys: The Remarkable Odyssey of the 1931 Claflin-Emerson Expedition)
  • **Jack Schmidt** (The Future of the Colorado River)
• **Science be Dammed: how ignoring inconvenient science drained the Colorado River** (Eric Kuhn, General Manager of the Colorado River Water Conservancy District, retired), October 2019 (held on the Utah State University campus).
• **The Future of Lake Powell** (8 experts presented on the hydrology and ecology of the Colorado River as it pertains to water storage in Lake Powell in a three-hour symposium, February 2020.)
CCRS Conversations

With the adjustments required of a pandemic year, the Center hosted a series of online discussions with Colorado River experts that attracted a significant live audience and continued online viewing and attention after posting.

- **Climate Change Perspectives: Brad Udall**, Senior Water & Climate Research Scientist, Colorado Water Institute (April 2020)
- **A Watershed Perspective: Eric Kuhn**, author and Colorado River District General Manager, retired (April 2020)
- **Tribal Perspectives: Daryl Vigil**, Ten Tribes Coalition and **Matt McKinney**, University of Montana (April 16, 2020)
- **A California Perspective: Chris Harris**, Executive Director, Colorado River Board of California (May 2020)
- **A Federal Perspective: Anne Castle**, assistant secretary for water and science in the U.S. Department of the Interior from 2009 to 2014 (June, 2020)
- **Returning Rapids Project: Peter Lefebvre and Mike DeHoff**, principal investigators of the Returning Rapids project and professional river guides (June 2020)

Numerous other outreach events over the past few years are documented on the Center’s website.

**Colorado River Scholar Program:** The Center supports PhD students and post-doctoral research scholars through the Colorado River Scholar Program.

- **Christina Leonard**, pursuing PhD. degree in Watershed Sciences. Research area: Linking high temporal resolution flux-based sediment budgets with channel change: What constitutes a big number?
- **Bryce Mihalevich**, pursuing PhD. Degree in Civil & Environmental Engineering. Research area: Studying effects of climate change and increasing water demand on the temperature regimes of the Colorado River through use of process-based hydrologic models that drive river warming or cooling.
- **Homa Salehabadi**, pursuing a PhD. in Civil & Environmental Engineering. Research areas: Working to define, develop and quantify the hydrologic inputs used in the Colorado River Simulation System and examine risks for low and high streamflow conditions.
- **Brian Healy**, pursuing a PhD. in Ecology. Research areas: understanding physical (hydrologic, thermal) and biological drivers of demographic vital rates (i.e., growth, survival, reproduction, recruitment) of native and invasive fishes through open- and closed-population mark-recapture and population viability modeling.
- **Jian Wang**, Post-Doctoral Fellow, Utah Water Research Laboratory. Research areas: identifying critical uncertainties in the Colorado River system, exploring available methodologies and tools to deal with
deep uncertainty and designing the combined long-term and short-term policies that allow the system to be adaptive to future changes.

Lindsey Bruckerhoff, Post-Doctoral Fellow in Fish Ecology. Research areas: synthesizing knowledge of fish population responses to temperature, hydrology, sediment, non-native species, and other drivers to predict how different water storage management scenarios may influence fish populations across the basin.

USU/BLM National Aquatic Monitoring Center

The primary mission of the National Aquatic Monitoring Center (NAMC) is to facilitate the development and application of scientifically sound and consistent methods for monitoring and assessing the condition of aquatic ecosystems. NAMC is a cooperative venture between Utah State University (USU) and the U.S. Bureau of Land Management (BLM) and is co-directed by Charles Hawkins (USU) and Scott Miller (BLM). Other major NAMC partners and collaborators include the U.S. Environmental Protection Agency (USEPA), the U.S. Forest Service (USFS), the U.S. National Park Service (USNPS), the U.S. Geological Survey (USGS), and several states in the western U.S.

NAMC staff includes a fulltime assistant director, three fulltime research scientists, a lab manager, three taxonomists, and approximately 20 students employed on a part time basis. Many of these employees support the operation of the NAMC sample processing lab, which processes 2000-3000 freshwater invertebrate samples a year. By employing students, NAMC provides on-the-job training to USU students interested in monitoring and assessment as a career. Data from these samples support monitoring efforts by state and federal agencies and research activities by USU faculty. Data from these samples are deposited in a national database of aquatic invertebrates, which NAMC uses to address both project-specific objectives and region- and state-wide activities. The NAMC database contains information on 5,663 unique taxa from over 30,000 sites.

Current NAMC research projects include:
- assistance in the development of BLMs west-wide Lotic Assessment Inventory and Monitoring Program (Lotic AIM),
- development of assessment methods applicable to non-perennial streams in the western US (US EPA and Arizona DEQ),
- development of stressor-specific biological indices for diagnosing the causes of ecological degradation (National Science Foundation and BLM),
- assessment of the effectiveness of eDNA in quantifying aquatic biodiversity (USGS),
- assessment of the effects of river flow management on aquatic life in the Green River below Flaming Gorge Dam (Bureau of Reclamation, Utah DNR, and the Western Area Power Administration) and within Dinosaur National Monument (NPS),
- assessment of the effectiveness of riparian buffer strips in protecting aquatic life from activities associated with forest harvesting (Washington State Department of Natural Resources), and
- development or refinement of biological indices for assessing the condition of aquatic life in Alaska (US NPS), Oregon (OR DEQ), and the San Juan National Forest (USFS).
Recently, NAMC merged with the Western Center for Monitoring and Assessment of Freshwater Ecosystems (WMC), a center established by NAMC co-director Hawkins in 2003 and funded by the USEPA to provide assistance to state and federal agencies tasked with monitoring freshwater ecosystems. The WMC also provided web-based content regarding the theory and practice of biological assessments (www.qcnr.usu.edu/wmc), which will soon be migrated to the NAMC web site.

**Water Quality Extension Program**

The Quinney College of Natural Resources is the academic home of several natural resource focused extension specialists and statewide educators, covering wildlife, recreation, water resources, rangelands, and water quality. These individuals are partially supported by USU Extension, and each is tasked with providing a program that meets the needs of their identified clients.

WATS currently has two water quality specialists: Nancy Mesner has held this position for over 25 years and is retiring soon and Erin Rivers was recently hired as her replacement. Both focus on identification and mitigation of nonpoint source pollution. Nancy has worked in rural and urban settings, while Erin’s research and programming will specifically target urban water quality impacts. Hope Braithwaite oversees the statewide citizen monitoring program, educator resource development and training, and direct delivery of hands-on youth programs.

The mission of the Water Quality Extension Program is to help people understand the link between their everyday activities and land uses and the quality of our water. The program’s primary website, www.extension.usu.edu/waterquality, is content rich and also links to many of the activities and programs available. The Utah State Water Quality Task Force, a multi-agency committee led by the Utah Division of Water Quality, identifies USU WQ Extension as the lead for their nonpoint source outreach efforts. The committee provides guidance on current and future needs and assists with funding and access to other water quality programs and professionals statewide.

**Citizen science and monitoring**

Utah Water Watch (UWW) is our statewide citizen science water quality monitoring program. Our volunteers expand the reach and capabilities of monitoring efforts statewide. Our materials are all posted on our website, including training and related resources. After QAQC checks, our data is publicly available through Citsci.org and shared with monitoring partners. Recent additions include salinity and stonefly monitoring in support of an NSF Project (Charles Hawkins, PI), and identification of harmful algal blooms across the state.

**Curriculum development and teacher training**

Our educational efforts include the Stream Side Science curriculum, which contains 10 lessons for K-6th grade and 14 lessons for 5-12th grade. Two Masters projects (see references) have demonstrated that these lessons result in significant increases in knowledge and in changes in student attitudes about protecting water resources.

In support of the program, we have trained and supplied thousands of educators and have increased our online training opportunities in response to the pandemic. All our educational materials are online, and we work continuously to align these to the latest standards (most recently the newly implemented Utah Science with Engineering Education (SEEd) standards).
Recent and planned activities include:

- implementation / coordination of The Nature Conservancy’s Wings and Water Wetlands Education program along the shores of the Great Salt Lake – Led by Braithwaite;
- lessons using remotely operated underwater vehicles to explore subsurface conditions (In-Stream Science). Led by Mesner;
- a lesson about the impact of salinity on macroinvertebrate species composition – Led by Mesner / Braithwaite;
- a fifth year Gear Up (Gaining Early Awareness and Readiness for Undergraduate Programs) experience, focused on urban water quality impacts along the Wasatch front. To include online resources and intensive trainings to be delivered to educators virtually. Led by Rivers
- a high school curriculum module about impacts of dust and plastic pollution to water resources. The program provides online resources and digital access for educators and students. We will be implementing our pilot program in 5 high schools in 2021 to refine resources before it is made available state-wide. Led by Rivers

Support for Utah’s watershed programs and nonpoint source efforts.

In 2020, in partnership with the Utah Water Quality Task Force, Mesner and Braithwaite launched two statewide social media outreach campaigns, focusing on: 1) water quality best practices on small acreage farms (https://www.dontshareutah.org/), 2) reducing human waste impacts from recreational activities on public lands (https://www.gottagoutah.org/). Braithwaite will continue managing and evaluating the impact of these campaigns.

Rivers is developing a virtual field trip resource, “Watershed Explorer.” Watershed Explorer is based in the Google Earth platform and allows viewers to identify their watershed, navigate along the stream to view 360° photos from headwaters to downstream, identify key components of the ecosystem, and view data.

Rivers also anticipates providing the following programming:

- Professional trainings and possible certification programs for urban water quality best management practices (prospective partners include UDOT, Extension faculty, and city and county agencies);
- Scenarios planning to investigate the water quality impacts of land use scenarios surrounding the Great Salt Lake and Utah Lake (Future submission to USDA AFRI program);
- Technical advice for improving green stormwater management facility designs.

Research

Mesner and Braithwaite have quantified the impacts of educational programs and nonpoint source best management practices. Mesner has also published on innovative approaches to water quality monitoring at a local and watershed scale.

Dr. Rivers’s appointment includes research so she will be in a good position to dive deeper into some of the unanswered questions about water quality practices in the state. She anticipates expanding and continuing these efforts, while developing projects that address emerging concerns associated with urban development, including stormwater management and land use decisions.
The Intermountain West is undergoing dynamic demographic changes accompanied by changing land uses, and increasingly diverse and often conflicting demands on limited natural resources. As a result, finding solutions to complex natural resource problems has necessitated an increasingly inter-disciplinary approach. A Cooperative Agreement signed between the US Department of Interior and Utah State University in 1935 established the existence, mission, and function of the Utah Cooperative Fish and Wildlife Research Unit. It provides an organizational mechanism that enables the Unit, in the setting of the College of Natural Resources, to create and facilitate cooperative, interdisciplinary relationships between Faculty in all departments of the college, with the Utah Division of Wildlife Resources, the Wildlife Management Institute, and the US Geological Survey and many other federal partners. The USGS Coop Program provides three full time faculty dedicated to helping the state of Utah meet their natural resource information needs. Further, the Research Work Order Process, unique to the Cooperative Research Unit Program, allows cooperative interaction between faculty at Utah State University and any federal agency. Specifically, it is the mechanism that allows acceptance of federal research funds non-competitively.

The mission of the Utah Unit, as stated in our Cooperative Agreement, is to conduct research on natural resource issues, educate students destined to work in the field of natural resources, and provide technical assistance to our cooperators and clientele. Our expertise includes landscape and spatial ecology, population and community ecology for both aquatic and terrestrial systems, aquatic food webs...
One of our current areas of emphasis is on experimental restoration of highly degraded yet dynamic desert streams, home to many endemic and endangered fishes. We are experimenting with the installation of beaver dam analogues, reintroducing nuisance beavers that would have been euthanized, non-native vegetation removal, and the addition of large boulders. We are evaluating the efficacy of such approaches in a rigorous experimental design because restoration in dynamic rivers, which move and also have highly modified hydrographs, is unchartered territory. This multi-river project includes graduate students who study fish and fish habitat as well beaver ecology. We have many state and federal partners who provide support, financial and other. We are also about to launch a large terrestrial animal migration and movement study.

We view our role as colleagues and partners who can bring our agency connections, as well as the administrative and material resources of the Unit to help our faculty colleagues in a meaningful way. The Unit vision is to establish a high caliber research program and a Unit program whose culture and operating principles are based on win-win interactions that enable, invigorate, and empower all parties. We accomplish our vision with partners who are as committed to the same values.

USFS Fish and Aquatic Ecology Research Unit

The mission of the Forest Service Fish and Aquatic Ecology Unit is to identify emerging aquatic resource issues, develop technology to help address these issues, and transfer this technology to field biologists. The Fish and Aquatic Ecology Unit provides scientifically sound, cost-effective technologies to aquatic resource specialists in support of the conservation and restoration of aquatic communities on Forest Service land.

The Fish and Aquatic Ecology Unit works with federal and state research organizations and universities to develop technology to address emerging resource issues. Once this technology is developed, we disseminate this technology to aquatic resource specialists through, continuing education workshops, presentations, publications, and on-site visits. Much of our recent research has focused on developing scientifically sound methods to measure in-stream and riparian habitat in western US watersheds.

STRENGTHS AND WEAKNESSES OF PROGRAMS AND DEGREES

Research

Research is the foundation for the department and is viewed as a core strength integrated throughout our education, extension, and outreach efforts. All faculty, graduate students, and research staff as well as many of our undergraduate majors engage in research. The general sense among department faculty, staff, and upper administration is that the quantity and quality of research conducted in the department is excellent. This sentiment was confirmed by the 2012 external review team and is continually affirmed in the many relationships the department and faculty maintain with external collaborators and partners. Another indicator of our research strength is our demonstrated ability to attract and retain high quality faculty, staff and graduate students, as well as our high per capita research budgets and publication
records. Given the importance of research to the department’s identity and value, any changes in the
department structure, personnel, activities, or operations should be made with careful consideration for
their potential impact on research activities.

Research space appears to be equitably allocated and fully utilized. There is some precedence for shared
facilities and equipment (e.g., multiple users of the Millville experimental facility, shared rtkGPS units),
but the majority of research resources within the department fall under the authority of a single faculty
member. This approach to facilities and equipment, emphasizing individual responsibility, appears to be
serving the department well given our current configuration.

Many faculty members in the department develop and conduct their research in close coordination with
stakeholders and external partners. Yet, there may be additional opportunities to strengthen efforts for
cooproduction of knowledge.

Office of Research contributions to startup packages have also presented challenges for Department
faculty members. The limited size of startup packages has been problematic for some faculty. Some
research labs are relatively inexpensive to set up whereas others require considerably more funding. A
broader problem is that the Office of Research has recently taken a strongly regulatory, rather than
facilitative, posture and has chosen to limit specific items that can be funded or used as match for Office
of Research funding in startup packages. For two recent WATS hires, publication costs were arbitrarily
disallowed to be used as match, without explanation. Publications are important contributions to USU’s
research mission and indicators of junior faculty research success. As publication costs have risen
considerably, these are often difficult costs for junior faculty members to obtain funding to cover.
Tuition and fees paid by the department for graduate students, as part of a faculty member’s startup
were also disallowed for inclusion in the startup packages for these new faculty members. In the most
recent iteration of the Office of Research rules for startup packages, undergraduate researchers, lab
managers, equipment service agreements, professional development activities, graduate tuition and
fees paid by the department, and vehicles have all been excluded. Concerns raised about how these
seemingly arbitrary rules may undermine the success of some faculty members and departments have,
up to the point of writing this report, been ignored.

Some faculty have also experienced challenges with research facilities in the Biology-Natural Resources
building. The BNR building was constructed between 1958-1962 and includes about ten faculty, student,
and staff offices as well as most WATS research labs. In recent decades, the BNR building has fallen
below the standards of what should be expected of a modern science building and perpetual problems
with plumbing, HVAC, fume hoods, and energy efficiency have caused problems for faculty, staff and
students housed there. While there are plans for renovating the building, initial investments were
almost exclusively used to renovate the portion of the building occupied by the Biology department.
That renovation presented hardships for some Watershed Sciences labs located near the areas being
renovated. Perhaps more problematic is that the portion of the building occupied by Natural Resources
is planned for a less thorough renovation, which is expected to be drawn out over several years.
Watershed Sciences faculty, staff and students are understandably concerned about how this may affect
working conditions and research productivity.

Educational Programs

Our educational programs have evolved considerably over the past several years. Our undergraduate
degree programs have remained relatively small, by design. However, the department now recognizes
opportunities to expand our undergraduate programs and prepare undergraduate students to be successful in a broader range of careers. Below we articulate some of the opportunities for growth and improved effectiveness in our current undergraduate programs and discuss ways those might be addressed. Our graduate program is considered to have been very successful in preparing students for research and management careers. In recognition of this success, the goals and structure of our graduate program have remained relatively similar for the past 15 years. The size of our graduate program is limited by the number of students faculty can support on external research grants, but we acknowledge that there may be opportunities to improve professional development for our graduate students, as discussed below. Further, we recognize opportunities to expand our graduate student population by serving a new group of graduate students aspiring to careers as restoration practitioners, as discussed below in the Vision and Emerging Initiatives section as well as improving our diversity.

1. Undergraduate Programs:

   a. The department has implemented a full-day retreat in May with the purpose of assessing and improving the undergraduate and graduate programs. The retreat is scheduled to immediately follow the school year while leaving time to implement changes before the next school year. Minutes documenting the discussions and summaries of the resulting action plans are available in the assessment area of the department webpage. We have used the retreats to strengthen connections among courses and to discuss and approve new majors. Assessment of learning at the level of individual courses is robust but is not well standardized or documented. The University recently provided resources to improve assessment at the program level. The Department Head is planning to work with the USU Office of Analysis, Assessment and Accreditation to improve documentation of learning assessment at both the course and program levels.

   b. Members of the WATS External Advisory Board encouraged the department to increase human dimensions training and education. Many of the deficiencies they reported in their own workforce, and specifically from students coming out of our program, are in understanding the societal and regulatory context for the science, communicating to a variety of different audiences, interpersonal skills including principles of leadership and teamwork, and people management. The Department Head is planning to work with faculty to conduct a review of all courses to identify where these human dimensions are currently being addressed and what opportunities exist in courses and extracurricular programs to enhance human dimensions knowledge for our undergraduates. We will also be evaluating opportunities to work with the QCNR Department of Environment and Society to identify opportunities for our students to obtain more human dimensions training both in and out of the classroom.

   c. The department offers only a few large-format (60+ students) classes (Oceanography, Physical Geography, Fundamentals of Watershed Sciences) that serve the broad population of students throughout Utah State University. This may be a missed opportunity for our faculty to share their deep knowledge about the science and solutions to many of the urgent environmental problems that society is facing. Science literacy is another general topic that could be integrated into some of these larger format courses. Offering more of these courses would enhance our departmental impact and increase our contributions to USU’s broader educational mission. This issue could be addressed by reconsidering teaching contributions of some existing faculty members and/or by hiring new faculty members with primary roles of teaching.

   d. We have very few courses that are fully available online to serve students and
professionals outside the Logan campus. To some extent, this is due to the fact that many of our courses depend on in-person labs and field experiences that cannot be easily replicated in an online course. At the same time, the lack of fully online courses may be another missed opportunity for communication and outreach regarding the many pressing environmental problems for which our faculty have deep knowledge and valuable solutions to offer. Offering more fully online courses also enables the department to expand our audience to a wider diversity of people, including older and non-traditional students, students from a wider range of income levels, and a wider variety of racial and ethnic backgrounds. This issue could be addressed by providing existing faculty resources to develop online courses, continuing to build on the remote-access adaptations faculty have made in response to the COVID-19 pandemic, and/or by hiring new faculty members with primary roles of teaching and expertise in online course development.

e. None of our faculty members have a position with a dominant teaching role. While all of our faculty are strongly committed to teaching as the secondary emphasis in their role, the lack of teaching faculty limits the number of courses we are able to offer, provides less instructional resilience when we have faculty members on leave, and may render the pedagogical expertise in the department at a less-than-desirable level.

f. We currently have only one undergraduate certificate program. Introducing several other undergraduate certificate programs could help students define their specific skillsets within the broader field of watershed sciences and make them more competitive for some jobs. Certificate programs may also attract some students from outside our department, which would increase our departmental contribution to USU’s educational mission. Department faculty have not yet been engaged in discussion about which, if any, new certificate programs we may want to consider offering in the future.

2. Graduate Programs

a. We have inherited a departmental business model in which we have very few department-funded fellowships and relatively little financial support for Teaching Assistants. The lack of central funding support for graduate students necessarily means that faculty members must obtain external funding to support graduate students. This reliance on external funding presents several challenges, most notably creating uncertainty in graduate student support, as funding is not always available at the right time, in the right quantity, or for the right duration to align with graduate student needs. This is particularly pressing for funding PhD graduate students. Further, our strong reliance on external funding creates a situation in which incoming graduate students may be somewhat constrained in the research they are able to undertake, as it is often tied to an existing project with specified deliverables. Despite these challenges, Watershed Sciences graduate students are typically well funded and remain fully funded throughout their entire program of study, even in cases where that program of study has to be extended one or several semesters. And the department has established a precedence of filling prospective funding gaps with teaching support or discretionary funding, but those funds are limited. While the current system is functional, it remains a source of concern, anxiety, and perhaps inflexibility for both faculty and students. Generating additional central funding at the department and/or college level would help ameliorate these concerns.

b. Our graduate program currently only has one required course, the 1 credit Graduate Student Induction Course. This can be viewed as a strength, as it offers students and
supervisory committees maximum flexibility to develop a program of study that is specifically tailored to their interests. But this minimalist approach can also be viewed as a weakness, as it precludes a common knowledge base and skillset that would define a watershed science graduate. A lack of a common Watershed Sciences core may also reduce the number of interactions among graduate students. After numerous discussions on this topic over the past decade, the department has agreed to add a 2-credit integrative ‘Big Ideas in Watershed Science’ course to the core requirements for all MS and PhD students, starting Fall 2021.

c. Professional development opportunities for graduate students are relatively conventional and tend to be targeted to students planning to pursue careers in research or management agencies. Some of these opportunities are centrally organized (i.e., grad student symposium, general structure for thesis/dissertation proposals, presentations, etc.), but most are ad hoc and organized within individual lab groups. To ensure a more consistent, and presumably overall improved, suite of professional development experiences the department could consider organizing more workshops and events that promote leadership and teamwork skillsets, communication to a wider variety of audiences, diversity and inclusiveness guidance, pedagogical training, and project management skills.

Extension and Outreach

Strengths of our extension programs:
The different NR extension programs in QCNR are reasonably well integrated, expanding the scientific base and audiences that each program has developed individually.

- WATS Water Quality Extension (WQE) specialists and staff are able to draw upon the expertise of other faculty and staff in the college. These individuals have been very generous with their time and resources, even when there is little benefit to them to do so (see weaknesses below).
- WQE collaborates well with faculty (Extension and non-Extension) in other USU Colleges, in particular Colleges of Agriculture, Engineering, Social Sciences, and Education.
- WQE also partners extensively with federal, state, and local agencies and NGOs, as well as other environmental programs and organizations around the state.
  - Mesner has deep ties with Utah’s state water quality task force (see https://www.utahcleanwater.org/utah-watershed-partners.html) and their watershed management programs, with particular focus on effectiveness of ag water quality BMPs. Rivers and Braithwaite are developing similar ties with the Task Force.
  - In particular, Braithwaite works closely with individual school districts and the state office of education and STEM affiliates. Rivers is developing ties with the Utah Dept of Transportation and municipal stormwater agencies.
- WQE’s environmental education materials and programs are assessed for effectiveness and have trained hundreds of teachers and reached thousands of students.
- WQE has been successful in acquiring external funding from many external sources, including EPA, USDA, NSF, BOR, UDWQ, UDNR, and USU’s Legislative earmarks for water and natural resources.
- Our new WQE extension specialist position has a research/extension split, rather than a research/teaching split.
• WQE’s online resources provide a content rich website, supplemented by several other websites, increasing presence in social media, associated with specific programs (Utah Water Watch, Stream Side Science, Utah Watershed Partners). Our online publications reach thousands through digital commons.

Weaknesses of our Extension programs
• Non-Extension faculty and staff represent a huge untapped resource for our outreach efforts, but institutional barriers often prevent this. Possible incentives include:
  o Small stipends for assistance;
  o Include expectations of outreach/extension in role statements and make this part of the P&T and annual review expectations;
  o “Buy out” a small percentage of faculty’s time for extension outreach (similar to UAES.) With UAES, this creates a pathway for their streams of funding, grants programs, and support.)

• “Big E Extension” is housed within the College of Agriculture, leading many legislators, partners, our citizen clients, and other USU extension faculty to equate Extension with Agriculture.

• WATS and, more broadly, QCNR have a fairly small percentage of total extension appointments in the USU system. As a result, NR’s Extension specialists are given very broad disciplinary assignments, leading to programming that is very wide but shallow or deep coverage for fewer actual extension needs.
  o WATS related areas in which we have no explicit expertise include: fish issues (aquaculture and wild fisheries), drinking water and well protection issues, small pond management, harmful algal blooms, and problems associated with aquatic macrophytes.

• Legislative money that is available through Extension and USU small grants programs have explicitly precluded many water quality projects and all K-12 educational projects. Water quality funding typically requires a specific link to water quantity.

• Needs still exist for rural and wildland water quality programming and are not being addressed with recent hires in WQE. Some of this is being addressed by county agents.

• Maintenance of online resources is extremely time consuming, and often comes at the expense of new program development.

