Table of Contents

Introductory Section and Background Information ................................................................. 2
The Professional Project ........................................................................................................... 12
Teaching & Learning: Assessment ......................................................................................... 15
Students ............................................................................................................................... 20
Faculty ............................................................................................................................... 27
Research, Scholarship, & Service ......................................................................................... 28
Resources & Planning ........................................................................................................ 31
Facilities .............................................................................................................................. 34
Comparable Programs ........................................................................................................ 35
Conclusions ........................................................................................................................ 37
Appendix 1: Survey of Water Resources Alumni, September 2019 .................................... 38
Appendix 2: Professional Project guidelines, Water Resources Program ............................ 46
Appendix 3: Affiliated Faculty, Water Resources Program .................................................. 57
Appendix 4: Master of Water Resources Outcomes Assessment Rubric ............................... 64


Introductory Section and Background Information

Introduction

Since its 1991 founding, the University of New Mexico Water Resources Program has been animated by a central goal:

To fill the need for well-educated water resource professionals able to understand and balance competing economic, social, technological, and cultural requirements.¹

This captures a critical distinction that sets us apart from many university water programs: professional education is our primary mission, with a particular focus on helping to solve important societal problems by sending our students into the world with the skills needed to do this. Research and scholarship do happen within the program, but they are secondary byproducts as we pursue our primary goal.

As faculty members active in the water resources management community beyond the boundaries of Redondo Drive, we see the results of this focus daily. Recent graduates of the Water Resources Program:

- Manage Albuquerque’s water rights portfolio to ensure a long-term reliable water supply for New Mexico’s largest city
- Oversee the water quality lab that ensures Albuquerque’s wastewater does not pollute the Rio Grande
- Administer environmental programs for the Pueblo of Santa Ana, one of the oldest communities on the Rio Grande
- Oversaw development of Santa Fe’s water conservation program, nationally recognized for policy innovations that have reduced the New Mexico capital city’s water use
- Analyze the risks of groundwater contamination to Albuquerque’s water supply
- Help rural New Mexico communities navigate the federal bureaucracy as they manage against the risk of wildfire, flooding, and other natural disasters
- Help reverse the harm caused by Albuquerque’s long history of over-pumping its groundwater

These examples illustrate the program’s central premise - that water management is no one thing. Only through the integrated application of a wide range of skills and expertise can we manage the formidable challenge of sustainably providing water in arid New Mexico and beyond.

By “integrated application,” we mean that our students need to understand the complex technical issues - hydrology, climate science, water chemistry, and the like - as well as institutional issues - water rights, water administration institutions and cultures, the rich complexity of environmental laws, the deep values embedded in our cultures.
By bringing together the water management version of what C.P. Snow called “the two cultures,” our students to the work needed to ensure a resilient and sustainable future for water management in New Mexico and the arid southwest.

History

The University of New Mexico Water Resources Program (WRP) grew out of a realization in the 1980s that water management in New Mexico and the arid southwestern United States faced growing challenges, and that the university was uniquely positioned to help. From the program’s founding document:

Social and political changes of the last quarter century have redefined the role of water administrators in the western states, expanding their responsibilities into areas where new expertise is required. Rapid urban growth in these states has occurred at the expense of river and ground water pollution and sharply increased competition for the region’s scarce water supplies. At the same time, declining federal subsidy of water diversion projects has decreased the likelihood of new sources of supply. The professional skills of the civil engineer, which were indispensable in solving the water management problems of previous periods, are not sufficient to solving the multifaceted water management problems of today.1

The purpose of this newly created academic program was to help develop future water management leaders skilled in the balance of competing economic, social, technological, ecological, and cultural requirements of the field. The program’s founding principle was that this diversity of intellectual activity, so essential to successful water resources management, was best served by practitioners not bound to the specific academic silos of individual university departments. The first student graduated from the program in 1991, and since that time there have been more than 200 graduates.2