Other

The department has a long history of maintaining a supportive, inclusive, engaged culture. And we have demonstrated effective teamwork and group decision-making. Nevertheless, we have very little ethnic and cultural diversity, despite our inclusive and supportive community. While we have started to address this issue in our student population, we have much more work to do to recruit a more diverse set of applicants and ensure those students are well supported. We also have a considerable amount of work to do to improve the diversity of our faculty and staff. Lack of diversity is a systemic problem at USU, as documented in the 2020 annual report of the Faculty Diversity, Development, and Equity Committee. Some of the factors underlying this problem are beyond our control, but it is clear that the department needs a plan to work on factors that are within our control.

Faculty salaries and operating budgets are relatively low, which presents challenges in recruiting and
Some faculty have expressed that teaching, outreach and science communication have been undervalued in annual reviews and decisions about merit raises in the past. We have attempted to remedy this by explicitly including these contributions in annual reviews and reserving some portion of merit raise funding pool to reward excellence in teaching as well as outreach/extension/science communication.

VISION AND DEVELOPING INITIATIVES

The vision for the Department of Watershed Sciences is to be a nationally leading source of impactful watershed research, as well as potent scientists, managers, and restoration practitioners. We are already fulfilling parts of that vision but acknowledge there are opportunities to enhance our impact and strengthen our educational and training programs. Over the next several years we aim for sustainable growth and adaptation that enables all members of the department to maintain high productivity and good mental health, while reassessing and refining how we operate at an individual and departmental level.

We have started several new initiatives in the past year in an effort to pursue our vision for the department:

External Advisory Board

With the intent of gathering input from some of our stakeholders and potential employers of our graduates, the department formed an external advisory committee in Fall 2020. The scope of the board is to:

- Assess WATS undergrad majors and ensure they are meeting workforce development needs.
- Provide guidance on proposed 5th year professional master of ecological restoration.
- Provide feedback on the suite of short-course and possible certificate programs we are developing for matriculated students and working professionals.

The committee was deliberately limited to a small group of northern Utah partners in an effort to foster more substantive discussion, rather than a larger, regional or national, group that could be more representative of the wide variety of stakeholders and potential employers. As an indicator of our departments value we received enthusiastic, positive responses to all six invitations issued. The external advisory board consists of:

- Lynn De Freitas: Executive Director of the Friends of Great Salt Lake
- Jodi Gardberg: Environmental Program Manager, Utah Division of Water Quality
- Tyler Thompson: Director, Utah Watershed Restoration Initiative
- Drew Cushing: Aquatic Section Chief, Utah Division of Wildlife Resources
- Brandon Albrecht: Co-Principal, BioWest, Inc.
- David Epstein: Water Resources Specialist

The first meeting of the external advisory board took place on January 13, 2021. Full minutes for the meeting are available upon request, but the most salient recommendations of the board include the following:
1. All of the board members articulated that many hires, and specifically some from our department, are lacking in basic human dimensions training, including basic teamwork and collaboration skills, emotional and social intelligence, and communication with specific audiences (esp. clients, general public that is not necessarily interested in science).

2. Board members also expressed the importance of practical training, methods that can be implemented with resources available, and pragmatic problem solving, approaches that may be less than ideal, but are acceptable to the relevant stakeholders or decision-makers. Students should be trained in how to develop a consensus among stakeholders, rather than having a single solution they are trying to push.

3. Formal communication, grant and report writing, public speaking are also highly valued and while WATS does emphasize this training already, we will be re-evaluating opportunities to strengthen this training throughout our curriculum.

4. Several board members expressed that students need better knowledge of the relevant laws and regulations and about the regulatory process in general.

5. Internships were discussed at length. All stakeholders viewed internships as mutually beneficial for the student, host, and department as long as they set up with clear goals and feasible logistics. Several specifically encouraged more applicants from our department for existing internships. One board member expressed interest in establishing a new internship program if there were sufficient interest from USU. Several challenges were discussed, including funding to support the students as well as staff at the host institution, timing of the internship as several hosts have projects that occur in the fall or projects that tend to require a 6 month commitment, and some stakeholders expressed a preference for being able meet prospective interns prior to hiring them. The department is considering establishing a ‘shadowing’ program in which WATS undergrads visit various prospective employers for a day prior to applying for internships. And the department is planning to bolster the internship program for undergraduates, Master of Ecological Restoration students, and possibly MS and PhD students.

Society for Ecological Restoration curriculum alignment

We recently had our Management and Restoration of Aquatic Ecosystems bachelor of science program curriculum evaluated and aligned with the Society of Ecological Restoration’s (SER) curriculum requirements. Aligning our program with SER ensures our students are taught to professional standards for those who are designing, implementing, overseeing, and monitoring restoration projects throughout the world. This alignment also enables our graduates to become a Certified Ecological Restoration Practitioner In-Training (CERP-IT) upon completing their degree. After three years of work experience, our CERP-IT certified graduates can apply to become a Certified Ecological Restoration Practitioner (CERP).

Professional Master of Ecological Restoration

Following numerous rounds of discussion among the faculty, in December 2020, the department formally submitted a proposal to offer a new Master of Ecological Restoration (MoER) degree. Combining coursework, an internship, and design exercises, the degree is intended to be completed within one year following attainment of a related BS degree. A master’s degree is the preferred entry point into the workforce in the field of ecosystem restoration and this new degree enables students to
obtain a BS degree and MoER degree within a five-year time frame.

The MoER builds on research and teaching expertise of existing WATS, QCNR and USU faculty, several of whom are internationally renowned as leaders in ecosystem restoration. The curriculum and professional development opportunities of the MoER program will provide graduates with a competitive advantage when applying for restoration and ecosystem management jobs, which will in turn improve WATS recruitment, persistence, and retention. As a coursework-intensive program targeting students who aspire to careers as restoration practitioners, MoER provides a useful applied-science complement to the successful and highly competitive, research-intensive MS programs currently offered by the department. Moreover, many of the courses for MoER already exist and are part of the Graduate Certificate in Aquatic Ecosystem Restoration, which is targeted to the department's research-oriented MS and PhD students.

The mission of the WATS MoER program is to prepare future restoration professionals with the perspective and skillsets needed to assess the condition of wetland, lake and stream ecosystems; identify causes of degradation; and develop and implement plans for restoration of ecosystem health. The Department of Watershed Sciences is uniquely positioned to accomplish this inherently interdisciplinary mission with respect to aquatic ecosystems. While MoER is proposed as an extension of the two existing WATS BS degrees (Management and Restoration of Aquatic Ecosystems (MRAE) and Fisheries and Aquatic Sciences (FAS)), the intention is to evolve the program over the next several years to enable students from similar BS degree programs (e.g., 'Landscape Architecture' and 'Conservation and Restoration Ecology' at USU and potentially similar undergraduate programs at other institutions) to enroll and complete the one-year MoER degree program. In considering development of the program, we conducted an analysis of labor market demand as well as student demand, both of which were highly favorable.

The MoER program will effectively function as a 4+1 program that enables students completing a relevant BS degree to obtain a restoration-practitioner focused professional master's degree in one additional year. After completing a relevant BS degree, students in the program will be required to earn a minimum of 30 credits, including all core curriculum requirements and a minimum of two credits from each of four elective blocks, to complete the MoER degree. Core requirements are outlined in Table X., including a professional internship (minimum of four credits, which translates to (4 credits x 45 work hours per credit =) 180 work hours). The department already has several internship opportunities but will expand, diversify and strengthen these opportunities. Core requirements also include participation in the Watershed Sciences Capstone class. The Capstone is a requirement of both WATS BS degrees and employs a variety of high-impact teaching practices to provide students with real-world experiences in restoration design, implementation and monitoring as well as stakeholder engagement. MoER students will have completed the Capstone course as part of their BS and will return to serve in mentoring and leadership roles as part of the MoER Capstone Mentoring class.
Table 2. Requirements for the proposed Master of Ecological Restoration degree

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATS 6240</td>
<td>Graduate Internship Practicum</td>
<td>4</td>
</tr>
<tr>
<td>WATS 6350</td>
<td>Capstone Mentoring</td>
<td>2</td>
</tr>
<tr>
<td>WATS 6700</td>
<td>Restoration Ecology</td>
<td>4</td>
</tr>
<tr>
<td>WATS 5620</td>
<td>Intro to Low-Tech Process-Based Restoration of Riverscapes</td>
<td>1</td>
</tr>
<tr>
<td>WATS 5625</td>
<td>Adaptive Management and Monitoring of Riverscapes</td>
<td>1</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

Elective Blocks (minimum 2 credits per block, 18 credits total)
- Block 1: Ecology
- Block 2: GIS and Remote Sensing
- Block 3: Quantitative Methods
- Block 4: Design

Equity, Diversity, and Inclusion

Watershed Sciences has consistently maintained an inclusive culture. Yet, the department has attracted very few applications from students of color at the graduate level where we typically recruit nationwide and to some extent internationally. The number of students of color in our undergraduate programs is even fewer. The few students of color who have enrolled in the graduate program have reported very positive experiences in department culture and their research and education. Some found the lack of diversity in Logan to be challenging. In an effort to increase the diversity of our graduate community, the department has offered two Justice, Equity, Diversity and Inclusion (JEDI) fellowships, starting August 2021. One of these fellowships will be for a PhD student, the other could be for an MS or PhD student. The department received seven applications, each with a faculty sponsor, for this first round of fellowships and we plan to offer additional fellowships in future years.

The department also has several faculty participating in the QCNR Diversity, Equity, Inclusion committee and one faculty member participating in the Unlearning Racism in Geosciences (URGE) pod hosted by the Department of Geosciences. While our diversity numbers have historically been very low, the department has a strong commitment to improve our diversity and maintain a safe and supportive environment for students of color.

Graduate Program Innovations

WATS faculty have discussed the idea of creating a common core for the department iteratively over the
past 15 years. Currently, students pursuing Ecology degrees are required to complete the Ecology Common Core (Table X), but the only other required course for WATS graduate degrees is the one credit Graduate Student Induction Course, which takes place over five days in the week prior to the start of each fall semester.

Advantages of creating a common core would be to 1. ensure all WATS grad students are exposed to some minimal set of fundamental concepts across the range of disciplines that comprise watershed science, 2. help establish more personal connections among our grad community, 3. establish a core knowledge base that can be built upon in more advanced courses, 4. help future employers understand the common knowledge base and skillsets of USU Watershed Science grad students, and 5. cover some basic professional development concepts. Disadvantages of creating a common core include 1. Reducing flexibility in customizing students’ program of study based on their specific career goals and 2. we would not want students to feel as though they are wasting time/effort in courses for which they have prior knowledge or little interest.

After considerable discussion in Fall 2020 the faculty opted to implement a new 2 credit core course that builds on the success of the Graduate Student Induction course. The course has tentatively been titled ‘Big Ideas in Watershed Sciences’ and is expected to 1. Continue the cohort-building interactions that are started in the Graduate Student Induction Course, 2. Expose students to a variety of core concepts in Watershed Sciences disciplines (ecology, hydrology, biogeochemistry, geomorphology, water quality, limnology), and 3. Involve reading and discussion of pivotal papers that dive deep into some disciplines, make connections between disciplines, and explore the various roles of science to inform society, policy, and management. The course may or may not explicitly include professional development activities, at the discretion of the two lead co-instructors. All MS and PhD students in the department will be required to complete the course, starting fall 2021.

REGENTS REVIEW 2012

The 2012 Regents’ Review Committee for the Department of Watershed Science comprised Dr. Clifford N. Daum, Professor in the Department of Biology at the University of New Mexico; Dr. William E. Dietrich, Professor in the Department of Earth and Planetary Science at the University of California, Berkeley; and Dr. D. Richard Cutler, Professor and Head, Department of Mathematics and Statistics, Utah State University. The format for the 2012 review was similar to the format for the current review. Six recommendations emerged from the 2012 review:

1) Continued, modest growth in number of E&G positions in the department. Faculty have thoughtfully planned future hires in fisheries biology, riparian ecology, and aquatic toxicology, and hires in these areas are endorsed by the graduate students.

2) As resources permit, we recommend the addition of an extension position to support the department’s outreach and extension activities.

3) Facilities for the department appear to be at, or near capacity. If future growth is realized, some planning will have to be undertaken with regard to facilities.

4) We applaud and support Utah State University’s administrative initiatives to increase operating
budgets and recommend continued growth, as possible, to support extension and outreach programs relative to the departmental mission with regard to the state.

5) We encourage the department, with support from the College of Natural Resources and Utah State University development office, to develop a long-term plan for creating an endowment to help strengthen the doctoral programs and to support more postdoctoral positions.

6) Some of the larger enrollment classes in the department have need of additional teaching support. We recommend the addition of teaching assistantships (TAs) to help this educational mission and to enhance graduate program teaching experience.

FACULTY

The Department of Watershed Sciences currently has twenty core faculty, including one Professor Emeritus. Another twelve adjunct faculty members from USU and elsewhere are connected to the department. We currently have two vacant tenure-track positions that are expected to be filled by July 2022.

FACULTY ROSTER, CREDENTIALS AND DIVERSITY

The faculty of the Department of Watershed Sciences as of February 2021 includes the following:

Department Head
Patrick Belmont, Ph.D., hydrology, geomorphology and climate adaptation science

Professors
Phaedra Budy, Ph.D., Federal Cooperator, fisheries management, aquatic ecology
Charles Hawkins, Ph.D., aquatic ecology, biodiversity, environmental assessment, watershed science
Karin Kettenring, Ph.D., wetland ecology, restoration, management
Nancy Mesner, Extension, MSE, water quality monitoring and policy, watershed management, environmental education
John (Jack) Schmidt, Ph.D., fluvial geomorphology, water policy
Peter Wilcock, Ph.D., sediment transport, river mechanics, management and restoration

Associate Professors
Sarah Null, Ph.D., water resource management, climate change
Joseph Wheaton, Ph.D., fluvial geomorphology, ecogeomorphology, ecohydraulics, stream and river restoration

Assistant Professors
Trisha Atwood, Ph.D., ecosystem ecology, predator-prey dynamics, biogeochemistry
Janice Brahney, Ph.D., environmental biogeochemistry, paleolimnology, isotope tracers, aquatic ecology
Soren Brothers, Ph.D., limnology, carbon cycling of shallow lakes
Edward Hammill, Ph.D., community ecology and landscape planning
Erin Rivers, Ph.D., ecohydrology, biogeochemistry, and water quality extension
Timothy Walsworth, Ph.D., fish ecology and management

Research Faculty
Brett Roper, Ph.D., Research Faculty, stream ecology and habitat relationships

Adjunct Faculty with Graduate Programs
Nicolaas Bouwes, Ph.D., BRRC Director, aquatic ecology, salmonid ecology and management
Carl Saunders, Ph.D., fish biology, fisheries monitoring and management

Professional Practicing Extension Assistant Professors
Hope Braithwaite

Adjunct Professors
Michelle Baker
Robert Gillies
Johnnie Moore
Joel Pederson
David Tarboton
Joanna Endter-Wada

Adjunct Assistant Professors
Philip Bailey
Stephen Bennett
Jennifer Follstad-Shah
Scott Miller
Michael Scott
J. Christopher Wilson

Professor Emeriti
Wayne Wurtsbaugh, Ph.D., limnology, water quality, fish ecology of lakes

<table>
<thead>
<tr>
<th>Table 3. Faculty Count by FTE and Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Headcount</td>
</tr>
<tr>
<td>Professor</td>
</tr>
<tr>
<td>Associate Professor</td>
</tr>
<tr>
<td>Assistant Professor</td>
</tr>
<tr>
<td>Adjunct Faculty with Graduate Programs</td>
</tr>
<tr>
<td>Adjunct Professor</td>
</tr>
<tr>
<td>Adjunct Associate Professor</td>
</tr>
<tr>
<td>Adjunct Assistant Professor</td>
</tr>
<tr>
<td>Emeriti Faculty</td>
</tr>
</tbody>
</table>
The department leaves much to be desired in the diversity of our faculty. While we have made progress in gender representation over the past decade (Figure 1), we have very little ethnic diversity (Figure 2). Our only Hispanic/Latino faculty member (2014-2019) in recent years discontinued employment with the department and accepted a non-academic position in California. The only Asian faculty member in the department utilized the voluntary separation incentive program in October 2020 to take a position at University of Arizona.

There are numerous challenges to improving diversity among WATS faculty, several of which are outside our control. According to the National Science Board’s Science & Engineering Indicators 2020 Report (https://ncses.nsf.gov/pubs/nsb20197), many groups of Americans remain underrepresented among science and engineering degree recipients. Women are at or approaching parity with men at most degree levels across all science and engineering fields, but within specific disciplines, long-standing inequities persist. Blacks are underrepresented at all degree levels and Hispanics, American Indians, and Alaska Natives are underrepresented at all but the Associate degree level. Beyond these troubling national degree recipient statistics, the lack of ethnic diversity in Utah presents challenges for USU and our department to attract and retain a diverse faculty. Nevertheless, we recognize diversity in our faculty as an imperative to fostering an equitable and inclusive culture and we are committed to making progress on faculty diversity in future hires.

Figure 1. Watershed Sciences faculty gender comparison over time. These numbers do not include faculty who are not funded directly from USU.
EXPLANATION OF FACULTY ROLE STATEMENTS

Each faculty member at USU (tenure-track, lecturer ranks, or research faculty) is assigned a Role Statement, which specifies the percentage of their faculty role that is associated with Teaching, Research, Extension, and Service (as well as Professional Engagement for the lecturer ranks). The percentages specify the evaluative weight that will be given to each activity during consideration for promotion and/or tenure. They are not intended to reflect the time spent on each activity. University policy (AKA the Faculty Code) specifies that a faculty member is expected to demonstrate excellence in their primary role and effectiveness in their other roles. Most research faculty in the Department of Watershed Sciences are appointed with percentages of 50% Research, 40% Teaching, and 10% Service. Thus, such faculty must demonstrate excellence in research in order to receive tenure, as well as demonstrating effectiveness in teaching. Role percentages may be revisited over the course of a faculty member’s career. The percentages are generally much different and more variable for Extension faculty and for faculty in the lecturer and research faculty ranks.

RESEARCH, SCHOLARLY ACTIVITIES, BROADER IMPACTS

As one of the most productive research entities at Utah State University, WATS faculty, staff and students are engaged in a wide variety of fundamental and applied projects. Our research spans some of the most remote and wildest parts of the world to densely populated urban areas. While much of our research is focused on specific organisms, processes, and watershed systems, we are informing policy and management at the scale of some of the largest and most charismatic resources in the world, including the Mississippi, Columbia, and Colorado rivers, the Mekong Delta, and the Great Barrier Reef.

Some of the big questions that cut across our research groups include:

How do climate, geomorphology, biogeochemistry, and hydrology interact to influence biodiversity and species interactions at different spatial scales?
How is global climate and environmental change manifesting at regional and local scales? What are the implications for water availability, aquatic biodiversity and species interactions, water quality, and recreation?

How have humans modified water, sediment, and nutrient dynamics? How do specific policy and management practices affect ecosystem health and resilience?

How can we most effectively and sustainably restore the structure and function of lake, wetland, stream and riverscape ecosystems to healthy and resilient systems?

Publications represent one important outcome from the department’s research activities. The department is actively pursuing ways to recognize and value a wide variety of contributions and measure the impact of our research and outreach activities. Nevertheless, number of publications (Table 4) is a somewhat useful, one-dimensional metric to demonstrate a basic level of productivity among Watershed Sciences faculty.

Table 4. Publications Produced by Faculty in the Department of Watershed Sciences.

<table>
<thead>
<tr>
<th></th>
<th>Books</th>
<th>Book Chapters</th>
<th>Extension Publications</th>
<th>Reports and other non-reviewed papers</th>
<th>Published datasets</th>
<th>Peer Reviewed Papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atwood, Trisha</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>Belmont, Patrick</td>
<td>1</td>
<td></td>
<td></td>
<td>17</td>
<td>7</td>
<td>50</td>
</tr>
<tr>
<td>Bouwes, Nicolaas</td>
<td>1</td>
<td>8</td>
<td></td>
<td>&gt;50</td>
<td></td>
<td>38</td>
</tr>
<tr>
<td>Brahney, Janice</td>
<td>1</td>
<td></td>
<td></td>
<td>14</td>
<td>2</td>
<td>31</td>
</tr>
<tr>
<td>Braithwaite, Hope</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Brothers, Soren</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Budy, Phaedra</td>
<td>3</td>
<td></td>
<td></td>
<td>102</td>
<td>12</td>
<td>94</td>
</tr>
<tr>
<td>Hammill, Edward</td>
<td>2</td>
<td></td>
<td></td>
<td>6</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>Hawkins, Charles</td>
<td>10</td>
<td></td>
<td></td>
<td>&gt;50</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Kettenring, Karin</td>
<td>1</td>
<td>6</td>
<td></td>
<td>&gt;20</td>
<td></td>
<td>55</td>
</tr>
<tr>
<td>Luecke, Chris</td>
<td>8</td>
<td></td>
<td></td>
<td>&gt;30</td>
<td>2</td>
<td>66</td>
</tr>
<tr>
<td>Mesner, Nancy</td>
<td>2</td>
<td>4</td>
<td>80</td>
<td>38</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Miller, Scott</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Null, Sarah</td>
<td>1</td>
<td></td>
<td></td>
<td>5</td>
<td>4</td>
<td>36</td>
</tr>
<tr>
<td>Rivers, Erin</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Roper, Brett</td>
<td>1</td>
<td>2</td>
<td></td>
<td>38</td>
<td>6</td>
<td>59</td>
</tr>
<tr>
<td>Schmidt, John</td>
<td>4</td>
<td></td>
<td></td>
<td>&gt;20</td>
<td>&gt;30</td>
<td>67</td>
</tr>
<tr>
<td>Walworth, Tim</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>19</td>
</tr>
<tr>
<td>Wheaton, Joseph</td>
<td>1</td>
<td>10</td>
<td></td>
<td>55</td>
<td>&gt;5000</td>
<td>60</td>
</tr>
<tr>
<td>Wilcock, Peter</td>
<td>7</td>
<td>14</td>
<td></td>
<td>35</td>
<td>6</td>
<td>93</td>
</tr>
</tbody>
</table>
Watershed Sciences faculty also contribute a wide variety of broader impacts to in order to help inform policy and management decisions and to communicate the value of our research to relevant stakeholders and the general public. Following is a list of broader impact activities that Watershed Sciences faculty members have contributed in the past few years.

WATS faculty frequently work closely with stakeholder groups to inform their research questions, study design, and interpret results. For example:

- One faculty member recently developed and provided a training workshop for stakeholders and water managers on a decision support model grounded in empirical data to compare the expected response of an endangered fish population to multiple alternative annual water management strategies. Water managers intend to use the outputs of this model to inform their water operations in spring of 2021.
- Another faculty member has been working for three years with 20 local, state, and federal agency staff members focused on forest, wildfire, and water resource management to identify the water supply reservoirs throughout the state that are most vulnerable to post-wildfire sedimentation and determine where preventative measures might be taken to reduce wildfire-related risks.
- WATS faculty have developed an internationally recognized standard of practice for Low-Tech Process-Based Restoration of Riverscapes, which has been adopted by numerous State and Federal agencies and for which training has been delivered to over 1500 students from 44 different US states and 14 different countries. These practices have been incorporated and included into Federal funding appropriations, state and federal policies and regulations.
- WATS faculty are working with the Utah state government (DWQ) to develop management and restoration strategies and policies for Utah Lake, which features recurrent harmful algal blooms.
- WATS faculty are providing multiple state legislatures with research findings and participating in international panel discussions on policy and the regulation and pollution.
- WATS faculty are providing international governments, research agencies and non-profit organizations with information on ocean-based natural climate solutions.
- WATS faculty are developing high school curricula and collaborating with web platforms to create content on the extent of plastic pollution.
- WATS faculty are developing professional trainings and workshops for stormwater best management practices that protect water quality during urban development.
- WATS faculty are developing and disseminating best practices for invasive species management and native plant restoration in wetlands.
- WATS faculty are developing region-specific guidelines for low impact development (LID) designs that treat stormwater quality. These will be added to the LID design guidebooks published and used by DWQ and UDOT.
- WATS faculty often have assignments in classes that get students engaged in communicating with the public, agencies, and policy-makers. For example, one faculty member has an undergraduate assignment where students write to politicians expressing concerns about an environmental issue important to them. One student was personally called by congressman Rob Bishop regarding their concerns over dewatering of the Great Salt Lake.
- WATS faculty have developed a water resources management museum exhibit to educate the general public on future water development choices in Utah and how they will impact river habitats. The exhibit is currently at the Utah Natural History Museum in Salt Lake City and will travel to the Swaner EcoCenter in Park City next year. It has the potential to reach 60,000 - 13,000 visitors (depending on the extent and duration of COVID social distancing protocols).
• Research completed by WATS faculty is shaping the trajectory of water resources and decision-making in multiple states. For example, the California Department of Water Resources is exploring climate-adaptive water year typing methods and assessing their potential impacts on the current water classification system and water operations in the state, which is based from and following recommendations by Dr. Null and her co-authors. Utah’s Wildlife Migration Initiative part of the Division of Wildlife Resources, is using models developed by Dr. Null to manage habitat for native fish species of concern, with future research targeting managing habitat to block the spread of non-native species.

RESEARCH FUNDING

Faculty and research staff in the Department of Watershed Sciences have been highly competitive in obtaining research funding. Over the past five years, research revenues have averaged over $4.5 M (Figure 3), which is considerable relative to the $1.5M the department receives each year in institutional support. External grants and contracts are obtained from a wide variety of local, state, and federal agencies, as well as non-profit and industry partners (Figure 4). Major funding sources include the Department of Defense, US Bureau of Land Management, US Bureau of Reclamation, National Science Foundation, Utah Department of Environmental Quality, and Utah Department of Natural Resources Division of Wildlife Resources (Figure 4). Watershed Sciences faculty have also received contracts and grants from dozens of minor funding sources, including federal, state and local agencies, non-profit organizations, and industry partners (Figure 5). Watershed Sciences accounts for approximately 5% of total contracts and grants awarded to Utah State University, equivalent to or greater than departments that are considerably larger (e.g., Wildland Resources, Plants Soils and Climate, Biology, Civil and Environmental Engineering, Figure 6).

Figure 3. External research funding from contracts and grants, by sponsor type.
Figure 4. Percentage of external contracts and grants obtained from major funding sources over the past five years.

Figure 5. Percentage of external contracts and grants over the past five years obtained from minor funding sources, which comprise the 45% listed as ‘others’ in the chart immediately above.
Figure 6. Percentage of total contracts and grants awarded to Utah State University over the past five years, by department.

FACULTY TEACHING LOADS

Teaching loads can be challenging to define in a way that ensures equity among faculty members. WATS teaches a wide range of courses, each with different class sizes and student demographics, different classroom, online, laboratory, and field requirements, varying relevance to WATS degree programs, and different levels of conceptual and quantitative content. Some WATS faculty are asked to teach courses that fit squarely within their expertise, while others are asked to develop integrative courses that cut across disciplinary boundaries.

At the most basic level, faculty teaching loads are guided by the Utah System of Higher Education Policy R485-3, which defines a 100% teaching load at a research-oriented university to be 18 credit hour equivalents each year. As a starting place for teaching load discussions, we multiply that value by the percentage of each faculty member’s role that is dedicated to teaching, typically around 40% (i.e., 18 credits x 0.4 = 7.2 credits per year). The annual teaching load may then be adjusted, in consultation with the faculty member, according to class size, teaching complexity, amount of preparatory work required, etc. While USU faculty code specifies that the Department Head has the authority to designate teaching responsibilities for all faculty, WATS maintains a culture in which faculty teaching responsibilities emerge from iterative, two-way discussions that consider faculty member desires in the context of program needs and student demand.
TEACHING INNOVATIONS AND HIGH-IMPACT PRACTICES

1. Cohort-building:
Cohort-building entry level seminar (WATS 2000): Helps students develop a peer network, exposes them to many of the big environmental issues that provide motivation for research and coursework later in their program, explores the variety of career options they might choose to pursue.

Since 2011, WATS has organized a Graduate Student Induction Course for all incoming MS and PhD students. The four-and-a-half-day course provides opportunities for the incoming cohort to meet each other, existing students, faculty and staff, helps students understand opportunities and responsibilities, and includes several field trip to discuss big concepts and common methods in watershed sciences. The course has been very successful and WATS faculty have agreed to build on that success by adding to our core MS and PhD requirements a 2 credit ‘Big ideas in Watershed Sciences’ course to be taught each fall semester.

2. Experiential learning:
Several courses provide hands-on field and laboratory experiences.
Fisheries field techniques (WATS 3110: Fish Diversity Lab): Multiple field trips introduce students to standard field survey techniques used by fisheries professionals in both lake and riverine settings. Students also gain experience with data collection, data management, analysis, and summarizing results in written and oral reports. GEOG 1005 provides hands-on data collection field experience in physical geography.

Aquatic Practicum: Field and Lab Methods (WATS 4950) is a seven-week 2-credit course that will provide students with the basics of limnological field techniques, sample processing, laboratory methods, and data analysis for both water properties and organisms. Throughout the course the students learn how to produce a technical report.

Freshwater Invertebrates (WATS/Biol 5550): Students learn to be proficient in the identification of freshwater invertebrates, basic aspects of survey and sampling designs, sampling techniques, data quality and factors that affect it, the theory and application of biological indices that water-quality agencies use to assess ecological integrity, and the need for clear technical writing.

3. Undergraduate research:
Aquatic Ecology Practicum II: Analysis (WATS 4520) has undergraduate students work with monitoring data collected by local agencies from Bear Lake (ID/UT) and regional alpine lakes, developing original cutting-edge research questions, writing up their analyses in the form of a scientific manuscript, and presenting their results to local stakeholders and management agencies.

Introductions to Coral Reefs Field Course (WATS 3450): This class fully immerses students in the study of coral reef systems through a two-week study abroad field course on Australia’s Great Barrier Reef. Students learn and practice techniques that allow them to study corals, fish, and invertebrates. Students also learn how to develop a scientific question, design a study, collect and analyze data, and present their findings through both written and oral reports.
4. Writing and multi-media communication intensive courses:
Persuasive letters to policymakers (WATS 3100: Fish Diversity and Conservation): Students research and write persuasive essays to policymakers regarding a key conservation issue in fisheries, providing them practice in researching and framing a concise and impactful argument with the goal of eliciting policy or legislative action.

Students in the CI course “Fundamentals of Watershed Sciences” (WATS 3700) write policy briefs outlining conservation issues in a specific watershed of their choice, directing their brief to a local policymaker. In the same class, students also work in groups to create educational videos describing a watershed of their choice.

5. Internships:
The department has encouraged students to complete professional internships with local, state, or federal agencies, non-profit organizations or consulting firms. As an incentive, the college provides matching funding for some internships. If students want to use the internship for credit towards their degree program, students are required to submit to the Department Head a proposal describing the work experience and explaining responsibilities that provide “increased complexity to help the student gain a more professional level of experience.” The number of credits will depend on the amount and nature of the work. Generally, USU defines one credit hour as equal to three hours per week (for lectures, one contact hour and two study hours each week) for the 15-week semester (i.e., one credit hour equals 45 work hours). To receive credit for the internship, the student must submit to the Department Head a summary report, approved by the student’s immediate supervisor, indicating that the requirements have been met. The report should mirror the initial proposal, summarizing the work experiences and highlighting any deviations from the plan initially proposed. Brief, supporting documentation by a supervisor at the internship workplace is encouraged, but not required.

In the past, the department has advertised opportunities and evaluated the experiences of students requesting credit for their internship. However, the department has not kept track of students completing internships if they do not request credit. However, recognizing the value of these experiences for our undergraduate students, and especially for our Master of Ecological Restoration students, the department will play a more active role in establishing internship opportunities, providing guidance and various forms of support for students and internship hosts, and reinforcing throughout our curriculum some of the professional development that students attain during internships.

6. Capstone experience:
Undergraduates in both majors are now required to take two 2 Cr Capstone courses (WATS 5340, WATS 5350) in their senior year. The courses emphasize application of science principles learned throughout the program. The fall course (WATS 5340) leads to an alternatives assessment and preliminary design for a reach of the Logan River. Students work with Logan City, Cache Water District, local consultants, and the Logan River Task Force to develop design alternatives for a priority reach of the Logan River. The spring course (WATS 5350) leads to a design/build implementation of a process-based design using low-cost, low-tech methods on US Forest Service or private land. The two courses include watershed and site assessment, decision analysis driven by stakeholder input, preparation of grading and design plans, cost estimates, and extensive group work with written and oral presentations to stakeholders.
FACULTY AWARDS AND RECOGNITION

Dr. Trisha Atwood was awarded a National Academies of Sciences, Engineering, and Medicine Gulf Research Early Career Award.

Dr. Patrick Belmont was a co-recipient of the Kirk Bryan Award for Excellence from the Geological Society of America in 2018.

Dr. Janice Brahney received the Aeolian Research Award for Top-5 cited publications in 2013. In 2016 she received the American Chemical Society Editor’s Choice Award. In 2014 she received an Honorable Mention (2nd) from the Ecological Society of America, Elizabeth Sulzman Award.

Dr. Phaedra Budy received the USGS/DOI Star Award in 2015, 2016 and 2017 for Superior Performance.


Nancy Mesner received the E.G. Peterson Extension Award honoring USU Extension faculty member who has provided outstanding service to the state. In 2013 she was a co-recipient of the Environmental Education Program of the Year for Bear River Celebration presented by the Utah Society of Environmental Education.

Dr. Sarah Null received a National Science Foundation CAREER award, 2017.

Dr. Jack Schmidt received the Department of Interior Partners in Conservation award in 2013.

Dr. Joseph Wheaton received the Gordon Warwick Award from the British Geomorphological Research Group in 2020.

Dr. Peter Wilcock was inducted as a fellow of the American Geophysical Union in 2013 and received the Hans Albert Einstein Award from the American Society of Civil Engineers in 2008.

FACULTY-STUDENT RATIOS

Table 5 presents data on the number of graduate and undergraduate majors in Watershed Sciences, departmental full-time equivalent (FTE) students, and student credit-hour production (SCH), as recorded by USU’s Office of Analysis, Assessment, and Accreditation (AAA). Also included are data on total student FTE per faculty FTE for 2015-2016 through 2019-2020.
Table 5. Department of Watershed Sciences Students, Full-time Equivalent Students, Student Credit-hour Productivity, and Students per Faculty Member for 2015-2020. These data are based on Fall third-week enrollment figures.

<table>
<thead>
<tr>
<th></th>
<th>Academic Year 2015-16</th>
<th>Academic Year 2016-17</th>
<th>Academic Year 2017-18</th>
<th>Academic Year 2018-19</th>
<th>Academic Year 2019-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Graduates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certificates</td>
<td>fall 2015</td>
<td>fall 2016</td>
<td>fall 2017</td>
<td>fall 2018</td>
<td>fall 2019</td>
</tr>
<tr>
<td>Associate Degrees</td>
<td>16</td>
<td>14</td>
<td>19</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>Bachelor’s Degrees</td>
<td>5</td>
<td>6</td>
<td>11</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Master’s Degrees</td>
<td>9</td>
<td>7</td>
<td>8</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>Doctoral Degrees</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total # of Declared Majors</td>
<td>71</td>
<td>79</td>
<td>102</td>
<td>101</td>
<td>100</td>
</tr>
<tr>
<td>Total Department FTE*</td>
<td>57.8</td>
<td>37.8</td>
<td>51.8</td>
<td>61.9</td>
<td>47.9</td>
</tr>
<tr>
<td>Total Department SCH*</td>
<td>766</td>
<td>462</td>
<td>675</td>
<td>808</td>
<td>636</td>
</tr>
<tr>
<td>*Per Department Designator Prefix</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student FTE per Total Faculty FTE</td>
<td>6.6</td>
<td>4.3</td>
<td>5.6</td>
<td>6.1</td>
<td>5.4</td>
</tr>
<tr>
<td>Cost (Cost Study Definitions)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Instructional Expenditures</td>
<td>$1,307,503</td>
<td>$1,293,592</td>
<td>$1,382,145</td>
<td>$1,530,566</td>
<td>$1,435,864</td>
</tr>
<tr>
<td>Cost Per Student FTE</td>
<td>$22,621</td>
<td>$34,222</td>
<td>$26,682</td>
<td>$24,726</td>
<td>$29,976</td>
</tr>
</tbody>
</table>

PROGRESS-RELATED TO FACULTY SINCE 2012 REGENTS REVIEW

The 2012 Regents Review team had two recommendations specific to faculty:

1) Continued, modest growth in number of E&G positions in the department. Faculty have thoughtfully planned future hires in fisheries biology, riparian ecology, and aquatic toxicology, and hires in these areas are endorsed by the graduate students.

Two new tenure-track faculty lines were added to the department in 2015 and 2016, in biogeochemistry and ecology.

2) As resources permit, we recommend the addition of an extension position to support the department’s outreach and extension activities.

WATS has since added a Professional Practice Extension Assistant Professor for Water Quality. The department also added a tenure track faculty member in 2013. The faculty member hired into that position was denied tenure, but that position is expected to be replaced by July 2022. The tenured Water Quality Extension faculty member in the department will be retiring in June 2021. However, the department was able to pre-emptively fill that position.

ADMINISTRATION AND STAFF

ADMINISTRATION

The main department operations are run by a small administrative staff including a Head, Dr. Patrick Belmont, a full-time senior staff assistant, Enid Kelley, and a three-quarters time staff assistant, Brian Bailey. We partner closely with the QCNR Business Service Center for all faculty and staff hiring and salary issues, purchasing, travel reimbursements, contracts and grants.
Since the last Regents’ Review in 2012, the department has experienced substantial changes in administration. Dr. Chuck Hawkins was Interim Department Head during the last review. In 2014, following a national search, Dr. Peter Wilcock was hired from Johns Hopkins University and appointed Department Head. Dr. Patrick Belmont was appointed as Department Head in July 2020.

Two other staff members have significant administrative roles in two of the department’s integrated research-education-outreach centers. Trip Armstrong is Assistant Director of the National Aquatic Monitoring Center and Curtis Gray is Program Coordinator for the Restoration Consortium. Brief descriptions of the roles of administrative staff are included below.

STAFF ROSTER, ROLES, AND DIVERSITY

Researchers and Technicians

Stephen Bennett, Ph.D., Researcher Lead, Supervisor, Joseph Wheaton
Andrew Caudillo, Taxonomist/Lab Manager, National Aquatic Monitoring Center, Supervisor, Trip Armstrong
Jennifer Courtwright, Researcher II, National Aquatic Monitoring Center, Supervisor, Trip Armstrong
James Eddings, Researcher I, Ecology Center
Alexander Hernandez, Geospatial Ecologist/
Kevin Landom, Project Coordinator I, Ecology Center, Supervisor, Timothy Walsworth
Wally Macfarlane, Researcher III, Supervisor, Joseph Wheaton
Daniel Nelson, Research Taxonomist, National Aquatic Monitoring Center, Supervisor, Trip Armstrong
Matt Tagg, Researcher II, National Aquatic Monitoring Center, Supervisor, Trip Armstrong
Gary Thiede, Researcher II, Supervisor, Phaedra Budy

Postdoctoral Fellows

Jaron Atkins, Ph.D., Postdoctoral Fellow I, Supervisor, Trisha Atwood
Lindsey Bruckerhoff, Ph.D., Postdoctoral Fellow II, Supervisor, John Schmidt
Scott David, Ph.D., Postdoctoral Fellow II, Supervisor, Patrick Belmont
Casey Pennock, Ph.D., Postdoctoral Fellow II, Supervisor, Phaedra Budy
Havalend Steinmuller, Ph.D., Postdoctoral Fellow I, Supervisor, Trisha Atwood
Justin Stout, Ph.D., Postdoctoral Fellow II, Supervisor, Patrick Belmont
Zhen Xu, Ph.D., Postdoctoral Fellow I, Supervisor, Janice Brahney

Administration

Trip Armstrong, Assistant Director of the National Aquatic Monitoring Center
Brian Bailey, Staff Assistant III, Department Office, Supervisor, Patrick Belmont
Enid Kelley, Staff Assistant Senior, Department Office, Supervisor, Patrick Belmont
Analysts

Susan Durham, Programmer/Analyst, Ecology Center

Program Coordinators

Curtis Gray, Program Coordinator II, USU Restoration Consortium [https://restoration.usu.edu/](https://restoration.usu.edu/)
Melanie Conrad, Academic Advisor, Program Coordinator (MNR)

DIVERSITY TABLE

Figures 7 and 8 show gender and ethnic diversity among Watershed Sciences staff. The staff has been predominately comprised of white males, with very little change since the 2012 Regents review.

![STAFF GENDER COUNT 2012-2020](image)

**Figure 7.** Staff gender comparison over time.
ROLES AND RESPONSIBILITIES OF ADMINISTRATIVE STAFF

Enid Kelley is the Senior Staff Assistant in the department’s main administrative office. Her responsibilities include:

- Provide staff assistance to the department head and faculty.
- Manage long-range paperwork: course scheduling, catalog, and course changes, annual, bi-annual, accreditation reports, prepare and distribute exit questionnaires to students and alumni.
- Manage and oversee the operation of department office.
- Prepare and maintain departmental records – examples include personnel records of benefitted employees, promotion/tenure files, prepare and maintain a 4-year projected schedule of the department courses.
- Update departmental website and social media.
- Create reports, posters, and brochures for departmental recruiting.
- Coordinate department annual retreat, meetings, and other social occasions.

Brian Bailey is a Staff Assistant III in the department’s main administrative office. His responsibilities fall into four categories:

- Graduate/Undergraduate Student Affairs: serve as the Graduate Program Coordinator (departmental liaison) with USU School of Graduate Studies; oversee graduate applications and acceptances; assist students through program milestones; process graduate assistantships; implement tuition awards and subsidized health insurance program; review theses/dissertations; allocate office space; and organize the WATS Graduate Student Research Symposium.
Office Management: answer phones; direct visitors; schedule rooms; create seminar flyers; distribute mail; manage copy machine accounts; issue and track building keys.

Assist WATS Faculty and Staff: Oversee IDEA course evaluations; conduct equipment inventory; and print material for courses.

Assist Administrative Assistant/Department Head: schedule appointments; post jobs; update website; provide student metrics; and take meeting minutes, all as necessary.

Trip Armstrong is the Assistant Director of the National Aquatic Monitoring Center. His responsibilities include the following:

- Oversight of taxonomic service center (40%)
  - Employee supervision
  - Provide scientific leadership and vision for Center direction and operations
  - Cooperative agreement, contract, and annual budget development
  - Coordinate Center database operations
  - Manage NAMC taxonomic QA/QC program
  - Manage client POs, quotes, requisition requests etc.
  - Oversee purchasing
  - Coordinate with IT related to database development and maintenance
  - Communicate with the Lab Manager regarding the receiving, scheduling and archiving of macroinvertebrate samples

- Research (30%)
  - Serve as the principal investigator or assist with Center research projects including proposal writing, providing technical assistance with project design, implementation, analysis, and manuscript preparation.
  - Field research coordination
  - Participate in field data collection as needed
  - Compute O/E or MMI index scores for macroinvertebrate samples
  - Bioassessment tool development to support service center and predictive models

- Outreach (20%)
  - Coordinate with partners to develop annual work priorities and funding needs
  - Conduct aquatic assessment trainings for state and federal agencies. Trainings can include, but are not limited to, instruction manuals, webinars, and in-person workshops.
  - Provide technical expertise with relevant research pursuits
  - Provide communication, coordination, expertise, and outreach to clients, including state and federal agencies

- Teaching (10%)
  - Mentor Center affiliated undergraduates, and staff
Curtis Gray is the Restoration Consortium Coordinator. His responsibilities are to oversee the administration of the Graduate Certificate in Aquatic Ecosystem Restoration and promote other programs in Restoration Ecology at Utah State University. The USU Restoration Consortium is a new and emerging center intended to promote restoration-related activities and train students to assist the recovery of stream, wetland, or lake ecosystems that have been degraded.

- Promote and market courses offered through the Restoration Consortium via social media, email notifications, and internal resources such as the Quinney College of Natural Resources Advising Center.
- Register external students seeking CEU (Continuing Education Units).
- Assist professors and instructors to organize short courses and workshops.
- Communicate with and advise potential and current students on the Graduate Certificate in Aquatic Ecosystem Restoration.
- Manage Restoration Consortium social media accounts (Twitter, Facebook, Instagram, YouTube).
- Interact with relevant societies and working groups. (e.g., Society of Ecological Restoration; SER).
- Oversee alignment of undergraduate majors (Management and Restoration of Aquatic Ecosystems – WATS Dept., and currently Conservation and Restoration Ecology – WILD Dept.) with the SER guidelines.
- Manage course fees and CEU fees for Restoration Consortium short course
- Manage payment of external instructors and consultants.
- Teach WATS/NR 6900 -- Data Management for Natural Resources.
- Interact with researchers and extension specialists regarding the Restoration Consortium.

2012 REGENTS REVIEW PROGRESS SUMMARY-STAFF

The 2012 Regents Review did not have any recommendations with regard to administrative staff.

STUDENTS

UNDERGRADUATE PROGRAMS

Watershed Sciences currently plays a modest role in undergraduate education at USU. Table 6 presents the numbers of student credit hours (SCH) generated by Watershed Science majors in each college at USU for Fall 2019 (most recent data available). Watershed Sciences undergraduates typically generate about half the number of SCHs each year compared to Wildland Resources and Environment and Society
(Tables 7 and 8). Watershed Sciences also produces a small fraction of SCHs compared to most departments in the College of Science (e.g., 21,000 for Biology, 16,000 for Chemistry and Biochemistry, 4,000 for Geosciences, 35,000 for Math and Statistics, 23,000 for Physics, data from 2015-2016 academic year).

Student Credit Hours Generated

Table 6. Student credit hours (SCH) generated by WATS majors in each college, Fall 2019.

<table>
<thead>
<tr>
<th></th>
<th>Agriculture</th>
<th>Arts</th>
<th>Business</th>
<th>Education</th>
<th>Engineering</th>
<th>CHS &amp;S</th>
<th>Nat. Resources</th>
<th>Science</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecology</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>101</td>
<td>6</td>
<td>0</td>
<td>108</td>
</tr>
<tr>
<td>FAAS</td>
<td>29</td>
<td>6</td>
<td>5</td>
<td>20</td>
<td>2</td>
<td>48</td>
<td>268</td>
<td>110</td>
<td>2</td>
<td>490</td>
</tr>
<tr>
<td>MRAE</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>12</td>
<td>6</td>
<td>122</td>
<td>63</td>
<td>0</td>
<td>231</td>
</tr>
<tr>
<td>WAES</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>WASC</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>101</td>
<td>10</td>
<td>0</td>
<td>136</td>
</tr>
<tr>
<td>Subtotal</td>
<td>42</td>
<td>6</td>
<td>5</td>
<td>37</td>
<td>39</td>
<td>57</td>
<td>601</td>
<td>189</td>
<td>2</td>
<td>978</td>
</tr>
<tr>
<td>% in College</td>
<td>-3%</td>
<td>0.1%</td>
<td>0.1%</td>
<td>3.8%</td>
<td>4.0%</td>
<td>5.8%</td>
<td>61.5%</td>
<td>19.3%</td>
<td>0.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 7. Student credit hours (SCH) by department in the Quinney College of Natural Resources for the past 5 academic years.

<table>
<thead>
<tr>
<th></th>
<th>AY 14-15</th>
<th>AY 15-16</th>
<th>AY 16-17</th>
<th>AY 17-18</th>
<th>AY 18-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watershed Sciences</td>
<td>1,757</td>
<td>2,119</td>
<td>2,182</td>
<td>2,263</td>
<td>2,438</td>
</tr>
<tr>
<td>Environment &amp; Society</td>
<td>3,912</td>
<td>4,295</td>
<td>5,083</td>
<td>4,712</td>
<td>4,753</td>
</tr>
<tr>
<td>Wildland Resources</td>
<td>3,535</td>
<td>3,573</td>
<td>4,587</td>
<td>4,413</td>
<td>4,704</td>
</tr>
<tr>
<td>Total NR</td>
<td>9,204</td>
<td>9,987</td>
<td>11,852</td>
<td>11,388</td>
<td>11,895</td>
</tr>
<tr>
<td>College % of USU</td>
<td>2.4%</td>
<td>2.6%</td>
<td>2.6%</td>
<td>2.5%</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

Table 8. Percentage of student credit hours (SCH) by department in the Quinney College of Natural Resources for the past 5 academic years.

<table>
<thead>
<tr>
<th></th>
<th>AY 14-15</th>
<th>AY 15-16</th>
<th>AY 16-17</th>
<th>AY 17-18</th>
<th>AY 18-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watershed Sciences</td>
<td>19%</td>
<td>21%</td>
<td>18%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Environment &amp; Society</td>
<td>43%</td>
<td>43%</td>
<td>43%</td>
<td>41%</td>
<td>40%</td>
</tr>
<tr>
<td>Wildland Resources</td>
<td>38%</td>
<td>36%</td>
<td>39%</td>
<td>39%</td>
<td>40%</td>
</tr>
<tr>
<td>Total NR</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>College % of USU</td>
<td>2.4%</td>
<td>2.6%</td>
<td>2.6%</td>
<td>2.5%</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

Number of majors in program

Watershed Sciences has maintained relatively small numbers of undergraduate majors. Numerous factors have contributed to the small size of our undergraduate program, but up to this point it has been a mostly deliberate decision. The department has attempted to right-size our number of majors to the perceived availability of jobs or graduate school positions that might be available. And historically, undergraduates have played a smaller role in the research-intensive activities that have been the primary focus of the department. Figure 9 shows the number of majors in four of our degree programs.
The Physical Geography (GEOG) major was terminated in Spring 2018. Watershed and Earth Systems (WAES) major was transitioned to Management and Restoration of Aquatic Ecosystems (MRAE) in Spring 2017, but declared majors were allowed to complete their degree under that title and corresponding degree requirements. Our last WAES major graduated in Fall 2020. Fisheries and Aquatic Sciences has sustained the largest number of majors, around 45-50 for the past several years. Figure 10 and Table 8 (above) show that WATS has consistently accounted for approximately 20% of all student credit hours from the Quinney College of Natural Resources.

Figure 9. Number of undergraduate students who declared a WATS major for at least one semester during each of the past five academic years. Note that the WAES degree was changed to MRAE beginning Fall 2016 semester. Declared WAES students were allowed to finish their degree under the previous name.

Figure 10. Percentage of student credit hours (SCH) by department in the Quinney College of Natural Resources, AY 18-19.
Undergraduate Retention and Graduation

Figure 11 shows the status of WATS undergraduate majors by cohort, defined as the year in which the student declared the major. For example, of the 17 students that declared one of the WATS majors in academic year 2015-2016, seven graduated, seven left the major, and three are still active (as of Spring 2020). These data indicate that beyond simply having a small number of undergraduate majors our retention of those majors is around 65%. Figure 12 shows the number of undergraduate degrees conferred by the department over the past five academic years.

**Figure 11.** Current status of all students within the same undergraduate cohort for the past five academic years.

**Figure 12.** The number of undergraduate degrees awarded for the past five academic years.
Undergraduate Placement Rates and Salary Data

In December 2020, the department conducted a survey of all graduates for the past fifteen years, from all of our degree programs. Out of a total 64 respondents, 24 were recipients of one of our undergraduate degrees. Of the undergraduate respondents 80% (19/24) indicated that their first position upon graduation was related to their degree. Half of these respondents went into government jobs. The mean and median reported annual incomes were $55,200 and $50,000, respectively, with a standard deviation of $29,000.

2012 REGENTS REVIEW SUMMARY

The 2012 Regents Review Committee were highly commentary regarding quality of the undergraduate program. They were satisfied with the size of the program, which had shown steady growth and expressed that the degree programs were well aligned with the departmental mission and expertise. Further, they found a high degree of satisfaction among undergraduates interviewed. They had no recommendations for changes in undergraduate programs.

Since 2012, WATS faculty have identified opportunities to 1) increase the number of undergraduates we serve, both within and outside our major and minor degree programs, 2) expand the variety of careers for which we are preparing students, most notably preparing more students for careers as restoration practitioners, and 3) enhancing high impact experiences of our undergraduates. Efforts along these lines are discussed under ‘Vision and Emerging Initiatives’.

GRADUATE PROGRAMS

Below is a sampling of research publications of some of our recent graduate students.

**Donald Benkendorf:**

Highlights: Accurate species distribution models (SDMs) are needed to predict effects of environmental perturbations on species. Shallow artificial neural networks are commonly used for species distribution modeling. In this study, deeper networks performed slightly better than a shallow network only when trained with large sample sizes. Random forest generally performed as well or slightly better than neural network models. Given enough data, increasing the number of hidden layers in a neural network can potentially improve SDM performance.

**Niall Clancy, John Draper, Marshall Wolff, Umarfarooq Abdulwahab, Maya Pendleton, Jennifer Weathered:**
Abstract: Crucial to the successful conservation of endangered species is the overlap of their ranges with protected areas. We analyzed protected areas in the continental USA to assess the extent to which they covered the ranges of endangered tetrapods. We show that in 80% of ecoregions, protected areas offer equal (25%) or worse (55%) protection for species than if their locations were chosen at random. Additionally, we demonstrate that it is possible to achieve sufficient protection for 100% of the USA’s endangered tetrapods through targeted protection of undeveloped public and private lands. Our results highlight that the USA is likely to fall short of its commitments to halting biodiversity loss unless more considerable investments in both public and private land conservation are made.

Sara Goeking:

Summary: A review of 78 recent papers on hydrologic response to forest disturbance in the western US found that post-disturbance streamflow and snowpack may increase, not change, or even decrease. These results were unexpected, given the long-held hypothesis that forest disturbance results in increased streamflow. The paper concludes by identifying circumstances under which streamflow or snowpack may decrease following forest disturbance: in areas with rapid and/or dense post-disturbance vegetative growth, and in watersheds with higher incoming solar radiation and high aridity, such as at lower latitudes and on south-facing slopes.

A publicly available US Forest Service summary of this work. (This is part of a formal USFS/Rocky Mountain Research Station series of plain-language summaries, known as "Science You Can Use," and should be available at that URL for the foreseeable future.)

Summary: The Rocky Mountain Research Station of the US Forest Service produced a plain-language summary of Goeking and Tarboton's (2020) review of post-disturbance streamflow and snowpack in western US watersheds. This summary is targeted at resource managers, and thus emphasizes where streamflow or snowpack are likely to be vulnerable to depletion following disturbance. It also describes some of the tradeoffs involved in managing forests for increased water yield versus for snowpack retention and thus soil moisture, which can increase future forest resilience to disturbance.

Brian Healy:

Partial Abstract: Translocations, defined herein as the human-assisted movement of individuals from a source population to other waters within their historical range, are prevalent in recovery plans for endangered fishes. Many translocations fail to establish new populations, however, and outcomes are often poorly documented. Endangered Humpback Chub Gila cypha persist as a self-sustaining population in Grand Canyon, Arizona, despite threats from introduced nonnative competitors and predators and modified flow, thermal, and sediment regimes due to river regulation.
Christina Morrisett:

Using groundwater modeling and in-situ seep mapping and temperature measurements, we demonstrate the potential for managed aquifer recharge (MAR) to benefit streamflow and stream temperature in the lower Henry's Fork. We also discuss how administrative water rules and regulations make it challenging to use MAR for fisheries conservation.


This paper was an interdisciplinary research project led by four graduate students as part of USU's Climate Adaptation Science program (National Science Foundation Grant No. 1633756). California legalized cannabis agriculture for recreational use in 2016 and instituted a new water policy framework to regulate water access for cannabis growers. We studied how this water access is mediated by policy, climate, and news media.

Mitchell Donovan:

This paper features two WATS graduate students (Donovan and Souffront) and one WATS undergraduate (Coombs). The paper tests new approaches to quantify and handle uncertainty in measurements of river channel width and migration rates. Methods are relevant for a variety of other remote sensing analyses involving digitization of linear features.


This paper explores causes and implications of the observation that river channel meander migration rates, measured from historical air photos, exhibit a timescale dependency. We find that the frequency of channel reversals exerts primary control on measurement bias for longer time intervals by erasing portions of the record of observable migration. The paper concludes that using long-term measurements of channel migration for sediment remobilization projections, streambank contributions to sediment budgets, sediment flux estimates, and perceptions of fluvial change will necessarily underestimate such calculations.
## Graduate Student Roster

<table>
<thead>
<tr>
<th>Name</th>
<th>Degree</th>
<th>Emphasis</th>
<th>Major Professor</th>
<th>Research Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zachary Ahrens</td>
<td>MS</td>
<td>Watershed Science</td>
<td>Dr. Phaedra Budy</td>
<td>Fish community impacts and conservation implications of a novel waterfall on the San Juan River, UT Valley bottom inundation patterns in beaver-impacted streams reveal hydrologic inefficiency Restoration of lacustrine wetlands of Utah Lake post invasive species removal</td>
</tr>
<tr>
<td>Karen Bartelt</td>
<td>MS</td>
<td>Watershed Science</td>
<td>Dr. Joseph Wheaton</td>
<td>Measuring DryFlux emissions of CO2 and CH4, as well as the primary production rate of the Great Salt Lake Understanding the trophic history of Utah Lake through calcium carbonate co-precipitation with phosphorus</td>
</tr>
<tr>
<td>Jes Braun</td>
<td>MS</td>
<td>Ecology</td>
<td>Dr. Karin Kettenring</td>
<td>Characterizing the movement ecology and patterns of the federally endangered Rio Grande Silvery Minnow in a fragmented riverscape</td>
</tr>
<tr>
<td>Martinique Chavez</td>
<td>MS</td>
<td>Ecology</td>
<td>Dr. Phaedra Budy</td>
<td>Measuring DryFlux emissions of CO2 and CH4, as well as the primary production rate of the Great Salt Lake Understanding the trophic history of Utah Lake through calcium carbonate co-precipitation with phosphorus</td>
</tr>
<tr>
<td>Melissa Cobo Arias</td>
<td>MS</td>
<td>Watershed Science</td>
<td>Dr. Soren Brothers</td>
<td>Measuring DryFlux emissions of CO2 and CH4, as well as the primary production rate of the Great Salt Lake Understanding the trophic history of Utah Lake through calcium carbonate co-precipitation with phosphorus</td>
</tr>
<tr>
<td>Mark Devey</td>
<td>MS</td>
<td>Ecology</td>
<td>Dr. Janice Brahney</td>
<td>Lentic ecosystem restoration and its influence on recovery of an endangered fish the animal community Balancing native wetland types and ecosystem function conservation in the face of an aggressive invader</td>
</tr>
<tr>
<td>Ryan Dillingham</td>
<td>MS</td>
<td>Ecology</td>
<td>Dr. Tim Walsworth</td>
<td>Lentic ecosystem restoration and its influence on recovery of an endangered fish the animal community Balancing native wetland types and ecosystem function conservation in the face of an aggressive invader</td>
</tr>
<tr>
<td>Aubin Douglas</td>
<td>MS</td>
<td>Ecology</td>
<td>Dr. Karin Kettenring</td>
<td>Lentic ecosystem restoration and its influence on recovery of an endangered fish the animal community Balancing native wetland types and ecosystem function conservation in the face of an aggressive invader</td>
</tr>
<tr>
<td>Dale Fonken</td>
<td>MS</td>
<td>Watershed Science</td>
<td>Dr. Mary Conner (WILD)</td>
<td>Survival and recruitment of an endangered fish in the intermountain west</td>
</tr>
<tr>
<td>Gordon Gianniny</td>
<td>MS</td>
<td>Watershed Science</td>
<td>Dr. Janice Brahney</td>
<td>Investigating the impacts of increasing temperatures on phosphorus production in mountain soils</td>
</tr>
<tr>
<td>Macy Gustavus</td>
<td>MS</td>
<td>Watershed Science</td>
<td>Dr. Janice Brahney</td>
<td>Investigating the impacts of increasing temperatures on phosphorus production in mountain soils</td>
</tr>
<tr>
<td>Rachel Hager</td>
<td>MS</td>
<td>Ecology</td>
<td>Dr. Karin Kettenring</td>
<td>Microplastics in aquatic environments</td>
</tr>
<tr>
<td>Coryna Hebert</td>
<td>MS</td>
<td>Ecology</td>
<td>Dr. Karin Kettenring</td>
<td>Restoring ecosystem function with native bulrush ecotypes in the Great Salt Lake Wetlands Differences between two post-grazing season implementation monitoring protocols to assess impacts on stream and riparian ecosystems Microtopography of Great Salt Lake wetlands; characterizing patterns and exploring potential implications for restoration</td>
</tr>
<tr>
<td>Name</td>
<td>Degree</td>
<td>Field</td>
<td>Instructor</td>
<td>Project Description</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------</td>
<td>---------------------------</td>
<td>-----------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Lauren Herbine</td>
<td>MS</td>
<td>Watershed Science</td>
<td>Dr. Joseph Wheaton</td>
<td>Developing and groundtruthing an algorithm to accurately describe river styles across the Mississippi River Watershed</td>
</tr>
<tr>
<td>Manny May</td>
<td>MS</td>
<td>Fisheries Biology</td>
<td>Dr. Tim Walsworth</td>
<td>Assessing the macrophyte and fish community response to restoration activities in Utah Lake</td>
</tr>
<tr>
<td>Deni Murray</td>
<td>MS</td>
<td>Ecology</td>
<td>Dr. Janice Brahney</td>
<td>The fate and cycling of nitrogen, phosphorous and trace heavy metals in beaver-altered headwater streams</td>
</tr>
<tr>
<td>Tansy Remiszewski</td>
<td>MS</td>
<td>Watershed Science</td>
<td>Dr. Phaedra Budy</td>
<td>Understanding the response of imperiled fishes to extreme geomorphic change in a historically degraded desert river</td>
</tr>
<tr>
<td>Rae Robinson</td>
<td>MS</td>
<td>Ecology</td>
<td>Dr. Karin Kettenring</td>
<td>Seed-based restoration of Great Salt Lake wetlands</td>
</tr>
<tr>
<td>Shelby Sawyer</td>
<td>MS</td>
<td>Watershed Science</td>
<td>Dr. Joseph Wheaton</td>
<td>Developing a commercial-grade web tool version of the Valley Bottom Extraction Tool for Bureau of Land Management</td>
</tr>
<tr>
<td>Jessica Scholz</td>
<td>MS</td>
<td>Ecology</td>
<td>Dr. Janice Brahney</td>
<td>Drivers of increasing phosphorus concentrations in mountain waterbodies of northeastern Utah, USA</td>
</tr>
<tr>
<td>Kate Sinnott</td>
<td>MS</td>
<td>Ecology</td>
<td>Dr. Karin Kettenring</td>
<td>Submerged aquatic vegetation restoration in the Provo River Delta Restoration Project</td>
</tr>
<tr>
<td>Sara Wall</td>
<td>MS</td>
<td>Watershed Science</td>
<td>Dr. Patrick Belmont</td>
<td>Controls on post-fire debris flow grain size distributions and volumes</td>
</tr>
<tr>
<td>Rachel Watts</td>
<td>MS</td>
<td>Watershed Science</td>
<td>Dr. Janice Brahney</td>
<td>The impact of high flow stream events on phosphorus flux</td>
</tr>
<tr>
<td>Umarfarooq Abdulwahab</td>
<td>Ph.D.</td>
<td>Ecology</td>
<td>Dr. Charles Hawkins</td>
<td>Mapping locations that best protect sensitive freshwater species (four amphibians and a reptile) while considering other land use needs in southern California</td>
</tr>
<tr>
<td>Alec Arditti</td>
<td>Ph.D.</td>
<td>Watershed Science</td>
<td>Dr. Patrick Belmont</td>
<td>Impacts of wood and valley bottom on sediment routing following wildfire</td>
</tr>
<tr>
<td>Donald Benkendorf</td>
<td>Ph.D.</td>
<td>Ecology</td>
<td>Dr. Charles Hawkins</td>
<td>Effects of temperature on macroinvertebrate communities and distributions</td>
</tr>
<tr>
<td>Molly Blakowski</td>
<td>Ph.D.</td>
<td>Watershed Science</td>
<td>Dr. Janice Brahney</td>
<td>Using meta analysis and geochemical techniques to study dust emission from the dry lakebed of the shrinking Great Salt Lake</td>
</tr>
<tr>
<td>John Draper</td>
<td>Ph.D.</td>
<td>Ecology</td>
<td>Dr. Trisha Atwood</td>
<td>Evaluating the effect of the order Carnivora on seed dispersal and carbon storage</td>
</tr>
<tr>
<td>Name</td>
<td>Degree</td>
<td>Department</td>
<td>Advisor</td>
<td>Research Title</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------</td>
<td>------------------</td>
<td>------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Ali Farshid</td>
<td>Ph.D.</td>
<td>Watershed Science</td>
<td>Dr. Sarah Null</td>
<td>Optimal selection and placement of green infrastructure to maximize water quality benefits and minimize implementation costs</td>
</tr>
<tr>
<td>Katlyn Gardner</td>
<td>Ph.D.</td>
<td>Watershed Science</td>
<td>Dr. Charles Hawkins</td>
<td>How stream salinity, with focus on specific ions, affect the distribution, abundance, and growth of aquatic insects</td>
</tr>
<tr>
<td>Sara Goeking</td>
<td>Ph.D.</td>
<td>Watershed Science</td>
<td>Dr. David Tarboton (CEE)</td>
<td>Effects of forest disturbance on runoff and water availability</td>
</tr>
<tr>
<td>Luke Gommerman</td>
<td>Ph.D.</td>
<td>Watershed Science</td>
<td>Dr. Jack Schmidt</td>
<td>Quantifying the effects of regulated river flows on National Park Service vegetation and sediment resources</td>
</tr>
<tr>
<td>Gregory Goodrum</td>
<td>Ph.D.</td>
<td>Watershed Science</td>
<td>Dr. Sarah Null</td>
<td>Quantifying aquatic habitat in hydroeconomic tradeoff analysis</td>
</tr>
<tr>
<td>Brian Healy</td>
<td>Ph.D.</td>
<td>Ecology</td>
<td>Dr. Phaedra Budy</td>
<td>Efficacy of conservation actions for native fishes in tributaries of the Colorado River, Grand Canyon</td>
</tr>
<tr>
<td>Christina Leonard</td>
<td>Ph.D.</td>
<td>Watershed Science</td>
<td>Dr. Jack Schmidt</td>
<td>Determining how large a sediment mass imbalance is necessary to cause a fundamental change in river channel form and behavior</td>
</tr>
<tr>
<td>Cat McClure</td>
<td>Ph.D.</td>
<td>Ecology</td>
<td>Dr. Edd Hammill</td>
<td>Understanding the varying effects of top-down vs. bottom-up controls on protist community structure</td>
</tr>
<tr>
<td>Jack McLaren</td>
<td>Ph.D.</td>
<td>Ecology</td>
<td>Dr. Phaedra Budy</td>
<td>Understanding the effects of eutrophication on river ecosystems and fish habitat</td>
</tr>
<tr>
<td>Christina Morrisett</td>
<td>Ph.D.</td>
<td>Watershed Science</td>
<td>Dr. Sarah Null</td>
<td>Optimizing water management for multiple stakeholders (ex. farms, fish, fishing experience)</td>
</tr>
<tr>
<td>Suzan Tahir</td>
<td>Ph.D.</td>
<td>Ecology</td>
<td>Dr. Karin Kettenring</td>
<td>Impacts of anthropogenic pollution (treated sewage) on wetland structure and function in the Willard Spur wetlands, Great Salt Lake</td>
</tr>
<tr>
<td>Emily Tarsa</td>
<td>Ph.D.</td>
<td>Ecology</td>
<td>Dr. Karin Kettenring</td>
<td>Investigating techniques to improve seed-based restoration of Great Salt Lake wetlands</td>
</tr>
<tr>
<td>Ellie Wallace</td>
<td>Ph.D.</td>
<td>Ecology</td>
<td>Dr. Tim Walsworth</td>
<td>How invasive species populations respond to alternative control methods and developing models to support management decisions</td>
</tr>
<tr>
<td>Jiahao Wen</td>
<td>Ph.D.</td>
<td>Ecology</td>
<td>Dr. Janice Brahney</td>
<td>Dust composition and their influences on alpine lakes and mountain ecosystems in the western US</td>
</tr>
<tr>
<td>Marshall Wolf</td>
<td>Ph.D.</td>
<td>Ecology</td>
<td>Dr. Edd Hammill</td>
<td>Investigating how beaver restoration influences the delivery of ecosystem services and functions</td>
</tr>
</tbody>
</table>
Figure 13. WATS graduate students broken down by gender.

Figure 14. WATS graduate students broken down by ethnicity.
Recruitment

WATS has been generally successful in recruiting talented graduate students and will continue to develop and pursue a mixture of recruitment strategies that ensure we recruit the highest caliber students possible. WATS does not recruit many graduate students via general, unsolicited applications to the department. In fact, language on our web page discourages such applications. Rather, individual faculty recruit students through a variety of mechanisms as funding becomes available.

Recruiting strategies for our MS and PhD degrees include the following:

1. We advertise open positions by sending position announcements to relevant email lists and colleagues and post some opportunities on our webpage.
2. The department reserves some funding to help faculty members cover travel costs to bring high-quality students to campus to personally interview. These visits allow candidates to personally engage with faculty and other graduate students. Our students are often our best recruiting agents.
3. We promote the uniqueness and interdisciplinary nature of our program via web page material and during interviews.
4. WATS will encourage faculty and students to clearly display the USU WATS ‘Brand’ when giving talks and presenting posters at professional meetings.
5. We will continue to select the best students possible based on multiple lines of evidence regarding their potential to excel in research, not just GPAs.
6. We will ensure that potential students know about CNR and USU fellowship opportunities and how receipt of one can embellish their resumes.

Recruiting strategies for the Master of Ecological Restoration degree:
Many of the strategies listed for the MS and PhD programs also contribute to recruiting for the new Master of Ecological Restoration (MoER) program. However, the MoER program is, at least initially, only open to students that complete one of the WATS undergraduate degrees, so our best recruiting for the MoER will be the quality and engagement of students in our undergraduate programs. However, we also view the MoER as an opportunity to recruit more, and a more diverse, students into our undergraduate program as many students see the value in being able to obtain their BS and a Master’s degree within a five-year timeframe. The department has ongoing research and education connections to the Yakima Nation, who have expressed support and expect to have students enroll in the MoER program. The department will similarly reach out to recruit students from Shoshone, Ute, Navajo and other Native American nations throughout the Intermountain West.

Applicants

Watershed Sciences faculty have typically discouraged prospective students from applying to the MS or PhD programs unless there is a foreseeable opportunity for a faculty member to support the student with a research assistantship. As a result, the number of applications and acceptances would appear to indicate an acceptance rate of about one-third (Figure 15). However, given that less competitive students that contact Watershed Sciences faculty to inquire about graduate positions are discouraged
from formally applying, the actual acceptance rate is likely on the order of 5-10% of initial inquiries. Acceptances increased in AY 20-21 with XX MS and PhD students accepted into the program, bringing our long-term average to around 15 students per year.

The total number of graduate students in the program has remained relatively steady over the past several years, with approximately 30 MS students and 15-20 PhD students (Figure 16). There has been a slight, but deliberate shift towards PhD students over the past few years, in response to the goal of increasing the proportion of graduate students, established in the five-year plan developed after our 2012 Regents review. The number of graduate students has remained relatively steady over the past several years, with similar numbers of MS and PhD students in the Ecology and Watershed Sciences degrees and only a few students in the Fisheries Biology program (Figures 17-19). Figure 20 indicates that the vast majority of students who start in the graduate program complete their degree. Figure 21 shows the number of graduate degrees conferred by the department each year over the past five years.

Figure 15. Number of applications to the WATS graduate program vs. the number of students accepted for each of the past five academic years.

Number of Majors in Graduate Program
Figure 16. Number of students enrolled in the MS and Ph.D. programs for at least one semester during each of the past five academic years.

Figure 17. Number of students enrolled in the MS and Ph.D. in Ecology programs for at least one semester during each of the past five academic years.
Figure 18. Number of students enrolled in the MS and Ph.D. in Fisheries Biology program for at least one semester during each of the past five academic years.

Figure 19. Number of students enrolled in the MS and Ph.D. in Watershed Science programs for at least one semester during each of the past five academic years.
Graduate Retention and Graduation

Figure 20. Current status of all students within the same graduate cohort for the past five academic years.

Figure 21. The number of graduate degrees awarded for the past five academic years.
Graduate Salaries, Tuition Waivers, Fellowships

Of the 44 current graduate students (Table 16), 25 are supported solely through a Graduate Research Assistantship, four are on fellowships (three of which receive additional assistantship money on top of their fellowship stipend), six are funded through an external agency (two of which receive additional assistantship money), and eight are on Continuing Graduate Advisement status, an official leave of absence, or finishing their grace semester. One graduate student is entirely self-funded.

Salaries for our Graduate Research Assistants (GRAs) start at $18,600/year for MS students and $21,000/year for Ph.D. students, with a 3% cost-of-living increase provided at the beginning of each fiscal year. Dependent on grant funding, some GRAs may be paid at a higher rate. Grants or start-up funds are expected to pay for the department’s portion of student health insurance, as well as the resident tuition portion and student fees for each GRA.

The Utah State University School of Graduate Studies waives the non-resident portion of tuition for students from outside of Utah (until they become eligible for residency) and for international students hired as GRAs. In addition, the department receives money from the School of Graduate Studies to pay some/all of the resident tuition portion for selected students hired as GRAs.

Utah State University offers Presidential Doctoral Research Fellowships (PDRF) annually. The department has proven to be competitive for these awards, with one WATS student currently funded through a PDRF. The Office of Research provides $10,000 annually toward the fellowship and pays the resident tuition portion. The recipient’s faculty advisor must provide additional funds for the annual stipend (to bring it up to the minimum base salary), the department’s portion of the health insurance premiums, and student fees.

The Quinney College of Natural Resources (QCNR) offers a Quinney Fellowship annually, with one WATS student currently funded through this fellowship. The QCNR provides $10,000 annually toward the fellowship. The recipient’s faculty advisor must provide additional funds for the annual stipend (to bring it up to the minimum base salary), the department’s portion of the health insurance premiums, and student fees. The Quinney Fellowship money is then paid to the recipient as if it were a Graduate Research Assistantship, which qualifies the student for a non-resident tuition waiver (if applicable) and a resident tuition award through the USU School of Graduate Studies.

The WATS department has recently carved out two additional MS fellowships, one in conjunction with the QCNR. Two students are currently funded through these fellowships. The WATS department or the WATS department/QCNR provides one year’s worth of stipend, the department’s portion of the health insurance premiums, and student fees. The fellowship money is then paid to the recipient as if it were a Graduate Research Assistantship, which qualifies the student for a non-resident tuition waiver (if applicable) and a resident tuition award through the USU School of Graduate Studies. The recipient’s faculty advisor must provide matching funding for the second year (note, expenses are usually divided annually between fellowship and faculty funds, so each is paying half of the annual expenses for the two years).
Graduate Student Placement Rates and Salary Data

In December 2020, the department conducted a survey of all graduates for the past fifteen years, from all of our degree programs. Of the total 64 respondents, 38 identified as students that had obtained one of our graduate degrees. Of those graduate respondents 92% (35/38) indicated that their first position upon graduation was related to their degree. Figure 22 combines undergraduate and graduate data from the survey to show the variety of jobs students obtained upon graduating.

![Figure 22](image)

**Figure 22.** Categories for the first job students obtained upon graduating from one of our degree programs. Note, these data include both undergraduate and graduate students.

If students have changed jobs since graduating, Figure 23 indicates the category of their current job. Notably, the number of graduates employed in research careers is reduced compared to Figure 22 above. The mean and median reported salaries for students that completed a graduate degree were both approximately $66,000, with a standard deviation of $25,000. Salaries generally increase with time since graduation (Figure 24).

![Figure 23](image)

**Figure 23.** Categories describing the current job of students who graduated from one of our degree programs. Note, these data include both undergraduate and graduate students.
Qualitative responses indicated that respondents were generally very satisfied with their experience and education at USU. When asked “Are there specific skillsets you obtained at USU that helped you be competitive for getting, or being successful in, your job?” the most common responses were GIS, R, Python, statistics, writing, problem solving/critical thinking. When asked “Are there specific skillsets you would like to see emphasized more in WATS degree programs?” the most common responses were ‘programming, professional development, people and data management.’ At the end of the survey, we asked the open-ended question “Do you have any other feedback for the department at this time?” Eighteen of the respondents wrote unprovoked, positive responses such as “The longer I am away from USU, the more I appreciate the outstanding education I received in ecology and aquatic science.” and “Really loved and appreciated my time there and the emphasis and support the department put on expanding field and lab research opportunities for undergraduates; this has been tremendously helpful in my current career as a sales manager for a METER Group, working with researchers across a variety of fields to provide them with scientific instrumentation and support.” Two respondents wrote negative comments, such as “My course work did not prepare me for the workforce or help me network.”

2012 Regent Report Recommendations-Graduate Program

The 2012 Regents Review Committee were highly complementary of our graduate program, noting that the flexibility afforded to students in developing their coursework, high quality of research experiences, and overall positive attitude of graduate students in the program at that time. The committee made two recommendations:

1. We encourage the department, with support from the College of Natural Resources and Utah State University development office, to develop a long-term plan for creating an endowment to help strengthen the doctoral programs and to support more postdoctoral positions.

Progress: The department has made some headway in expanding the amount of graduate student support available. Specifically, the Center for Colorado River Studies has provided support for several graduate students, the NSF-funded Climate Adaptation Science program provided support for several students and
the department has invested some of its limited internal funding to support graduate student fellowships and research projects. However, obtaining significant and reliable funding streams to better support our graduate students and post-doctoral researchers remains a priority for the department.

2. Some of the larger enrollment classes in the department have need of additional teaching support. We recommend the addition of teaching assistantships (TAs) to help this educational mission and to enhance graduate program teaching experience.

Progress: The department received an increase in graduate student TA support in Fall 2020. Department Head Patrick Belmont plans to conduct a review of all TA needs and obligations and distribute TA compensation in an equitable manner starting in Fall 2021, which will likely involve an across-the-board increase in TA support, new TA support for a few courses, and substantially larger TA stipends for a few courses. However, any substantial changes to TA support have been delayed due to unique challenges and increased need for teaching support related to the covid-19 pandemic.

In response to the 2012 Regents Review Committee recommendations and other discussions among the faculty in 2012, the department completed a five-year plan built around the following goals:

1. Decide on how to best structure, and potentially restructure, our interdisciplinary graduate program and degree options to meet the needs of current and future students;

   Progress: The department has engaged in numerous, ongoing discussions about whether and how to modify our existing graduate programs. Graduate students are generally pleased with the quality of the program and flexibility in deciding research and coursework. Faculty have agreed to introduce a new 2-credit required course that will engage all graduate students in the first year of their program. The course is initially being developed by Peter Wilcock and Soren Brothers and is expected to combine short guest lectures on core concepts in Watershed Science disciplines, highlight active research, engage in paper discussions, and include some professional development activities. The department has also started offering a Graduate Certificate in Aquatic Ecosystem Restoration for MS and PhD students. Increased course offerings as part of the Master of Ecological Restoration program are expected to also benefit WATS MS and PhD students that are considering careers related to ecological restoration.

2. Add 1-3 new faculty members in critically needed areas of expertise;

   Progress: The department has added 2 new faculty lines, including biogeochemistry and ecology/conservation planning.

3. Increase the number of PhD students to approximately 25 (or 50% of total students);

   Progress: The department has made progress towards this goal and is maintaining a PhD population above 20. Availability of long-term (4-to-5-year duration) external funding opportunities and limited availability of internal funds to support PhD students are the primary challenges in attaining this goal. Also, we partner with many state and local agency stakeholders on projects that
have timelines that often are more conducive to MS students. WATS faculty also remain mindful of the paucity of academic job openings relative to the number of PhD students graduating each year. Nevertheless, WATS faculty recognize that a strong PhD program is an essential component of a high-quality research department. Our program is primarily targeted to producing PhDs who intend to pursue research careers, but there may be more we can do to prepare our PhD students to be competitive for, and successful in, a broader range of careers.

4. Maintain and improve the quality of graduate student mentoring;
   
   Progress: The 2012 Regents Review Committee was complementary regarding the amount and quality of mentoring provided to WATS graduate students. WATS faculty members maintain close working and mentoring relationships with their students, even through the covid-19 pandemic. The Department Head has consistently welcomed requests for small amounts of funding or resources to facilitate graduate student mentoring and to help faculty and graduate students overcome challenges. The department is considering providing some professional development workshops and resources focused on best practices in mentoring.

5. Maintain and improve the level of graduate student support, including support for research, stipends, and teaching assistance; and
   
   Graduate student support for research has remained consistently high for the past several years. The department has established minimum stipends for MS and PhD students, which increase 3% annually. As discussed above, TA support was increased in Fall 2020 and the department will develop a plan to distribute TA funding in an equitable manner starting in Fall 2021.

6. Improve, and initiate new, cross-campus collaborations designed to generally enhance the comprehensiveness and quality of graduate education in the water sciences.
   
   The department maintains good working relations with several other departments across campus, most notably Wildland Resources, Environment and Society, Civil and Environmental Engineering, Geosciences, Math and Statistics, and Biology. WATS students regularly take courses in those departments, attend seminars in those departments, and both faculty and students have research collaborations with peers in those, and other, departments. In recent years, the department has especially enjoyed improved access to courses in Civil and Environmental Engineering. New cross-cutting programs, such as the Logan River Task Force and Climate Adaptation Science program have offered graduate students opportunities to engage with colleagues from all across campus. USU nominally maintains a cross-campus Water Initiative, but funding for the Water Initiative has been very limited in recent years and the main annual activity hosted by the Water Initiative, the Spring Runoff Conference, has been postponed indefinitely.
PROGRAM COSTS

INSTRUCTIONAL COSTS

Table 9 indicates the instructional expenditures and legislative appropriations for the Department of Watershed Sciences per data provided by the Office of the Provost.

Table 9. Instructional Costs and Legislative Appropriations. Source: Provost Office

<table>
<thead>
<tr>
<th>Cost (Cost Study Definitions)</th>
<th>Academic Year 2015-16</th>
<th>Academic Year 2016-17</th>
<th>Academic Year 2017-18</th>
<th>Academic Year 2018-19</th>
<th>Academic Year 2019-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Instructional Expenditures</td>
<td>$1,307,503</td>
<td>$1,293,592</td>
<td>$1,382,145</td>
<td>$1,530,566</td>
<td>$1,435,864</td>
</tr>
<tr>
<td>Cost Per Student FTE</td>
<td>$22,621</td>
<td>$34,222</td>
<td>$26,682</td>
<td>$24,726</td>
<td>$29,976</td>
</tr>
<tr>
<td>Funding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appropriated Fund</td>
<td>$1,224,309</td>
<td>$1,496,294</td>
<td>$1,536,667</td>
<td>$1,565,732</td>
<td>$1,570,013</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Legislative Appropriation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Fees/Differential Tuition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>$1,224,309</td>
<td>$1,496,294</td>
<td>$1,536,667</td>
<td>$1,565,732</td>
<td>$1,570,013</td>
</tr>
</tbody>
</table>
SUPPORT COSTS

Table 10 indicates support from incoming funds and other sources for FY 2016-2020 for the Department of Watershed Sciences per QCNR Business Service Center review.

<table>
<thead>
<tr>
<th>Table 10. Department of Watershed Sciences Budget for FY 2016-2020. Source: QCNR BSC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dept E&amp;G</strong></td>
</tr>
<tr>
<td>Faculty and Staff Salary</td>
</tr>
<tr>
<td>Graduate Assistant Salary</td>
</tr>
<tr>
<td>Hourly Wages</td>
</tr>
<tr>
<td>Operating</td>
</tr>
<tr>
<td>ACH Growth funding</td>
</tr>
<tr>
<td><strong>Department E&amp;G Subtotal</strong></td>
</tr>
<tr>
<td><strong>Dept other sources</strong></td>
</tr>
<tr>
<td>Course fees</td>
</tr>
<tr>
<td>Dept F&amp;A</td>
</tr>
<tr>
<td>Utah Leg Grad Support salary</td>
</tr>
<tr>
<td>Utah Leg Grad Support other</td>
</tr>
<tr>
<td><strong>Dept other sources Subtotal</strong></td>
</tr>
<tr>
<td><strong>Agricultural Experiment Station (AES)</strong></td>
</tr>
<tr>
<td>Salary</td>
</tr>
<tr>
<td>Operating</td>
</tr>
<tr>
<td><strong>AES Subtotal</strong></td>
</tr>
<tr>
<td><strong>Ecology Center</strong></td>
</tr>
<tr>
<td>Salary</td>
</tr>
<tr>
<td>Operating</td>
</tr>
<tr>
<td><strong>Ecology Center Subtotal</strong></td>
</tr>
<tr>
<td><strong>Extension</strong></td>
</tr>
<tr>
<td>Salary</td>
</tr>
<tr>
<td>Operating</td>
</tr>
<tr>
<td><strong>Extension Subtotal</strong></td>
</tr>
<tr>
<td><strong>Total Salary</strong></td>
</tr>
<tr>
<td><strong>Total Operating</strong></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
</tr>
<tr>
<td><strong>Soft funded</strong></td>
</tr>
<tr>
<td>Staff salary</td>
</tr>
</tbody>
</table>

PROGRAM SUPPORT

FACILITIES

Most members of the Department of Watershed Sciences are housed in the Biology-Natural Resources (BNR) or the Natural Resources (NR) buildings. The NR Building was constructed in 1983 and generally meets the needs of faculty and staff housed there. Most of the department’s spaces in NR are offices.
The BNR building was constructed between 1958-1962 and includes a variety of faculty and staff offices as well as several research labs and teaching spaces. In recent decades, the BNR building has fallen below the standards of what should be expected of a modern science building and perpetual problems with plumbing, HVAC, fume hoods, and energy efficiency have caused problems for faculty, staff and students housed there. Aside from these functional problems, the aesthetic of the building is less than inspiring. Plans to rehabilitate the BNR building have been made several times over the past few decades. In 2018 the Utah Legislature committed $20M and private donors contributed an additional $3M to renovate the BNR building. However, the vast majority of those funds were expended rehabilitating the north and west wings of the BNR building, which is primarily used by the Biology Department. Renovation of the south wing, which contains all Watershed Sciences spaces, is anticipated to take place in four phases over the next several years, using capital improvement funding. The budget for the proposed renovations is considerably lower than the north wing and the renovations are expected to be less thorough, which is concerning to some members of the Watershed Sciences community.

Watershed Sciences utilizes six rooms in the Janet Q Lawson building, just north of the NR and BNR buildings. The largest of these spaces is used as graduate student office with other rooms used for Water Quality Extension and offices for research faculty. The department maintains three field-based lab facilities, including one on Bear Lake, about an hour to the east of Logan and two research stations 20 minutes south of Logan at the Predator Research Facility and Millville Aquatic Research Facility. The Bear Lake Environmental Lab has been used for research on Bear Lake for over three decades. The space at the Predator Research Facility is a shed used for boat and equipment storage. The Millville Aquatic Research Facility contains indoor and outdoor experimental chambers, including 90 experimental ponds.

**EQUIPMENT**

The department maintains a wide variety of equipment to support research efforts. The vast majority of research equipment is maintained by a single faculty member, but there is precedence for sharing some of the equipment and established use costs for some pieces of equipment. USU has several internal sources of funding for cost-sharing equipment purchases from the Office of Research, Utah Agricultural Experiment Station, and Extension. A complete list of equipment is available upon request. Briefly, the department faculty and staff maintain seven trucks, two SUVs, and three sedans, six rigid-body boats and three inflatable boats with a variety of outboard motors, several boat trailers, a single beam echosounder and a multi-beam sonar, two Acoustic Doppler Current Profilers, four Marsh McBirney flow meters and one Acoustic Doppler Velocimeter, an assortment of electrofishing equipment, a variety of Passive Integrated Transponder tags, readers, and antennas, survey equipment including multiple Total Stations, five real time kinematic GPS units, a terrestrial lidar scanner, three unmanned aircraft systems, one UAS-mounted lidar system, two LI-COR soil gas flux measurement instruments, a lab-based gas chromatograph, a Lachat nutrient analyzer, a Fiber Optic oxygen meter, a GasScouter mobile gas concentration analyzer, a wide assortment of microscopes, a LISST laser diffraction grain size analyzer, and a variety of drying ovens, muffle furnaces, refrigerators and freezers.
COURSE FEES

Course fees are charged when funding is needed beyond the typical development, instruction, and assessment of courses, which is borne by the department and college. Course fees may be used to support computers, software, equipment, materials, supplies and consumables, student teaching assistants, field trips and visiting experts, per USU Policy. Course fees are reviewed by the instructor and Department Head on an annual basis and are adjusted on a three-year schedule, depending on need. Below is a detailed list of how course fees are used in WATS courses.

GEOG 1005 Physical Geography $40
Lab $44 Field trips (van rental from motor pool). Logan Canyon field trip = $144 Blacksmith fork river = $144 Shoreline trail = $144 Total of $432 Lab supplies: Plastic bins for field equipment, baggies, batteries for GPS, tape measures, sampling bottles, petri dishes, matric state testing kits = $168 Total cost for all fees $600 Average number of students enrolled in the course: 15 Average cost per student $40

GEOG 1800 Introduction to Geographic Information Sciences $40
$75 Computers: Usage, replacement, repairs, and maintenance: This course has a lab section that takes place in the Quinney Library computer labs, with a total of 53 PCs. Students use these computers during 1-hour lab sessions each week during the semester and to complete lab assignments outside of lab sessions. The replacement schedule for the computers is every 5 years. The computers are also used by other lab-based courses in QCNR (GEOG/WILD 1800, with an average of 117 students per year). Using a conservative estimate of 35 students per year in WATS 4930 (based on on-campus past enrollments), each student should be assessed a $15 fee for replacement of the computers, for a total cost of $525 per year. The hardware replacement portion of the fee covers approximately 50% of the total amount required to upgrade/replace hardware in the computer lab every five years, with the balance being subsidized by the QCNR Dean's office using Quinney funds. Computer Software: Usage, upgrades and licensing: This course (along with GEOG/WILD 1800) requires the use of ESRI ArcGIS software. The QCNR is responsible for paying $3,800 as our share in the annual licensing cost of this software to the university. Using the conservative estimate of 35 students per year in WATS 4930 (based on on-campus past enrollments), each student should be assessed a $25 fee for their portion of the software use and licensing, for a total of $875 per year. The QCNR pays $5000 per year towards the University license for the ESRI GIS software. The total cost of the software is $17800 per year. We pay this expense from operating or development funds each May and then use course fees from WATS 4930 to recoup the expense. Total Cost for all fees: $1400. Avg # of students enrolled: 35 Avg cost per student $40.

WATS 2000 NR Professional orientation $10
Four Field trips WILD Field Trips Fall $425 WILD Field Trips Spring $425 WATS Field Trips Fall $425 ENVS Field Trips Fall $425 Total Cost $1,700 Avg # of students 170 Individual Course Fee $10.

WATS 3100 Fish Diversity and Conservation $7
Materials and Supplies: $21 each, 12 posters (3 students per poster). Total costs for all fees: $252 Avg # of students $35 Avg cost per students $7.

WATS 3110 Fish Diversity Laboratory $75
Materials and Supplies: Replacement waders 180 2 @ $90 Syringes for PIT tag insertion $80 4 @ $20 PIT Tags $150 30 @ $3 Microscope slides $25 box of 50 Supplies SUM $435 Field Trips: Logan River 3 vans $120, Fuel $25, Lab Truck $40; Cutler Reservoir River 3 vans $120, Fuel $25, Lab Truck $40;
Porcupine Reservoir River 3 vans $120, Fuel $25, Lab Truck $40; Spawn Creek River 3 vans $120, Fuel $25, Lab Truck $40 Total Cost $1125, Avg # of Students 15 Avg cost per student $75.

WATS 4310/6310 Wetland Ecology and Management $210
Rental Vehicles $45 per day per vehicle, 4 vehicles: $918; Vehicle fuel additional charge $249; Instructors and Administration $1500; Lunches for field trips $960. Total cost $3627.90. Average 17 students. Cost per student $210.

WATS 4490/6490 Small Watershed Hydrology $50
Materials and Supplies: Replacement waders 180 @ $90 Replacement measuring tape $60 Supplies SUM $240 Field Trips: Bear Lake Vans and Fuel $225, Weber River $285, Field Trips Sum $510. Total cost for all fees $750 Avg # of students 15, Cost per student $50.

WATS 4510 Aquatic Ecology Practicum I: Lab Methods $100
Field Trip #1 (off-shore Bear Lake sampling) Boat gasoline (90 gallons @ $2.80/gal) $252 Car rentals (80 miles return @ $0.42/mile) (assume 3 cars - two for students, one for boat) $100.8 Student to drive the boat ($100 per day) $100 Field Trip #2 (near-shore Bear Lake sampling) Car rentals (80 miles return @ $0.42/mile) (assume 2 cars) $67.2 Lab Component C/N Analysis (Brothers lab: 10.34 first sample, 0.44 per additional sample, 24 samples) $20.46 Brahney Labs (5 labs, $8.50 per student, assuming 10 students) $85 TP and SRP Analysis $220 Alkalinity test kit $50 Ethanol for pigment extractions, invertebrate preservation $4 disposable cuvettes, chromatography paper, coverslips, and miscellaneous lab supplies $119.8 Sum $1019.26 Per student (assuming 10) $100 fee.

WATS 4530/6530 Water Quality and Pollution $20
Field Trips and Class Activities Travel - 3 motor pool vans for 1 field trip (in-valley) at $38/van $114 Lab supplies Glass fiber filters for bioassay experiment $14 Ethanol for pigment extractions in bioassay experiment $10 Analytical Support 3 Total N and P analyses; Aquatic Biogeochem lab $20/ Tn or TP $60 E coli IDEXX kits = 10 @ $12 each $120 Total cost for all fees: $318 Avg # of students $15 Avg cost per student $20.

WATS 4930/6920 Advanced GIS and Spatial Analysis $40
The total annual cost for ESRI software is $4800. The following classes use this software: GEOG/WILD 1800 WATS 4930/6920, WILD 5750/6750, GEOG/WILD 1800 avg. enrollment is 179 - ESRI site license portion is $3401, WATS 4930/6920 avg. enrollment is 50 - ESRI site license portion is $950, WILD 5750/6750 avg. enrollment is 24 - ESRI site license portion is $456, Avg enrollment 50, Per student fee $19 We are proposing to remove the course fees that included the cost of hardware since there is a surplus of funds, which will be used for the next three years to pay for computer maintenance and replacements as necessary. This would include the cost of the software Deepfreeze which QCNR IT uses as a backup system. This proposed fee is for software use only. The average enrollment for the three courses that use the software has been 256. The course fee would then be $18.75 ($19 rounded) for each student, which will be suspended until the next semester (Spring 2021) and then evaluated.

WATS 5150/6150, GEO 5150/6150 Fluvial Geomorphology $100
Field Trips: Logan River Gaging Station $94, Logan River Rendezvous Park $94, LHPS Canal $94, Pinedale $518, Cub River $94, Big Creek $161, Green River $603, Provo River $159 Total Cost $1817 Average # of students 12. $150 per student. The department is covering additional expenses at this time.
WATS 5200 Fish Habitats $75
Materials and Supplies: Replacement Drysuit $900 1 $900, Replacement Drysuit Gasket $60 2 $120, AquaSeal for repairs $16, Sub-total $1036 Field Trips Vans $80, Fuel $24, Lab Truck $50, Sub Total $154. Total Cost $1190. Avg # of Students 16 Avg cost per student $75.

WATS 5300 Principles of Aquatic Ecosystem Restoration $18
Estimated enrollment 17 2 field trips w/ 3 vans each cost of minivan rental and fuel (<100 mi) $50.00 $40 rental + $10 fuel number of minivans per field trip 3 cost of field trips $300.00 Avg cost per student $18.

WATS 5310 Ecology of Restoration of wetland & riparian plants $17
Estimated enrollment 20 number of field trips under 100 mi 1 number of field trips over 100 mi 1 cost of minivan rental and fuel (<100 mi) $50.00 $40 rental + $10 fuel cost of minivan rental and fuel (>100 mi) $65.00 $50 rental + $15 fuel number of minivans per field trip 3 cost of field trips $345.00 student cost per field trip $17.00 Total fees $345.00 Avg cost per student $17.

WATS 5340 Management and Restoration of Aquatic Ecosystems Capstone 1 $75
Field Trips: Logan River $185, Cutler Reservoir $185, Provo River $210, Spawn Creek $135, Total Field Trips $715; Supplies: Replacement Waders $180. Total $895 Avg # of students 12, Avg cost per student $75.

WATS 5350 Management and Restoration of Aquatic Ecosystems Capstone II $75
Field Trips: Logan River $185, Birch Creek $250, Logan River $185, Raft River $275, Total Field Trips $895; Avg # of students 12, Avg cost per student $75.

WATS 5550 Freshwater Invertebrates $91
All costs are per student: vans for field trips $13, ethanol for preserving samples (gallons) $11, forceps for lab $6, write in the rain paper for sample labels (pages) $1, printing handouts and taxonomic keys $6, binder/dividers for handouts and keys $4, microscope rental $50, Total per student $91 *Each scope will need to be repaired every 10 years Annual cost of repairing one scope = $500/10 = $50 Total Cost for all fees $1365.

WATS 5610/CEWA 5610Field Introduction to Low-Tech Process Based Restoration of Riverscapes $100
All costs are per student. Vans/trucks for field trips $20, restoration construction equipment and materials $50, meals, drinks and snacks for field trips, $15, PPE supplies and waders $15. Avg # of students 10, Avg cost per student $100.

WATS 5624/CEWA 5624 Implementing Low-Tech Process-Based Restoration of Riverscapes $100
All costs are per student. Vans/trucks for field trips $20, restoration construction equipment and materials $50, meals, drinks and snacks for field trips, $15, PPE supplies and waders $15. Avg # of students 10, Avg cost per student $100.

WATS 5625/CEWA 5625 Adaptive Management & Monitoring of Low-Tech Process-Based Restoration of Riverscapes. $100
All costs are per student. Vans/trucks for field trips $20, restoration construction equipment and materials $50, meals, drinks and snacks for field trips, $15, PPE supplies and waders $15. Avg # of students 10, Avg cost per student $100.
WATS 5630/CEWA 5630 Beaver Translocation $100
All costs are per student. Vans/trucks for field trips $20, restoration construction equipment and materials $50, meals, drinks and snacks for field trips, $15, PPE supplies and waders $15. Avg # of students 10, Avg cost per student $100.

WATS 5680/6680, GEO 5690/6680, PSC 5680/6680 Paleoclimatology $75
The class involves a weekend field trip to southern Utah to make observations and collect Quaternary paleoclimate data. 2 vehicles are required. 800 mi roundtrip x 2 x $0.485 per mi = $776. Camping fees average $40, and camp groceries average $80. Total cost of field trip = $896.

WATS/WILD 6700 Restoration Ecology $38
Field Trips and Class Activities: Hardware Ranch 20 miles $80 twice, Farmington Bay Waterfowl Management Area 75 miles $150 Estimated miles 230, estimated gas cost $112, vehicle rental $266 Total estimated cost $378 Avg # of students 10, Avg cost per student $38.

PROFESSIONAL DEVELOPMENT

The department encourages professional development of its faculty and administrative staff. For example, WATS faculty regularly participate in grant-writing workshops and an annual Proposal Writing Institute, and the department encourages visits to funding agencies, with partial support available from the department and Office of Research. USU has recently increased the number of professional development opportunities offered on campus, most notably including a variety of events and programs offered by the Office of Empowering Teaching Excellence. USU has also started offering workshops in leadership for faculty and staff and the Ecology Center recently sponsored a workshop on Enabling Interdisciplinary and Team Science Course. However, funding for such opportunities is very limited, especially given the inflation-adjusted decrease in the department’s E&G operating budget over the past 7 years. Any requests for professional development opportunities are typically funded from the department’s limited Facilities and Administration recovery accounts. Further, the Office of Research recently decided that professional development activities cannot be funded by, or used as match for, Office of Research faculty startup funds.

2012 REGENTS REVIEW PROGRESS SUMMARY

The 2012 Regents Review Committee had two primary recommendations with regard to funding and facilities:

1. Facilities for the department appear to be at, or near capacity. If future growth is realized, some planning will have to be undertaken with regard to facilities.

Facilities have expanded slightly since the 2012 review and have remained at, or near, capacity. As the faculty has expanded slightly over the past 9 years, the department has increased lab space for two new hires, added a hydrology teaching lab, and added new offices in the Janet Quinney Lawson building. Dr. Joe Wheaton serves on the University Space Committee and has represented departmental space issues well. A few faculty members were significantly impacted by the renovation of the north and west wings of the BNR building and all nearly all WATS faculty will be impacted by renovations in the BNR south wing, which are anticipated to start in summer 2021 and persist for several years.
2. We applaud and support Utah State University’s administrative initiatives to increase operating budgets and recommend continued growth, as possible, to support extension and outreach programs relative to the departmental mission with regard to the state.

Unfortunately, operating budgets have stalled over the past five years, declining by approximately 10% since 2015 after accounting for inflation. The decline in departmental operating support is concerning, has limited growth of our research, education, and outreach programs, and reduced our ability to deal with emerging issues. WATS faculty have been flexible and creative in dealing with this issue, but continued declines in operating support will be increasingly difficult to manage.

SCHOLARSHIPS

OVERVIEW

QCNR Scholarships
The following scholarships are available to students in the Quinney College of Natural Resources.

Allen W. & Alice H. Stokes Scholarship
Arthur Dwight Smith Scholarship
Arthur F. Johnson Scholarship
Class of 1950 Endowment
College of Natural Resources Alumni Scholarship
Evelyn Irving Memorial Scholarship
Frank O. & LaRae Skeen Fonnesbeck Scholarship
George E. Hart Scholarship
Gregory Ray Rost Scholarship
J. Whitney & Virginia P. Floyd Scholarship
Jeb Stuart Scholarship
Jeffrey S. Workman Memorial Scholarship
Jerry W. McGee Memorial Scholarship
Jessop B. Low Memorial Scholarship
L.A. Stoddart Memorial Scholarship
Lewis M. Turner Memorial Scholarship
Linda Gurr Stuart Memorial Scholarship in Natural Resources
Mark R. Boyer Scholarship
Mary Lu Roskelley Endowed Scholarship
Mathias & Johanna Neuhold Scholarship
Paul M. & Neva Dunn Scholarship
Philip J. Urness Scholarship
Poe Brothers Scholarship
Robert D. & Lenore L. Nielsen Scholarship in Natural Resources
Ronald J. Ryel Natural Resource Conservancy Scholarship
Samuel E. Jorgensen Scholarship
Undergraduate Opportunity Scholarship
William F. Sigler Scholarship
William G. Kohner Scholarship in Natural Resources
William T. (Bill) Helm Scholarship
Table 11. The number of WATS students who received scholarships for the past four award cycles and the amount they were awarded.

<table>
<thead>
<tr>
<th>Award Year</th>
<th>Undergraduate Recipients</th>
<th>Graduate Recipients</th>
<th>Undergraduate Award Totals</th>
<th>Graduate Award Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>10</td>
<td>0</td>
<td>$24,741.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>2019</td>
<td>8</td>
<td>1</td>
<td>$13,500.00</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>2018</td>
<td>6</td>
<td>0</td>
<td>$12,800.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>2017</td>
<td>6</td>
<td>0</td>
<td>$5,800.00</td>
<td>$0.00</td>
</tr>
</tbody>
</table>

CRITERIA FOR SCHOLARSHIPS AND AWARDS

The QCNR Scholarship Committee meets in the spring to award the scholarships. The committee is chaired by Associate Dean Claudia Radel and consists of a representative from each department (Edd Hammill is the current WATS representative), academic advisors, and the Director of Development for the QCNR.

The criteria for each scholarship differ based on the initial donor agreement. However, in general, students are selected based on their current GPA, financial need, and academic and community involvement.

PROGRAM ASSESSMENT

OVERVIEW

Our assessment of undergraduate programs is targeted toward ongoing improvements that ensure all graduating students have the knowledge and skills required to be productive and advance in their professional field of endeavor. At the center of our assessment, we track achievement relative to program learning objectives in classes required of all majors. This information is tracked throughout the school year and is then reviewed, along with course evaluations and other outcomes data, when the department faculty hold an in-service day at the end of spring semester. At this meeting, we make data-based decisions and implement changes for the next school year.

Graduate education is characterized by expectations that include mastery of subject material greater than typically associated with undergraduate education. The MS and PhD degrees have additional expectations for original research and scholarly activity conducted in an ethical manner. The learning objectives allied with each degree are described following this outline of our assessment plan.

Mastery of subject material by individual students in the MS and PhD programs is assessed by their supervisory committee following standard procedures required by the graduate school and department. The learning objectives for students in these research-based programs are established through a plan of study for each student and approved by their supervisory committee. Committees meet at least annually to assess student progress in the program and their plan of study. For doctoral students, competencies related to their plan of study and research proposal are assessed during a qualifying examination conducted by the graduate committee. The qualifying examination includes both written
and oral portions specifically developed to test achievement and preparation for the graduate degree. Final assessment of student achievement occurs during the defense of their thesis or dissertation.

The department collects outcomes data on the overall performance of our programs to augment the assessments of individual student learning provided by supervisory committees. Outcomes are reviewed by the graduate program committee comprised of the department’s graduate faculty members leading to data-based decisions that ensure overall program objectives are being met. The department faculty assess the graduate program during an in-service day held at the end of spring semester to finalize plans for putting the data-based decisions into practice.

LEARNING OBJECTIVES

Students graduating with a B.S. in Management and Restoration of Aquatic Ecosystems will have demonstrated:

1. Competence in applying computing and mathematical methods
2. Functional knowledge of the physical and biological, chemical components of aquatic ecosystems
3. Ability to make and analyze observations of aquatic ecosystems
4. Ability to understand and apply the principles of aquatic ecosystem restoration
5. Effective oral, written, and visualization communication skills
6. Understanding of the social context of ecosystem management and restoration in modern society
7. Ability to identify, formulate, and develop solutions to ecosystem management and restoration problems using modern analytical tools, synthesizing knowledge from supporting sciences

Students graduating with a B.S. in Fisheries and Aquatic Sciences will have demonstrated:

1. Competence in applying computing and mathematical methods
2. Functional knowledge of the physical and biological, chemical components of aquatic ecosystems
3. Ability to make and analyze observations of aquatic ecosystems
4. Ability to understand and apply the principles of fisheries conservation and management
5. Effective oral, written, and visualization communication skills
6. Understanding of the social context of ecosystem management and restoration in modern society
7. Ability to identify, formulate, and develop solutions to ecosystem management and restoration problems using modern analytical tools, synthesizing knowledge from supporting sciences

Learning objectives for graduate students in these research-based programs are established through a plan of study for each student and approved by their graduate committee. The plan of study is unique to each student and combines foundational and advanced courses as needed to obtain the specialized learning required to complete the student’s research. Credit, course and other degree requirements can be accessed here. MS and PhD students in Ecology have additional course requirements described here.

As a result of successfully completing the requirements toward the PhD degree, students shall:

- Demonstrate mastery of subject material.
- Design, conduct, present, and defend a body of research leading to an original and significant contribution to knowledge.
- Be able to conduct scholarly activities in an ethical manner.

As a result of successfully completing the requirements toward the MS degree, students shall:
• Demonstrate mastery of subject material.
• Conduct, present, and defend a body of research conducted during their program.
• Be able to conduct scholarly activities in an ethical manner.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>WAES</th>
<th>FAAS</th>
<th>GEOG</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATS 1020</td>
<td>Professional Orientation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geog 1000</td>
<td>Physical Geography</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geog 1800</td>
<td>Intro to GIS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATS 2000</td>
<td>Oceanography</td>
<td>8.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATS 3100</td>
<td>Fish Diversity &amp; Conservation</td>
<td>7.7</td>
<td>8.9</td>
<td>8.5</td>
</tr>
<tr>
<td>WATS 3110</td>
<td>Fish Diversity Lab</td>
<td></td>
<td></td>
<td>8.2</td>
</tr>
<tr>
<td>WATS 3700</td>
<td>Fundamentals WATS Science</td>
<td>8.5</td>
<td>6.9</td>
<td>7.9</td>
</tr>
<tr>
<td>WATS 3820</td>
<td>Climate Change</td>
<td>8.5</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>WATS 4400</td>
<td>Small Watershed Hydrology</td>
<td>7.7</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>WATS 4500</td>
<td>Limnology</td>
<td>8.3</td>
<td>6.3</td>
<td></td>
</tr>
<tr>
<td>WATS 4510</td>
<td>Aquatic Ecology Praduor</td>
<td>9.5</td>
<td>8.3</td>
<td>9.7</td>
</tr>
<tr>
<td>WATS 4520</td>
<td>Water Quality and Pollution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATS 4560</td>
<td>Fishery Mgmt</td>
<td>8.9</td>
<td>8.7</td>
<td>8.9</td>
</tr>
<tr>
<td>WATS 4561</td>
<td>Aquatic GIS &amp; Spatia Analysis</td>
<td></td>
<td></td>
<td>7.9</td>
</tr>
<tr>
<td>WATS 4890</td>
<td>Dept Seminar</td>
<td></td>
<td></td>
<td>8.5</td>
</tr>
<tr>
<td>WATS 5150</td>
<td>Fluvial Geomorph</td>
<td>6.8</td>
<td>9.2</td>
<td></td>
</tr>
<tr>
<td>WATS 5170</td>
<td>Fluvial Geomorph Lab</td>
<td>7.8</td>
<td>8.8</td>
<td>8.8</td>
</tr>
<tr>
<td>WATS 5200</td>
<td>Fish Habits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATS 5560</td>
<td>Freshwater Inverts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATS 5570</td>
<td>Wetland Ecology &amp; Mgmt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATS 5570</td>
<td>Analysis Fisheries Data w/R</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Objectives—Watershed Sciences

Information used to track student progress and success includes:

- Progress on learning objectives is assessed in courses required of all majors. The learning objectives and the classes used for assessment in the FAAS and the MRAE majors are available here: Courses used for assessing learning objectives. Instructors for these courses report on student performance at the annual program review conducted by the faculty in May of each year.
- Students’ ratings on each course and its instructor are collected on every course using the IDEA survey. Feedback includes progress towards achieving the learning outcomes for the course and the effectiveness of the instructor. The syllabus for each course maps the specific learning outcomes for the course to the learning objectives defined in the IDEA survey to facilitate interpretation of IDEA feedback on a course-by-course basis.
- The Department Head evaluates the transcripts of graduating seniors with regard to major requirements and with respect to US Office of Personnel Management (OPM) requirements for positions in Fish Biology, Wildlife Biology, Fish and Wildlife Administration, and Hydrology.
- The Department Head and Faculty Advisors meet every semester with the QCNR advisor to discuss scheduling, course prerequisites, and other advising issues.
- The Department Head conducts exit interviews with each graduating senior to discuss whether the program has met each student’s particular abilities and interests. Prior to the meeting, each student completes a questionnaire regarding their undergraduate experience. Students are asked to evaluate their achievement on each of the seven learning objectives, with specific follow up in the one-on-one exit interview with the Department Head.
- USU Career Services conducts employment and continuing education telephone survey across graduates from all USU colleges. WATS maintains a more complete database of graduate placement, which provides important feedback on the success of our students as professionals.

Watershed Sciences Assessment

The Program in Management and Restoration of Aquatic Ecosystems educates students to think critically, communicate clearly, and collaborate effectively as they apply the fundamentals of watershed science to aquatic ecosystem problems. Our graduates are prepared to be successful professionals in private and governmental organizations and students in strong graduate programs.

The Program in Fisheries and Aquatic Sciences educates students to think critically, communicate clearly, and collaborate effectively as they apply the fundamentals of fish ecology and aquatic science to problems of fishery and aquatic conservation. Our graduates are prepared to be successful professionals in private and governmental organizations and students in strong graduate programs.

PhD in Watershed Science, PhD in Ecology

This is a traditional research-based degree program. Students are admitted only after they are accepted into, and funded by, the research program of an individual faculty member. Course work follows a plan of study developed in conjunction with their major professor and graduate committee. The plan of study must meet the core requirements of the department and graduate school and will also include courses pertinent to the student’s research project and later career goals. PhD students getting an Ecology
degree have additional course requirements, which can be checked here. Students must demonstrate a mastery of course materials by passing a qualifying examination administered by their supervisory committee. Students must also present their work at least twice before a department-wide seminar, generally by presenting their proposed research in the first year, and research updates in subsequent updates every other year. They must also successfully defend their research as a significant original contribution to knowledge conducted in an ethical manner. The defense includes a public presentation of the research results as well as an oral examination conducted with their graduate committee.

**MS in Watershed Science, MS in Fisheries Biology, MS in Ecology**

This is a traditional research-based degree program. Students are admitted only after they are accepted into, and funded by, the research program of an individual faculty member. Course work follows a plan of study developed in conjunction with their major professor and graduate committee. The plan of study must meet the core requirements of the department and graduate school and will also include courses pertinent to the student’s research project and later career goals. MS students getting an Ecology degree have additional course requirements, which can be checked here. Students must demonstrate a mastery of course materials to their supervisory committee during defense of their research conducted in an ethical manner.

**OUTCOMES OF ASSESSMENT**

Program assessment outcomes data are updated throughout the school year and reviewed in advance of an annual in-service day scheduled immediately following the end of the Spring Semester. The faculty agree on modifications to courses, curricula and programs at this meeting, leaving time to develop changes prior to the start of the next academic year. Programmatic issues are also addressed, as needed, during faculty meetings throughout the school year.

**Undergraduate Assessment Plan**

Our assessment of undergraduate programs is targeted toward ongoing improvements that ensure all graduating students have the knowledge and skills required to be productive and advance in their professional field of endeavor. At the center of our assessment, we track achievement relative to program learning objectives in classes required of all majors. This information is tracked throughout the school year and is then reviewed, along with course evaluations and other outcomes data, when the department faculty hold an in-service day at the end of spring semester. At this meeting, we make data-based decisions and implement changes for the next school year.

**Graduate Assessment Plan**

Mastery of subject material by individual students in the MS and PhD programs is assessed by their supervisory committee following standard procedures required by the graduate school and department. The outcomes data evaluated by the supervisory committees includes plans of study, research proposals, qualifying exams, and theses and dissertations.

In addition, the department employs a variety of tools to collect feedback on the overall performance of its graduate programs, including, but not limited to:

- Average GPA for entering students
- Number of students in each degree
- Average time to degree completion
- Percentage of students completing degrees in targeted time frames
Department of Watershed Sciences Review, January 2021

2 years for MS
5 years for PhD
Number of publications and professional presentations per student
Average stipend for MS and PhD research assistantships
Teaching experience gained while in residence
Career placement and professional advancement

Professional Placement: In addition to alumni and graduate surveys conducted by the university, the department maintains its own database of career placement for our graduate students. We have nearly 100% information on the professional activities of students in the years following graduation.

Detailed Data can be found at the following webpages:
https://qcnr.usu.edu/wats/about/assessment/undergraduate_assessment
https://qcnr.usu.edu/wats/about/assessment/graduate_assessment

APPENDIX

FACULTY PROFILES

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Appointed Date</th>
<th>Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trisha Atwood</td>
<td>Assistant Professor</td>
<td>6/1/2015</td>
<td>B.A., M.S., Ph.D.</td>
</tr>
<tr>
<td>Patrick Belmont</td>
<td>Professor</td>
<td>12/1/2009</td>
<td>B.S., M.S., Ph.D.</td>
</tr>
</tbody>
</table>

Past Professional Appointments:
- Dr. Atwood: Postdoctoral Fellow, Global Change Institute, University of Queensland, St Lucia, Australia
- Dr. Belmont: Postdoctoral Research Associate, National Center for Earth-surface Dynamics; Lecturer, Department of Civil Engineering, University of Minnesota

Current Appointment:
- Dr. Atwood: 50% Research, 40% Teaching, 10% Service
- Dr. Belmont: 70% Administration, 10% Teaching, 20% Research

Trisha Atwood
Assistant Professor, appointed 6/1/2015
B.A., M.S., Ph.D.

Past Professional Appointments: Postdoctoral Fellow, Global Change Institute, University of Queensland, St Lucia, Australia
Current Appointment: 50% Research, 40% Teaching, 10% Service

Her research program uses marine and freshwater ecosystems to understand the influence of global change on ecological communities and biogeochemical cycles. As both a community ecologist and ecosystem ecologist, she studies how interactions among microbes, plants, and animals influence ecosystem properties (e.g., carbon stocks) and processes (e.g., carbon cycling). The nature of Dr. Atwood’s research allows her to investigate novel questions that help advance our understanding of basic ecological theory, as well as inform conservation actions to protect aquatic species and habitats. Dr. Atwood teaches undergraduate courses in ecology, oceanography, and a study abroad field course in coral reef ecology on Australia’s Great Barrier Reef. Dr. Atwood has mentored 4 MSc students, 1 PhD student, and three postdoctoral scholars. She has published 40 peer-reviewed journal articles. She is currently funded by the National Science Foundation, National Geographic’s Pristine Seas Program, and the National Academies of Sciences, Engineering, and Medicine Gulf Research Program.

Patrick Belmont
Professor, appointed 12/1/2009
B.S., M.S., Ph.D.

Past Professional Appointments: Postdoctoral Research Associate, National Center for Earth-surface Dynamics; Lecturer, Department of Civil Engineering, University of Minnesota
Current Appointment: 70% Administration, 10% Teaching, 20% Research

Patrick Belmont is a hydrologist and geomorphologist. His research has advanced understanding of how landscapes and rivers change over time and the implications for water quantity and quality, flood risk, water resource management, and ecosystem health. Specific
Research approaches include development of water and sediment budgets, mathematical modeling of sediment transport as well as fluvial and hillslope erosion processes, geochemical sediment fingerprinting, and quantitative landscape morphometric analysis. The majority of his research has been funded by the National Science Foundation, in addition to funding from state and federal agencies and a small amount from non-profit and industry partners. Much of his current work focuses on predicting the impacts of climate change, with an emphasis on how continued increases in wildfire are likely to impact water supply and fish populations in Utah and the Intermountain West. He has published a total of 50 peer reviewed papers as well as other research reports and datasets, graduated 9 MS students and 2 PhD students and was recognized as Utah State University Researcher of the Year in 2018.

<table>
<thead>
<tr>
<th>Janice Brahney</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistant Professor, appointed 8/1/2016</td>
</tr>
<tr>
<td>B.S. M.S. Ph.D.</td>
</tr>
<tr>
<td>Past Professional Appointments: Postdoctoral Research Scientist, Earth and Environmental Sciences, Economics, University of British Columbia; Visiting Professor, Biology, Okanagan College; Affiliate Honorary Assistant Professor, Earth and Environmental Sciences, University of British Columbia</td>
</tr>
<tr>
<td>Current Appointment: 50% Research, 40% Teaching, 10% Service</td>
</tr>
<tr>
<td>Her research sits at the nexus of several critical zone disciplines and includes three primary themes, 1) the atmosphere as a vector for material transport to aquatic ecosystems, 2) climate change effects in mountain environments, and 3) the cause, effect, and mitigation of water quality impairment. Dr. Brahney teaches graduate and undergraduate courses in limnology, biogeochemistry, and methods in aquatic sciences. She has had 11 MS students and 2 PhD students. She has published one book chapter and 31 peer-reviewed articles. Dr. Brahney is an associate editor for Freshwater Science. Her research is funded through the National Science Foundation, the Department of Energy, as well as other federal and state sponsors.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soren Brothers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistant Professor, appointed 8/1/2017</td>
</tr>
<tr>
<td>B.S. M.S. Ph.D.</td>
</tr>
<tr>
<td>Past Professional Appointments: Postdoctoral Fellow, University of Guelph</td>
</tr>
<tr>
<td>Current Appointment: 50% Research, 40% Teaching, 10% Service</td>
</tr>
<tr>
<td>His research program focuses primarily on carbon cycling and primary production in lakes and rivers. His work has explored climate change feedbacks with lakes, including the effects of desiccation and warming on greenhouse gas fluxes from lakes. He also works as a scientific advisor to the Utah Division of Water Quality for improving the water quality of a local eutrophic lake featuring harmful algal blooms (Utah Lake), and his research on ecosystem functioning includes a focus on regime shift theory. He is an expert in benthic algal (periphyton) production dynamics, and has served as a lead independent reviewer, for instance, of the periphyton monitoring protocol at Lake Tahoe (CA,NV). He teaches undergraduate courses in watershed sciences and an aquatic practicum, and a graduate course in advanced limnology. He has mentored two MS students, one PhD student, and five undergraduate students. He has published 20 peer-reviewed journal articles (one of which is in press). He is currently funded by the Henry's Fork Foundation and the Utah Division of Forestry, Fire, and State Lands.</td>
</tr>
</tbody>
</table>
**Phaedra Budy**

Professor, appointed 11/1/1996

B.S. Ph.D.

Past Professional Appointments: Postdoctoral Fellow, Utah State University, Colorado State University, Puerto Rico LTER site; Quantitative Fishery Biologist, US Fish and Wildlife Service Columbia River Fisheries Program Office

Current Appointment:

Phaedra Budy is the Principle Investigator for the Fish Ecology Lab at USU and is the Unit Leader of the U.S. Geological Society, Utah Cooperative Fish and Wildlife Unit. In that capacity, she helps the Utah Division of Wildlife Resources (UDWR) meet their research needs, for more informed management of aquatic natural resources in Utah while, serving as a faculty member of the Watershed Sciences faculty. In the fish ecology lab, we do research that fits into an overall framework of evaluating the factors that structure and limit fish populations in both lentic and lotic systems. We work broadly in the conservation biology, invasion ecology, and food web dynamics of aquatic systems with an emphasis on fishes. Our current research covers a wide geographical range including almost all of Utah (from the south of the state up to high elevation points in the Bear River drainage), Oregon and Washington and Alaska and includes many species of salmonids, imperiled native desert fishes (the "three species"), and numerous warm water lentic fishes. We also do experimental and adaptive desert stream restoration and large river management. Phaedra is a senior editor of the journal of Ecology of Freshwater Fishes. Her funding comes largely from federal partners (Bureau of Reclamation, Bureau of Land Management, U.S. Fish and Wildlife Service), the UDWR, and the National Science Foundation. She has advised 28 graduate students to completion and published 94 publications in the peer-reviewed literature including 4 book chapters.

**Edward Hammill**

Assistant Professor, appointed 8/1/2015

B.S. M.Res. Ph.D.

Past Professional Appointments: Postdoctoral Research Fellow, University of Victoria; Research and Teaching Fellow, University of British Columbia; Environmental Decisions Research Fellow, University of Queensland; Lecturer, University of Technology, Sydney

Current Appointment: 50% Research, 40% Teaching, 10% Service

His research program focuses on the processes that structure ecological communities and their distributions on landscapes. By understanding how ecological communities are affected by their environments and changes to these environments, we can make informed conservation decisions. A large component of Dr. Hammill’s research program is using environmental conditions to guide biodiversity management. He teaches a large general education class on biodiversity and sustainability, a major-specific class on watershed sciences, a graduate level class on quantitative conservation decision making, and a field class on coral reef ecology. Dr Hammill currently has 3 Ph.D students and 1 undergraduate technician, and has previously supervised 4 masters students to completion. He has published 45 peer-reviewed journal articles and 3 book chapters. He is a board member for the Utah Wildlife Society and has been an editor for Ecology and Evolution. He is currently funded by the National Science Foundation, the Utah Division of Wildlife Resources, and the Department of Defense.
Charles Hawkins
Professor, appointed 9/6/1983
B.A. M.A. Ph.D.
Past Professional Appointments: Post-doctoral researcher, Oregon State University
Current Appointment: 50% Research, 20% Teaching, 30% Service
Dr. Hawkins conducts research designed to (1) understand the role that regional and local processes play in controlling aquatic biodiversity and (2) use that knowledge to improve survey designs, predictive modeling of community composition, use of aquatic biota to assess and monitor ecological integrity, and use of biota to diagnose the causes of ecological degradation. He is Co-Director of the USU/BLM National Aquatic Monitoring Center and has worked extensively with state and federal agencies to develop scientifically defensible indices of ecological condition, regulatory criteria applicable to naturally heterogeneous landscapes, and ways to effectively communicate the results of technical analyses to the public. His most recent research projects address the effects of temperature and salinity on the macroecology of freshwater invertebrates (NSF), classification and prediction of natural flow regimes in arid landscapes (USEPA), effectiveness of riparian buffer strips in protecting aquatic life (WA-DNR), use of eDNA in monitoring and assessing the biodiversity of freshwater ecosystems (USGS), conservation planning to protect sensitive amphibian species (USDOD), development of indices of ecological condition for Alaska streams (USNPS) and nonperennial streams in the arid western United States (USEPA). He is a Fellow of the Society for Freshwater Science and Editor-in-Chief of Freshwater Science. He was a member of the technical analysis team that developed biological indices used in the USEPA’s National Aquatic Resource Surveys. He has mentored 12 PhD and 18 MS students and has published over 100 journal papers and other peer-reviewed technical reports.

Karin Kettenring
Professor, appointed 8/1/2008
B.A. Ph.D.
Past Professional Appointments: Postdoctoral Researcher, Postdoctoral Fellow, Research Associate
Current Appointment: 50% Research, 40% Teaching, 10% Service
Karin is head of the Wetland Ecology and Restoration Lab in the Department of Watershed Sciences at Utah State University. Her current research efforts focus on (1) the ecology, genetics, and management of wetland invaders, (2) seed ecology of native wetlands plants, with implications for wetland revegetation, and (3) restoration genetics for sustainable, functioning wetland restorations. Much of her research is conducted in wetlands of the Chesapeake Bay, as well as Great Salt Lake and Utah Lake. She's developing new projects in Suisun Marsh in the San Francisco Bay Delta. Karin has graduated 10 M.S. students and 2 Ph.D. students. She currently has 1 Ph.D. student and 4 M.S. students in her lab. She has published more than 50 peer-reviewed publications and 5 Extension publications. Her research is supported by more than a dozen state and federal agencies, non-profits, and foundations.

Nancy Mesner
Professor, appointed 8/1/1998
B.S. M.S. M.S.E.
Past Professional Appointments: Water Quality Planner, Natural Resources Specialist,
### Nancy Mesner

**Current Appointment:** Extension 50%, Teaching 40%, Service 10%

Nancy Mesner is an extension specialist in water quality, whose work focuses on mitigation and prevention of nonpoint source pollution of natural waters. She is partially retired (0.5 FTE) and will fully retire on August 31, 2121. She and Hope Braithwaite recently launched 2 statewide outreach campaigns to address unmet needs identified by the state: nonpoint source pollution from small acreage farms and impacts of human waste resulting from recreational activities on federal lands. Braithwaite now coordinates two of Mesner’s major programs (STEM curriculum development / teacher training and Utah Water Watch) but Mesner has continued to develop and evaluate additional monitoring based activities in support of these programs. These include: 1) an exploration of salinity in Utah rivers and its relationship with stonefly diversity; and 2) lessons on how to construct and remotely operate underwater vehicles to measure depth, oxygen concentrations, temperature and light. GoPro attachments also allow students to visualize underwater conditions.

### Sarah Null

**Current Appointment:** 50% Research, 40% Teaching, 10% Service

Sarah Null's expertise is in environmental water management, and her research program addresses the potential to protect aquatic ecosystems while maintaining water resources benefits for people in water scarce regions. Ongoing research includes improving aquatic habitat objectives in water resources systems models, evaluating tradeoffs between human and environmental water uses with uncertainty, and identifying climate change adaptations for water systems. She teaches physical geography, water ecosystem and water system modeling, drones for environmental restoration, and water resources management. She has mentored 3 post-doctoral, 4 PhD, 8 MS, and 12 undergraduate researchers. She is currently funded by the National Science Foundation, Utah Division of Wildlife Resources, USAID, and Henry’s Fork Foundation. She is a 2017 recipient of the National Science Foundation CAREER award.

### Erin Rivers

**Current Appointment:** Extension 60%, Research 35%, Service 5%

Her research program focuses on best management practices for nonpoint source pollution with a particular focus on the use of stormwater control measures to improve urban water quality. Her current research is studying urban stormwater inputs and the transport of pollutants and contaminants to Utah Lake from the surrounding cities. Proposals are being developed to launch her research program. Projects in development will study soil improvement methods in stormwater bioretention systems to increase water storage and reduce pollutant export, model land use scenarios along the Wasatch Front to determine possible development effects on water use and quality, and evaluate the effect of visitor waste in the backcountry on public lands to determine possible management strategies to reduce pollutant transport. Her Water Quality Extension programming will provide
professional trainings and possible certification programs for water quality best management
practices, technical advice for improving green stormwater management system designs, and
resource and curricula development for youth education and public outreach.

<table>
<thead>
<tr>
<th>Brett Roper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Assistant Professor, appointed 7/1/2003</td>
</tr>
<tr>
<td>B.S. M.S. Ph.D.</td>
</tr>
</tbody>
</table>
| Current Professional Appointment: National Aquatic Monitoring Program Leader, US Forest
  Service, Newspaper Columnist. Past Professional Appointments: Forest Fisheries Biologist,
  District Fisheries Biologist |
| Current Appointment: Federal Collaborator |
| He is a federal collaborator that works for the Forest Service and uses the students and
  knowledge base associated with the University to better evaluate the effects of land
  management actions on fish and aquatic habitat. The goal of the relationship between the
  Forest Service and the University is to leverage the strengths of both institutions to
  understand and improve the rationale behind public land management decisions. Brett has
  been working to understand if changes in national policies related to timber harvest, livestock
  grazing, and travel management have improved riparian and stream conditions and the
  viability of rare aquatic and terrestrial biota dependent on these ecosystems. He teaches
  fisheries management to undergraduates and graduates. This class seeks to link societal
  demands for recreational fisheries with the tools state and federal biologist need to make
  informed decisions. In this class he forces undergraduates to use the statistical program R to
  assess standard fisheries data. He works with a half dozen MS and MNR students. He has
  published over 80 peer-reviewed journal articles. In addition, Brett writes bi-weekly articles
  related to hunting and fishing for the local paper and is an elected board member of the
  county’s water district. |

<table>
<thead>
<tr>
<th>Jack Schmidt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor, appointed 9/1/1991</td>
</tr>
<tr>
<td>B.A. M.A. Ph.D.</td>
</tr>
</tbody>
</table>
| Past Professional Appointments: Hydrologist; Earth Resources Associate; Chief, Grand Canyon
  Monitoring and Research Center |
| Current Appointment: Research 50%, Teaching 30%, Service 20% |
| Jack’s research is in fluvial geomorphology, especially focused on the application of that work
  to rehabilitation and management of the Colorado River and other large rivers of the
  Intermountain West. Jack’s recent work has focused on sediment transport, channel change,
  estimation of natural flows, the geomorphic basis of aquatic habitat, and the efficacy of river
  restoration actions. Jack conceived of the Future of the Colorado River project which he has
  led for the past 2.5 years. This multi-university, multi-investigator project funded by private
  foundations and the U.S. Geological Survey Climate Adaptation Science Center seeks to
  identify alternative management strategies for the Colorado River that yield sustainable water
  supplies and desirable ecosystem outcomes. Jack leads the Center for Colorado River Studies
  at Utah State, and served as the Chief of the USGS Grand Canyon Monitoring and Research
  Center between 2011 and 2014. Jack received the National Park Service’s Directors Award for
  his career of research concerning the large rivers of the National Park system. He was a
  member of the team awarded the Secretary of the Interior’s Partners in Conservation award
  for his work planning the pulse flow release into the Colorado River delta in Mexico. He is
author or co-author of more than 60 peer-reviewed journal articles, 4 book-length USGS or AGU publications, numerous book chapters, and government reports. He is a widely recognized expert in management of the Colorado River, serves on numerous advisory panels, and is frequently interviewed in the press. He has mentored 3 successful PhD students, and supervises 2 on-going PhD students; he has mentored numerous MS students.

**Timothy Walsworth**  
Assistant Professor, appointed 8/1/2020  
B.S. M.S. Ph.D.  
Past Professional Appointments: Associate Research Specialist, Postdoctoral Research Associate, Analyst, Postdoctoral Research Fellow  
Current Appointment: Research 50%, Teaching 40%, Service 10%  
His research program focuses on how fish populations and communities respond to environmental and management changes, as well as how fisheries managers can make decisions in the presence of ecological uncertainty. He is currently supervising graduate students studying how lake ecosystems respond to non-native species removal efforts, how alternative approaches to non-native species control and water management should be prioritized for maximum conservation effectiveness, and the factors affecting stocking success of a threatened fish species. This research provides critical information to managers tasked with prioritizing efforts to recover species of conservation concern. He teaches an undergraduate course in Fish Diversity and Conservation and is the faculty advisor for the Fisheries and Aquatic Sciences major. He has published 19 peer-reviewed papers and is currently funded by the June Sucker Recovery Implementation Program, U.S. National Park Service, and the U.S. Bureau of Reclamation.

**Joseph Wheaton**  
Associate Professor, appointed 7/1/2009  
B.S. M.S. Ph.D.  
Past Professional Appointments: Consultant, Lecturer, Research Assistant Professor  
Current Appointment: Research 50%, Teaching 40%, Service 10%  
His research program is focused on better understanding the dynamics of riverscapes, how such fluvial processes shape instream and riparian habitats, and how biota modulate and amplify those processes. For example, some of his research focuses on how the dam building activity of beaver alter physical habitat for their own benefit, but also to the benefit of a slew of other fauna and flora. Much of Joe's work focuses on taking such understandings and translating them into useful applications. For example, Joe has helped pioneer the development of new stream restoration approaches (e.g. low-tech process-based restoration using beaver as a restoration agent), building large scale monitoring programs that leverage the latest technologies (e.g. Columbia Habitat Monitoring Program), and building new analytical software apps (e.g. Geomorphic Change Detection Software) and simulation models (e.g. MORPHED, BRAT) to help scientists and practitioners alike. Joe's work straddles the interface between physical and ecological sciences. He has mentored 11 MS students and 2 PhD students to successful completion. He has published one textbook, ten book chapters and 59 peer-reviewed journal articles. He is the founder of the Riverscapes Consortium, and an active member of Utah State University's Restoration Consortium.
Peter Wilcock

Professor, appointed 7/1/2014
B.S. M.S. Ph.D.

Past Professional Appointments: Consultant; Geologist; Professor, Johns Hopkins University

Current Appointment:

Dr. Wilcock specializes in erosion and sedimentation processes and their application to stream and watershed restoration and management. His research spans grain-scale mechanics, sediment-channel interactions at the reach scale, and the control and management of sedimentation at the watershed scale. Applications include channel restoration, reservoir and channel response to dam removal, and reservoir operations for downstream channel maintenance. He has worked extensively in experimentation, field observation, and computer simulation of sediment systems and has published more than 100 peer-reviewed articles. After serving on the faculty of the Whiting School of Engineering at the Johns Hopkins University for 27 years, he joined Utah State University to serve as Head of the Watershed Sciences Department in the Quinney College of Natural Resources from 2014 to 2020. He has advised or co-advised five MS students since arriving at USU and is currently on sabbatical leave. Prof. Wilcock is a Fellow of the American Geophysical Union and received the Hans Albert Einstein Award from the American Society of Civil Engineers for outstanding contributions to the understanding of sediment transport in gravel-bed rivers.

Wayne Wurtsbaugh

Professor, Emeritus, appointed 7/1/1983
B.S. M.S. Ph.D.

Past Professional Appointments: Fishery Biologist, Biologist, Staff Research Scientist

Wayne Wurtsbaugh is an emeritus faculty member continuing his limnological work on lakes. Ongoing research is on the primary production in Great Salt Lake and the limnology of Iran's Lake Urmia. He is currently writing manuscripts on: 1) NSF-funded research on nutrient transport through watersheds and lakes; 2) pollution and water management to protect salt lakes, particularly Great Salt Lake and Lake Urmia, with funding from the State of Utah and the Semnani Foundation. He has published 1 edited book, 8 book chapters and 94 peer reviewed journal articles. He has had 5917 citations of his work.
GLOSSARY

This section primarily contains abbreviations and terms that are specific to USU or the meaning of which may differ among institutions.

AAA Office of Analysis, Assessment, and Accreditation, the unit that compiles institutional statistics and course evaluations.

AES Agricultural Experiment Station (also UAES, Utah Ag. Exp. Sta.)

AIS Academic and Instructional Services, the office that supports classroom instruction.

BNR Quinney Biology Natural Resources Building, which currently houses most Biology faculty.

DC Digital Commons, an open archive for faculty publications and datamaintained by the USU Libraries.

DE Distance Education

DM Digital Measures, an online database for faculty activities that includes a record of courses offered, publications, grants, etc.; used to generateannual reports of faculty productivity; maintained by AAA.

E&G Educational and General Funds

EC Ecology Center, an umbrella unit of USU that includes over 100affiliated faculty across most colleges and many departments.

F&A Facilities & Administrative funds

GA Graduate Assistant (used to refer to both GTA and GRA)

GPC Graduate Programs Committee

GRA Graduate Research Assistant

GTA Graduate Teaching Assistant

NACADA National Academic Advising Association

ORGS Office of Research and Graduate Studies

PAC Promotion Advisory Committee, assigned to nontenure-track or tenured faculty seeking promotion.

PDRF Presidential Doctoral Research Fellowship, a graduate funding programof ORGS; the program will be discontinued in AY 2019.
RC Regional Campus(es)

RCDE Regional Campus and Distance Education (formerly a single administrative unit, now separated into Distance Education (DE) and Regional Campuses (RC))

RS Role Statement, a document used to establish the basis for the evaluation of each faculty member (see note below)

TAC Tenure Advisory Committee, assigned to pre-tenure faculty.

USTAR Utah Science, Technology, and Research Initiative

UTA Undergraduate Teaching Assistant

UTF Undergraduate Teaching Fellow, a competitive position similar to, but more prestigious than, a UTA

VPR Vice President for Research
R411 Review of the Department of Watershed Sciences

Review Committee:
Dr. Laurie McNeill, Professor of Civil and Environmental Engineering, USU
Dr. Ellen Wohl, Professor of Geosciences, Colorado State University
Dr. Stanley Gregory, Professor Emeritus of Fisheries, Oregon State University

The Review Committee met via Zoom with various groups of faculty, staff, and students in the Department of Watershed Sciences (WATS) at Utah State University on March 15, 16 and 17, 2021 to discuss issues related to the Department. The Department provided video tours of their lab spaces; the Review Committee chair also toured departmental facilities in-person and discussed her observations with the other team members. A copy of the Review Committee itinerary is attached as Appendix A to this report. Prior to these meetings a thorough and informative self-study report of the Department was provided to the committee members.

Since the last review in 2012, the Department of Watershed Sciences has educated an increasing undergraduate and graduate student population while maintaining a high research profile. The Department of Watershed Sciences clearly supports the objectives of its mission statement to “foster the discovery, learning and application of knowledge about aquatic and earth resources and their related ecosystems to promote stewardship of the environment.” The curriculum, seminar series, field courses, and collegial atmosphere provide extensive and stimulating applications for both undergraduate and graduate students, and the robust research and extension programs contribute to the national, regional, and local reputation of the Department. The strength and cohesion of their program is notable because it integrates the physical and biological sciences effectively. In many universities, such programs are separated, creating barriers to collaboration of faculty and students. Administrators at Utah State University should recognize that successful interdisciplinary teaching and research of WATS in watershed sciences and fisheries is exceptional and held in high regard among its peers.

The department has a productive and engaged faculty with diverse research backgrounds providing a broad range of undergraduate and graduate courses and research opportunities for students. Faculty are very productive in research, training undergraduate and graduate students, obtaining research funding, and publishing peer-reviewed manuscripts. Active student clubs and the strong research program provide a rich variety of extra-curricular experiential learning opportunities for undergraduates. Student clubs and weekly coffee gatherings in the lounge (pre-pandemic) create a sense of community and support that are a major strength of the department. The relatively new department head, Dr. Patrick Belmont, has assumed his duties under the uniquely challenging conditions imposed by Covid and has done a remarkable job of fostering departmental collegiality and involvement by students, staff, and faculty, as exemplified by the weekly online discussion of “Now, here’s a question.”
Areas for improvement and continued program evolution include clarification of the benefits and requirements of its diverse degree and certificate programs, development of more structured planning and review of the curriculum, focused outreach to recruit and retain students from underrepresented groups, better communication with graduate students regarding funding and teaching/research responsibilities, upgrades to lab spaces, targeted hires for faculty diversity, increased starting salaries and faculty retention, continued communication regarding expectations for promotion and tenure processes (especially for Extension positions), collaboration with University administration to increase flexibility in startup packages for entry-level faculty, and developing an ombudsperson/advocate program for faculty and students.

The review team found much to commend during the virtual site visit. Overall, we strongly recommend that the Department of Watershed Sciences continue its creative and strategic development of preparing its undergraduate and graduate students for careers in watershed sciences and fisheries with the support and benefits of a robust scientific research program. In particular, the department should continue to foster the existing warm and collegial climate that welcomes a diversity of students, staff, and faculty.

We greatly appreciate the time and energy invested by our external review team, especially given that this review was done remotely via videoconference during a busy time, mid-semester and nearly a year into the covid-19 pandemic, when everyone was suffering from considerable videoconference fatigue. Members of the Department felt that the review was effective and comprehensive. Replies to external reviewer comments are included in blue throughout this document for clarification, explanation, or to identify action items the Department will take.

The Department of Watershed Sciences provided 10 questions for the review committee to consider. We will use these questions to provide greater detail about our findings:

1. How can WATS better inform undergraduate and graduate students about the broad spectrum of career paths that exist and keep track of if/how the career paths students wish to pursue is changing over time?

WATS has dedicated much attention to the variety of career paths available to its students and the evolving needs for professionals in watershed sciences and fisheries. WATS has developed two undergraduate degrees (B.S. in Fisheries and Aquatic Sciences, B.S. in Management and Restoration of Aquatic Ecosystems) and five graduate degrees (M.S. and PhD in Ecology, M.S. and PhD in Watershed Science, MS in Fisheries Biology). In addition, WATS offers three certificates: Undergraduate Certified Ecological Restoration Practitioner In Training, Graduate Certificate in Geographic Information Systems, and Graduate
Certificate in Aquatic Ecosystem Restoration. The department also has submitted a proposal for a Master of Ecological Restoration (MoER), which will function as a 4+1 program based on a B.S. degree plus one year of additional coursework, internship, and design exercises.

The many different programs can be sources of confusion for prospective students as well as students currently enrolled in different degree programs. In our interview, undergraduates described some confusion about the differences between these options, and graduate students raised concerns that potential employers will not recognize the distinctions between the proposed non-thesis MoER degree and thesis-based degrees, which potentially could dilute the value of their degrees.

The department should develop information, website support, and advising to clarify the requirements and explain the career benefits and limitations of the alternatives. WATS could also work with its External Advisory Board to develop a survey to better understand the range of perceptions of the spectrum of likely employers of its students and share those results with its students. Such a survey would also provide an opportunity to inform potential employers about the characteristics of the different degrees they will encounter as they interview students from the WATS programs.

New programs also require systematic plans for administration. This takes lead time. Shifting roles in the University create additional challenges for WATS staff as they implement new programs. Strategic planning of the roll out and initial implementation should make future program changes more successful.

We thank the reviewers for these comments and suggestions. We will update our website and other recruiting materials to ensure that prospective and current students understand the distinctive features of each program and the careers for which each degree prepares students.

The Department Head has previously discussed with graduate students the concern regarding employers not differentiating between the research-oriented, thesis-based Master of Science and the practitioner-oriented, non-thesis Master of Ecological Restoration. There are many distinctions between these two degree types. Students in these programs have fundamentally different experiences and are trained with very distinct skillsets. Future employers will evaluate applicants based on relevant experience and skillsets for the relevant career track. Further, admissions to the Master of Science programs are highly competitive and successful applicants receive tuition remission, stipend, and benefits, whereas the MoER is open to any students who complete a WATS undergraduate degree with a 3.0+ GPA, though those MoER students pay their own tuition and fees. Further, implementing the Master of Ecological Restoration program benefits Master of Science students because there will be more restoration-oriented workshops and courses, which could count towards MS students obtaining a graduate certificate in aquatic ecosystem restoration.
2. Do you find our undergraduate educational and research programs to be robust and well targeted for the careers our students want to pursue? Do you recommend any specific pedagogical changes, or extracurricular offerings?

The undergraduates whom we spoke to were articulate, engaged, and generally seemed happy with the program. All spoke highly of the Department Head, Patrick Belmont, and the advisors, Melanie Conrad, Shelly Kotynek, and peer-advisor Alice Kenley. Advisors remarked that the Department Head makes Departmental operations more streamlined and predictable. We commend the department for having both BS degree curricula meet OPM requirements for federal employment.

The number of students in the Fisheries Biology MS program is small, and the PhD degree in that area was recently phased out. Faculty indicated this is because many students instead join the Ecology MS and PhD programs, which are perceived to be more prestigious and have more funding and professional development opportunities. Nevertheless, they indicated that some government agencies require students to have a Fisheries degree, and there will likely be a new faculty hire in that area which may spark new student interest. The Department may want to evaluate the viability and continued need for the Fisheries MS degree.

The Department has received approval to move forward with a Fisheries Biology faculty hire, so we play to retain the Fisheries BS degree for the now, but will revisit the need for this degree in the future.

WATS currently uses annual departmental retreats and discussions with the External Advisory Board to collectively decide on curriculum changes. The absence of a departmental curriculum committee is notable -- such a committee could be very useful in maintaining oversight of departmental offerings and required curriculum for undergraduate majors. A formal curriculum committee would also provide greater support and systematic implementation of the many degree programs in the department.

WATS has avoided forming a curriculum committee in the past to minimize the administrative burden on the faculty. However, this approach comes at some cost of the curriculum perhaps not being as well developed as it could be and some miscommunication or misunderstanding among the faculty about the curriculum and curricular changes. Department Head Belmont has committed to addressing deficiencies in the curriculum and aligning it with the needs of prospective employers, but agrees with the comment of the external review team that a more inclusive process may lead to a better outcome and a stronger sense of ownership by the faculty. As such, [Action item] the Department will
establish a curriculum committee of at least 3 faculty members, including the Department Head, starting in Fall 2021.

One interesting suggestion from the academic advisor is to consider requiring undergraduate students to meet with a faculty advisor once per year to increase their engagement in the department. If this is implemented, the Department Head would need to carefully choose which faculty serve as advisors and how to acknowledge this additional service load.

The Department has two faculty advisors, one for each undergraduate major (MRAE: Peter Wilcock, FAS: Tim Walsworth). While the Department does not have a requirement that students meet with their faculty advisor each year, students are encouraged to meet with the faculty advisor as often as they deem helpful. Having said that, not all students take the opportunity to meet with a faculty advisor each year. Fisheries students tend to meet with the faculty advisor more consistently than MRAE students. Rather than creating a (potentially unenforceable) requirement, [Action item] Department Head Belmont will encourage faculty advisors to more proactively pursue meetings, at least annually, with students.

The University provides access to advisors and a variety of other programs for academic support and to the CARES Team for counseling. Students and advisors also noted that the Department Head is accessible and helpful for students, staff, and faculty alike. Nonetheless, it appears that the University does not have an independent ombudsperson to provide confidential support and assistance for academic and non-academic concerns about administrative issues, workplace issues, grievances, or complaints. (This is for items that fall outside the purview of the Office of Equity). Such a position or office could provide an independent liaison for students, staff, faculty, and administrators. The University, College of Natural Resources, and WATS could consider creation of such a position to foster the success and safety of its students and faculty.

Such a position is currently under consideration at the University level. It is not financially feasible, nor would there likely be sufficient need, for the Department to create such a position. [Action item] Department Head Belmont will continue to advocate for such a position at the University level.

WATS does not synthesize the Student Evaluation of Teaching (SET) scores for the department as a whole and compare them to the median scores for the College and University. We encourage the department to evaluate its collective performance and better
understand the effectiveness of its teaching program within the University as a whole. These summaries of SET scores could be tracked annually and help the department and college administrators as they adjust their program to better serve the students and provide ongoing feedback to instructors, with the caveat that SET are not the only indicator of teaching effectiveness and they have been shown in some cases to be discriminatory towards female and minority faculty. The plan for peer reviews of teaching by fellow faculty is a great way to provide an additional source of feedback on teaching effectiveness.

USU recently adopted an updated version of the IDEA Student Evaluation system, which provides this functionality. It is unfortunate that this information was not available in time for this review, but the Department will certainly utilize this information in the future as one measure to help track faculty teaching effectiveness. Starting Fall 2021 WATS will be implementing a new peer teaching review system in which each faculty member will provide, and receive, at least two reviews each year. This is not only expected to improve teaching, but is also expected to help faculty develop a better understanding of the WATS curriculum and continuity in the coursework of our degree programs.

We encourage WATS to continue to develop and refine assessment practices for classes and graduate students and add formal assessment of advising practices. The University AAA Office is placing an increased emphasis on program assessment and can provide recommendations in this area.

Yes, AAA recently made available several new resources for this purpose. In a recent evaluation of program-level assessment processes, WATS degrees were all classified as ‘Initial’ (i.e., in early stages of development) for assessment implementation and using assessment results. WATS degrees were all classified as ‘Emerging’ (i.e., moderate stage of development) for having assessable outcomes, assessment planning, and annual feedback on assessment. Department Head Belmont will meet with AAA Assessment Specialist Peter Crosby to learn more about how WATS can further develop our program-level assessments. [Action item] Possible courses of action will be discussed at the Fall 2021 faculty retreat.

3. How can we increase the number and quality of undergraduate students we recruit into our programs?

Undergraduate and graduate students both noted that the student population was not ethnically diverse and suggested that recruitment in high school and community colleges could be improved to get the word out about these great programs. They suggested that the department could recruit actively in other geographic areas, especially areas with higher
populations of Native Americans, Latinos, and other minority groups. They indicated that recruiting in urban areas, such as Salt Lake City or Ogden, might reach more underrepresented groups, especially if that outreach is done by recruiters who are themselves from diverse backgrounds. In addition, the campuses in Blanding and Vernal are located in areas with greater populations of Native Americans and Latinos, so active recruiting out of these campuses could be productive. Students also recommended that having diverse TAs and faculty can increase persistence of minority students.

Recruiting from a broader diversity of ethnic communities has been a high priority for the Admissions Office at the University level. Those efforts have been relatively successful. The WATS Department has very limited resources to invest in recruiting for the undergraduate degrees and we are limited in the amount of time we can interact with high school students for recruiting purposes. Nevertheless, these suggestions are appreciated and we will take them in consideration as we develop a more coherent recruiting strategy.

Ongoing activities aimed at increasing the number and quality of undergraduate students include our curriculum assessment and alignment with prospective employer needs, creation of a new pathway for students to obtain a Master’s degree in one year, post-BS (i.e., the Master of Ecological Restoration) and Department-level investment in our new Justice, Equity, Diversity, and Inclusion (JEDI) Fellowships. WATS is also taking more initiative in science communication and public outreach with the expectation that higher visibility will translate to more students enrolling in our programs. The Department integrated public relations experience into the requirements for the Senior Staff Administrator position, which was recently filled. The person hired for that position will work with WATS faculty on press releases and science communication articles and social media posts to garner more attention for the Department. [Action item] The Department should also be recruiting more actively from the pool of undeclared majors at USU. Department Head Belmont will meet with Exploratory Advising staff to determine how the Department could more proactively connect with these students.

Maintaining some elements of online learning developed during the pandemic may also help increase the reach of WATS programs to a greater number and diversity of students. However, it could be challenging to remotely deliver hands-on laboratory and field experience course content.

The Provost and Academic Instructional Services have been meeting with faculty to discuss what online learning resources should be maintained post-pandemic. While, as the reviewers note, our degrees require considerable hands-on experiences and are therefore not amenable to fully online, certainly some of the online content developed during the pandemic will be useful for WATS in the future.
4. *Do you find our graduate educational and research programs to be robust across multiple sub-disciplines and career paths, appropriately balanced between research and education, and well targeted for the careers our students want to pursue? What recommendations do you have for additional professional development opportunities for our graduate students?*

The graduate students whom we spoke with during the review were articulate and generally happy with the departmental programs, faculty and staff, course offerings and professional training that they receive. However, the graduate students mentioned a few points about which they are concerned: (1) The lack of department-specific advanced courses in applied skills, including statistics, analytical methods, data visualization, numerical methods, and developing graphics for research publications. They understand there is a need to collaborate with other departments to avoid overlap of courses, but they feel there could be a better balance between having an interdisciplinary course versus WATS-specific courses.

Thank you for the feedback. We will keep this in mind as we adjust faculty teaching assignments and hire new faculty members. Our upcoming faculty hire in climate science is expected to have teaching as their primary role, which should allow the Department to offer several more courses along the lines of those suggested by graduate students.

(2) The difficulty in searching the university-wide course catalog to find relevant courses outside of the department, and concern about paying differential tuition in other departments (e.g., CEE).

[Action item] Department Head Belmont will pass along the concern about the catalog to the registrar’s office. WATS cannot control differential tuition charged by other departments, but these costs are paid by the faculty advisor using external research funds. In some cases, it is possible that faculty grant accounts may not have funds to cover differential tuition, but the Department would be open to covering these costs in those rare circumstances. [Action item] Department Head Belmont will clarify the need for differential tuition in some departments and how those costs should be covered for Watershed Science graduate students in the department-maintained graduate student handbook.

(3) The need for written guidelines and contracts for students employed as teaching or research assistants or graders, as well as the need for a structured salary and enforced base salary rate. Related to this is some concern about the differences in stipends for ‘regular’ graduate students and those who work for the federal government.
Expectations for research assistants are written out in general terms in the graduate student handbook. However, each research project is unique and naturally evolves as the research is conducted. Therefore, specific expectations must be communicated, often iteratively, between the graduate student and their advisor/supervisory committee. If a student is unable to obtain clear guidance about the expectations of their research project from their advisor they may ask the Department Head or Dean to facilitate discussion.

Written guidelines and expectations for teaching or grading positions are helpful to ensure students know what they are committing to when they accept a TAship and they provide continuity among years and between different sections of a course. Faculty members retain the authority to conduct their courses as they see fit as long as they are aligned with the professional responsibilities outlined in USU Policy 407. But faculty are encouraged to provide written guidelines for TAs and graders. This has been discussed in prior faculty meetings and will be increasingly emphasized in the future.

The Department has implemented a minimum graduate student stipend, which increases at a 3% rate annually. In exceptional circumstances, advisors may offer and graduate students may accept a stipend below that minimum, subject to approval by the Department Head. There is no policy that differentiates stipends for ‘regular’ students versus those who work for the federal government. Stipends are agreed upon between the student and advisor and Graduate Program Coordinator Brian Bailey has been asked to ensure students are informed prior to any changes in pay taking effect. As with any other issues, any concerns about TA expectations, stipends, etc. that cannot be handled by the graduate student and their advisor should be brought to the Department Head.

There is also a need for inclusivity training since TAs are often the first point of contact for students.

[Action item] Department Head Belmont has contacted the Office of Equity and initiated a discussion about development of inclusivity training for TAs. Several graduate students have volunteered to be engaged in the effort.

(4) The absence of an ombudsperson or mediator/grievance officer outside of the department. It was also noted that there is a departmental graduate student handbook, written by graduate students; however, students also noted that official policy is often subject to interpretation by individual faculty advisors.

The Department has a peer ombudsperson system set up at the department scale and DH Belmont meets with that graduate student representative monthly. The Department further supports the graduate student request for an ombudsperson at the University level. There are two graduate student handbooks. The primary graduate student handbook was developed by the faculty and staff and outlines all major policies and resources. Department Head Belmont
made significant edits to this handbook last year and will make additional edits this year, in response to graduate student feedback. All policy documents are subject to interpretation. However, if/when differences in interpretation between faculty members and graduate students it is important that both parties can discuss differences clearly and openly and, if necessary involve the Department Head or Dean to resolve disagreements. [Action item] It seems that a reminder about this, and perhaps more discussion about conflict resolution, may be useful to include in the graduate student handbook.

The second document that some refer to as a graduate student handbook was developed by graduate students and apparently is more of a guide to living in Logan and getting the most out of graduate school. The faculty and staff do not have, nor do they need to have, access to that document, but DH Belmont has recommended that graduate students update it and a group of students have volunteered to work on it over the summer of 2021.

(5) Some of the students strongly expressed a concern that the new 1-year MoER Masters degree could devalue the traditional, thesis-based MS degree. Although the faculty widely support the new MoER degree, the graduate students have a lot of questions, so one or more informational meetings/listening sessions might help.

This issue has been addressed earlier and has been discussed on several occasions with graduate students. The MoER and MS degrees have distinct missions, admission requirements, curricular requirements, and prepare students for distinct career paths. QCNR has been offering a professional Master of Natural Resources (MNR) degree for the past decade. The MNR degree has not, in any way, devalued the thesis-based research MS degrees offered within the college. To the contrary, the MNR has increased visibility for the college, attracted new students, and provided a new pathway for students to obtain an advanced degree that suits their desired career path and personal situations. There is no reason to believe that the MoER would have any detrimental impact on research-oriented MS students. Nevertheless, [Action item] DH Belmont will host discussion sessions to ensure that graduate students understand why the MoER has been developed, how it is distinct from the WATS MS degrees, and how the MoER program will create new opportunities for MS students.

Providing professional development for graduate students is challenging. The department may want to consider something similar to what College of Science has for graduate student Individual Development Plans ([https://www.usu.edu/science/pages/students/graduate-individual-development-plan](https://www.usu.edu/science/pages/students/graduate-individual-development-plan))
Thank you for providing the link. WATS faculty discussed at our Spring 2021 retreat (Apr 28) the CoS Individual Development Plans and other similar options for creating professional development for graduate students. [Action item] We will continue the discussion at our fall faculty retreat and implement a coherent set of professional development opportunities within and outside of classes starting in fall 2021 or spring 2022.

5. Do you have any recommendations for strengthening the research, education, and outreach activities of the Restoration Consortium and other Integrated REO centers?

The Restoration Consortium is addressing very important academic and professional needs, but faculty and resources seem to be stretched somewhat thin. The role of the Restoration Consortium for WATS and the University could be defined more clearly. The Consortium needs dedicated and focused leadership to clearly articulate their mission and seek solutions to these challenges. In addition, the activities of the Research Consortium and the Extension Program are not closely linked even though there is substantial overlap in the science and conservation issues they address. The lack of connections between the Extension staff and the Restoration Consortium suggests that an opportunity is not being utilized. Even greater synergy could be achieved if the expertise and objectives of the Extension staff were expanded to encompass aquatic ecology, fisheries, and restoration practices (it’s about more than just restoring streams). This is not to detract from the productive and well-integrated Extension Program in the Department, but rather is intended to encourage the University-wide Extension Program to create additional capacity in a very productive program for the University.

The Restoration Consortium is among the most important initiatives the Department is working on currently as it is intended to encompass, integrate, and promote the diverse restoration-related research, education, and outreach activities occurring in the Department. So it is helpful, if concerning, to hear that the review team found that the role, leadership, and mission of the Restoration Consortium are inadequate. Indeed, the Restoration Consortium is about much more than restoring streams and the personnel, activities, and outcomes must strongly demonstrate that. [Action item] DH Belmont and other Restoration Consortium faculty will work with Restoration Consortium Coordinator Curtis Gray to develop a strategic plan to strengthen the mission, activities, resources, and visibility of the Restoration Consortium.

There are certainly opportunities for both new Extension faculty members (Erin Rivers and Hope Braithwaite) to engage with, and promote research and educational outcomes from, the Restoration Consortium. And the Department is expecting to hire a third Extension faculty member in the near future. The University-wide Extension program has expressed interest in working more closely with faculty in Watershed Sciences, but there are structural barriers
preventing closer collaboration unless faculty have Extension as an explicit part of their role statement. Nevertheless, **[Action item]** the Department will continue to engage with Extension and build stronger connections between Restoration Consortium and Extension.

For the most part, the research support staff and staff in department-affiliated programs (NAMC, Coop Unit, Extension) are satisfied and their units appear to be functioning well. The presence of NAMC and the Coop and Extension staff clearly benefits the faculty, students, and department as a whole by providing expertise, opportunities for education and collaboration, and funding for specific purposes such as equipment. The specific concerns that were expressed by research and other support staff include (1) the lab space for the Coop Unit is sometimes fragmented,

DH Belmont met with Co-op section leader Phaedra Budy to discuss fragmentation of lab space, but Dr. Budy felt that it is a benefit to have members of the Co-op unit thoroughly integrated into the college, rather than grouping them together into a single area. While the Department will need to carve out quality space for the fish biologist we are planning to hire in FY22, no change in Co-op space appears to be needed at this time.

(2) the Extension program noted a need for help in maintaining and updating their website and a desire for additional Extension “bandwith” in the department,

Extension faculty members have an operating budget for needs like maintaining and updating their website. Additionally, the Department Senior Staff Administrator (Daniel Carolan) and the QCNR Web Designer (Brian Kartchner) both have the ability to help with website maintenance. If Extension faculty have needs beyond currently available resources, they are welcome to present those needs to DH Belmont and/or Associate Vice President for Extension Brian Higginbotham.

and (3) research staff noted problems with attrition and repair of shared field equipment (e.g., survey gear) and the need for a department-wide way to fund maintenance and new purchases.

This is an important problem without a simple solution. The Department lacks funding to support a position that would maintain all of the equipment needed, especially considering the incredibly diverse variety of equipment used in the Department. The range of expertise that would be required of one individual to maintain the diversity of potentially shared field (and lab) equipment would make it all the more challenging to maintain equipment centrally even if funds could be generated for a position. Instead, WATS has proceeded with a model in which specific pieces of field or laboratory equipment are typically managed by individual faculty members and a usage/rental fee is assessed any time the equipment is used by that
often faculty have been successful in applying for internal funds (through Office of Research, Agricultural Experiment Station, or Extension) to obtain funds to purchase new pieces of equipment. The advantage of this model is that each piece of equipment is maintained by someone who is most familiar with it and who has a vested interest in keeping it operational. Disadvantages of this model are that it places some administrative burden on the faculty, maintenance and replacement costs are often difficult to estimate for individual pieces of equipment, the ability/willingness of faculty members to maintain/update equipment is highly variable, and the University has been resistant to establishing cost centers for faculty to manage funds for such equipment maintenance and upgrades. Nevertheless, a clear strategy is needed. [Action item] The Department faculty and relevant staff will meet in late summer 2021 or fall 2021 to discuss options and develop an Equipment Management Plan.

6. **How can we better ensure that broader impacts, community engagement, teaching innovations, and exceptional service are adequately represented in our faculty annual reviews, tenure, and promotion decisions?**

We were not able to address this issue during our review.

The Department has formally and explicitly included these items in annual faculty performance reviews and will continue to discuss how we can properly evaluate and recognize these contributions relative to more traditional academic metrics.

7. **Do you feel we are striking the right balance between individual freedoms/responsibilities and community-coordinated efforts in our research, teaching, and outreach activities?**

The Review Committee interviewed undergraduate and graduate students, staff, faculty, and administrators. It is notable that we heard no concerns or issues about fairness, freedoms and responsibilities, or coordination among different components of the department in any of our interviews. Students, staff, and faculty consistently praised Patrick Belmont for his fairness, availability, and guidance as Department Head. While that reflects highly on his leadership, it also demonstrates the cohesive efforts and dedication of all members of WATS. The Review Committee strongly commends the Department for creating an inclusive and supportive community for its students, staff, and faculty.

Thank you, we appreciate the commendation.

8. **Do you have any recommendations for how to handle shortcomings in our facilities, stagnation of operating budgets, challenges associated with our heavy reliance on external
funding (e.g., funding continuity, limited safety net if/when research cannot be accomplished according to plan), and other challenges in obtaining sufficient research support from USU?

The department clearly needs more space. At present, the department is spread across three buildings and, although physical proximity is not absolutely necessary, there is abundant evidence that physical proximity fosters the informal interactions that range from spontaneous research collaborations to feeling part of a supportive and enjoyable community. At a minimum, we suggest that future planning and space allocations prioritize the proximity of advisors and graduate students. We also suggest that the department be allocated a designated conference room for outside and inside seminars, thesis/dissertation defenses, club meetings, and so forth.

We will take these recommendations into consideration, especially in the context of the upcoming BNR partial remodel.

The University administration should work with WATS to improve planning and coordination of remodeling and facilities maintenance activities. The university should provide a more effective scheduling and general approach to renovations, including mitigating the negative effects of renovations on individual faculty and research groups. In particular, BNR 003 has suffered significant degradation from renovation of the Biology side of the BNR building.

There is a need for better response from University Facilities in general maintenance and upkeep of lab and office spaces. For example, there are numerous examples of frustrating shortcomings in lighting, HVAC and climate control systems, sink drains, window-blinds, and air/water taps in labs that should be relatively simple for Facilities to upgrade or fix.

The Department will continue to try to work with the USU Space Committee and Facilities to rectify these situations. Indeed, there are many shortcomings in the quality of space WATS utilizes. Research and teaching activities have been significantly impacted by construction of the Biology side of the BNR building and faculty are very concerned about the long timeline for renovations of the NR side of the BNR building. Several known problems are being addressed during summer 2021. [Action item] The Department will re-assess needs at the fall faculty retreat.

We did not hear anything about outreach to alumni, but this can be a means to attract supplemental funding for scholarships, seminar series, maintaining equipment, and other purposes. A regular departmental newsletter (perhaps annual) mailed to all alumni and including targeted requests for funds in specific areas can be effective in this respect. The department does not have a dedicated development officer, making it challenging to promote additional funding for endowed professors, student scholarships, and experiential learning
opportunities. A dedicated alumni relations staff person, possibly added to the College, could assist the department head in continued efforts of donor relations.

Alumni development and fundraising are undoubtedly areas in which WATS and QCNR could both improve. The Wildland Resources Department recently started an alumni group that is providing mentoring and professional development experiences for students. WATS may well follow their lead. WATS is also currently re-thinking our approach to social media (Twitter, Facebook and recently initiated Instagram account and youtube channel). [Action item] The Department will consider how to specifically engage alumni as part of the evolving social media strategy and will consider sending an annual newsletter. Certainly the Department has plenty of good news to fill a newsletter each year.

QCNR has a dedicated development officer (Emily Blake) and while WATS has worked with the QCNR development officer in the past there are likely opportunities for the Department to play a more active role in improving visibility of the University and developing/improving relations with prospective donors. The University is starting a new capital campaign in November 2021. Given the current University development office structure and limited resources within the Department, [Action item] DH Belmont will work with the QCNR Development Officer to develop a coherent and effective fundraising effort and communicate any needed assistance to the faculty and staff.

Utah State University implements differential tuition in some colleges; the Quinney College may want to consider adding differential tuition to some of their programs in lieu of course fees. While this creates funding flexibility in diverse programs, it also can increase the financial burden and create confusion for students and their families. Several graduate students noted the negative aspect of taking classes in other colleges, especially Engineering, due to increased costs of differential tuition there. If differential tuition is implemented, WATS should provide clear, unambiguous summary information on the likely total costs of undergraduate and graduate education, including all tuition, fees, and surcharges, as well as an accounting of where those additional tuition dollars are spent.

Thank you for the suggestion. WATS will consider the possibility of eliminating course fees and using differential tuition to cover otherwise unfunded costs of courses and programs. Excessive regulation of course fees may be resulting in less efficient use of those funds, so the increased flexibility afforded by differential tuition may result in not only improved teaching and learning experiences, but also reduced costs to students. [Action item] DH Belmont will provide an analysis of the benefits and detriments of shifting to a differential tuition model to cover ancillary teaching and program expenses at the fall faculty retreat.

When the Review Committee met with the Vice President for Research, she commended the WATS Department on their success in bringing in external research funding and hiring outstanding new faculty. She noted the overall quality of the department’s faculty is very
high and the students are significantly engaged in research at both the undergraduate and graduate level. She explained the Office of Research’s (OR) approach to providing start-up funding for new faculty. This funding is a critical part of recruiting and retaining new hires, and we understand there are concerns about which items will be matched by OR. However, new faculty hires require a wide range of resources and alternatives for developing their teaching and research program, including field and laboratory equipment, computers, and support for both graduate and undergraduate students. We strongly recommend that OR provide greater flexibility to department heads and deans in setting up this funding to support the broad range of research activities of new faculty.

9. What would you recommend to improve and better support human diversity and equity at all levels in the WATS community?

Everyone we spoke to acknowledged that the university, college, and department are not highly diverse, but everyone also perceived that as an issue that needs to be targeted for improvement. Hence, step one (recognition of a problem) seems to be in place. Diversity in the student population could be improved by focused outreach to high schools, community colleges, and minority groups. In our experience, hires targeting diverse populations for positions such as undergraduate academic advisor or graduate teaching assistants can create a high-profile example of diversity that may attract more diverse students to a program. Providing incentives for current students who are minorities to participate in off-campus recruiting (or even in something like an online departmental introductory video for prospective students) may also encourage a more diverse student applicant pool. The JEDI graduate fellowships are an innovative approach to increasing enrollment of underrepresented minority students in the graduate programs.

While the gender diversity of the WATS faculty has improved, ethnic diversity remains a major weakness. The University strives to serve the full population of the state of Utah, including Native American and Latino populations. Recruitment of faculty and students should be representative of the larger population of the state and region. Outreach activities may increase ethnic diversity in the students of the WATS Department (see suggestions above), but opportunities to add faculty and recruit minority faculty will be less frequent. The normal open hiring process is unlikely to rapidly recruit minority faculty. We encourage WATS to work with the University to create targeted hires to increase the ethnic diversity of their faculty.

Indeed, the Department’s lack of ethnic diversity is a major weakness and one that will require considerable time, effort, and resources to rectify. The Department has started to make progress on this issue during FY21, in discussing the issue often and openly, in our department seminar series, and in establishing the JEDI fellowships. Based on the
recommendation from the external reviewers the Department is also working with the USU Office of Equity to develop DEI training for TAs, which faculty may also choose to attend.

Other planned efforts include implementing best practices for hiring and supporting diverse faculty members, including the recommendations made in White-Lewis, 2021 (Before the Ad: How Departments Generate Hiring Priorities That Support or Avert Faculty Diversity, Teachers College Record Volume 123, 010309). [Action item] The Department will also develop a plan to support/incentivize ethnically diverse students to help with recruiting and student support activities. And the Department will discuss with the Dean the possibility of creating targeted hires to address this issue.

10. How would you recommend we approach improving the environmental sustainability of our research, teaching, and outreach activities?

Given their location in the semiarid, fire-prone western US, and the disciplinary focus of the department, USU and WATS should be leading in issues related to sustainability. Some of the existing programs, such as the Restoration Consortium, are already closely tied to sustainability. Consideration of additional approaches, such as inviting outside speakers giving a seminar to present online (in a room with a large screen that USU attendees can watch together, after Covid restrictions are eased) and have discussions with USU faculty and students online could reduce both the costs of hosting speakers and the resources used to physically transport speakers from outside of USU.

Thank you for the consideration. We plan to implement this recommendation. The Department is also building a carbon budget for the past three years that accounts for emissions related to research, education, and outreach activities. This information will be used for faculty, staff, and students to consider which activities produce the most carbon pollution and how we might adapt our behaviors to reduce the amount of carbon pollution we generate.

The Review Committee also identified two additional issues:

Recruiting and retention of new faculty

Recruitment and retention of new faculty is a critical requirement for a productive and growing academic department. Starting salaries for Assistant Professor in WATS are relatively low, especially compared to other departments with related subject areas (e.g., Biology). Junior faculty told the Review Committee that starting salaries were a potential faculty retention issue, as well as a challenge for hiring qualified post-docs -- one person relayed an example where a post-doc he was trying to hire would have to take a significant payout to come to USU because
their current post-doc salary was higher than that of the USU faculty member. We recognize that obtaining funds for increasing salaries of existing faculty and increasing starting salaries for new faculty is difficult. We encourage the University and WATS to work together to find ways to make salaries and start-up packages more competitive and retain successful new faculty. Increasing base salaries is important, but University administrators can also provide additional resources and flexibility to meet the needs of productive tenure-track faculty. Entry-level professors have a wide range of needs for funds, infrastructure, personnel, and research and teaching schedules. The University and WATS Department could recognize this complex challenge and collaboratively develop policies and opportunities to increase the success of incoming faculty.

Recruitment and retention of faculty is indeed a critical part of fostering a productive, collegial, and growing academic department. Watershed Sciences has generally done very well in these endeavors, with the exception of our lack of ethnic diversity as discussed above. The Department recruited excellent faculty members in every search over the past five years and has been successful in employing the first or second choice. While hiring decisions ultimately are made by the Department Head, every search has resulted in substantive discussion and a broad consensus on candidates. The tremendous success of faculty who have been hired over the past several years is the best indicator that WATS has been successful in recruiting and ultimately supporting excellent faculty. Certainly, there is always room for improvement, but the empirical evidence suggests that Watershed Sciences is a department that can attract excellent people and empower those people to thrive.

In terms of retention, retaining 100% of faculty members is not a desirable goal. Rather, the goal for the Department is to provide opportunities and support people equitably while they are part of our community. In some cases, faculty members are offered opportunities that are better fits for them personally or professionally, in which case the Department has an obligation to make the transition as smooth as possible for that faculty member and the rest of the department and retain connections to that faculty member insofar as it serves a purpose. In other cases, faculty may not meet expectations of the department during the probationary pre-tenure time period. While these are challenging situations for all involved, WATS has a rigorous faculty performance review process with reviews and extensive feedback on an annual basis from the faculty member’s P&T committee, Department Head, and Dean. Faculty members who have not been successful in obtaining tenure have been given several years of feedback leading to that difficult decision.

Faculty salaries have been an ongoing concern and these concerns have been significantly exacerbated over the past year as the price of housing has increased dramatically. DH Peter Wilcock completed a gender equity salary study and rectified issues during his last two years as Department Head. However, gender inequities manifest in many other ways (space, resources, communications) and DH Belmont and the entire WATS faculty are committed to ensuring the
Department continually evolve in ways such that everyone has equitable opportunities to succeed. DH Belmont requested in fall 2020 for HR to conduct a broader salary equity study using data from faculty all across campus. The study indicated that WATS Assistant Professors were paid, on average, 3.5% less than colleagues in other departments with reasonably similar levels of productivity. Associate Professors were paid, on average, 1% less than colleagues in other departments with similar levels of productivity. DH Belmont is committed to transparency about how decisions regarding raises are made each year and will continue to work with the QCNR Dean and USU Administration to increase salaries.

The junior faculty also expressed concerns about the Promotion and Tenure (P&T) process. While the department is close-knit and supportive and there is generally good communication about P&T expectations, there is some concern about recent departures of two untenured faculty and questions about changing requirements. Faculty appreciate regular meetings with the Department Head, but also expressed a desire for increased mentoring. Recent USU policy changes have decreased the mentoring aspects of P&T committees and made their role primarily evaluative. Some committees do continue to provide mentoring, and junior faculty said they were able to find additional advising outside of their committee; nevertheless, a more structured mentoring program could be helpful.

USU Faculty Senate recently conducted an extensive survey of faculty about the P&T process at USU and the sentiment was generally very positive, especially for faculty in QCNR. And while the role of the P&T committee is primarily evaluative, very thoughtful, specific, and detailed feedback is provided to pre-tenure faculty members each year in the P&T annual review letter. Further, the generally very collegial atmosphere in WATS lends itself to ample informal mentoring opportunities. However, faculty who arrived at USU during the covid-19 pandemic have had a much more difficult time connecting with other faculty members during this first year. This problem is expected to be diminished as the University returns to more normal in-person operations starting in summer 2021. [Action item] Nevertheless, DH Belmont will reach out to junior faculty to determine what specific mentoring needs they have and do what is feasible to ensure those needs are met.

The P&T process also can be confusing for Extension faculty as P&T expectations for Extension differ from those of the rest of the faculty. It appears that the WATS Department has an inclusive process for forming tenure advisory committees and current committees can include County Extension Agents and Extension Specialists as appropriate. The University and WATS should be certain that all members of P&T committees are familiar with the requirements for Extension faculty and that decisions for promotion and tenure are equitable and consistent with those of other university faculty.
Indeed, contributions from Extension faculty that should be considered for tenure and promotion decisions differ from contributions made by faculty with primarily research or teaching roles. Given that Watershed Sciences is strongly skewed towards faculty with research-dominant roles, it is important that all members of P&T committees are familiar with the activities and outcomes that are valuable for Extension faculty. Tenure requirements for Extension faculty are outlined in USU Faculty Policy 405.4 and Associate Vice President for Extension Brian Higginbotham has developed additional materials for supervisors and P&T committees for Extension faculty. **[Action item]** DH Belmont will ensure that all members of Extension P&T committees are familiar with these materials.

**Effective coordination and implementation of programs and policies**

Administrative guidance for policies and implementation of new programs has changed rapidly, especially in the Business Center, Office of Research, and Human Resources. Such changes inevitably create challenges for communication and coordination throughout the university, but high rates of turnover in the School of Graduate Studies and Quinney College Business Center have exacerbated these issues. WATS staff have encountered confusion in the University about the roles and responsibilities of staff in these offices, which have been compounded by changes in programs and policies. Responses of the Human Resources Office to staff inquiries have been perceived as less than welcoming. While WATS and the Department Head have been supportive during these changes, the university support systems and services could be strengthened. The Review Committee encourages the administrators of the College of Natural Resources and WATS to work with University administrators to improve coordination, implementation, and guidance on programs and policies and more clearly articulate the roles and responsibilities of specific university programs.

High turnover in many of the support services of the university has created considerable confusion, delays, and policy changes. Deficiencies in these support services can have long-lasting impacts on the productivity and morale of faculty, staff, and students. Issues with the QCNR Business Service Center appear to have largely been rectified with the hiring of a second business manager and other changes to how the office operates. Nevertheless, **[Action item]** DH Belmont will work with the QCNR Dean and other department heads to ensure that the root causes of problems in support services are rectified.