Vision and Mission

The University of New Mexico’s location in the southwestern United States means that there is a natural emphasis on dry-region water issues; however, the Master of Water Resources (MWR) degree is designed to provide its students a firm grounding in water resources that is applicable throughout the world. The MWR degree is generally directed toward students wishing to further develop their qualifications and expertise in the practice of water resources management. Therefore, although it does include considerable exposure to research topics and methods in this area, the principal orientation of the MWR degree is toward practice rather than research. Entering students are assumed to have a basic proficiency in at least one water-related discipline (defined rather broadly) such as engineering, sociology, management, public administration, environmental studies, economics, law, chemistry, planning, political science, geology, geography, and biology, or professional experience in a water-related field. The program seeks to expand

---

1 Brown, F. Lee, “A Proposal to Establish a Graduate Program in Water Resources Administration” (Interdisciplinary Water Curriculum Committee of the University of New Mexico, January 31, 1989).
and deepen students’ knowledge of their primary disciplines, provide them with an integrated perspective on water in nature and society, improve their capacity to think carefully and comprehensively, and develop their technical and communication skills.

The interdisciplinary nature and practical orientation of the MWR program reflect the growing complexity of water issues. Over the past several decades, population shifts, industrial developments, changes in water law, and advances in technology have intensified competition for water resources and placed new burdens of decision on the people who manage them. Increasing problems of water pollution, for example, require not only an understanding of water chemistry and transport systems, but also an appreciation for the short- and long-term implications of water allocation and land-use practices. Practitioners must understand the valuation of negative externalities. Communication - an ability to work effectively with specialists in various fields, policymakers, and concerned citizens – is central to the task. In short, effective water resource professionals need many competencies. The WRP strives to help provide these competencies.

The WRP Mission Statement (from the 2010 Academic Program Review) identifies the program goal as: “to become a regionally prominent center of expertise on water-related issues and training for environmental professionals, promoting fair, healthy and sustainable solutions to the challenges of water use in New Mexico and the southwest.”

**Interdisciplinarity**

The program is, by construct, “interdisciplinary,” interpreted broadly. There are a number of different definitions and labels for this concept:

- “Multidisciplinary” - researchers from more than one discipline bringing their separate disciplinary perspectives to a problem, each retaining their own disciplinary focus,
- “Interdisciplinary” - the use of an innovative blend of more than one disciplinary focus, creating a synthetic approach to a problem,
- “Transdisciplinary” - the incorporation of non-academics along with academics in a research effort, bringing a more practical problem-based focused to the integration across disciplines.

While the University of New Mexico Water Resources program embraces the label of “interdisciplinarity,” and does work that most closely matches “transdisciplinary” as defined above, it is agnostic about the details of the labeling, comfortably doing work that matches many different flavors of work across disciplines, in and out of the academy.

The program initially offered a Masters in Water Resources Administration (MWRA) degree.

In 1998, the highly-structured MWRA degree became the current Master of Water Resources (MWR) degree. The more flexible two-concentration Water Resources degree affords students greater options in their coursework program (Policy/Management or Hydroscience) and expands the number of available

---

participating faculty. Three semester credits were given for the Professional Project, bringing the total number of semester credits to 39 for degree completion. The Water Resources Program (WRP), the graduate unit responsible for administering the degree, was transferred to University College in 1998. In part because University College is primarily focused on lower division education advisement and also because other interdisciplinary graduate programs have been instituted at UNM, UNM and the WRP established a dialog regarding possible administrative relocation to another academic unit. In Summer 2013, the WRP was transferred to Graduate Studies at UNM, reporting to the Dean of Graduate Studies (Dean Julie Coonrod). Also in Summer 2013, Professor Robert Berrens (Economics) replaced the retiring Director, Professor Bruce Thomson (Civil Engineering), who had successfully led the program for seven years. John Fleck (Water Policy and Governance, Economics) took over as Director in Summer 2016.

Organizational Structure

The Water Resources Program is administered by Director and Professor of Practice John Fleck; Associate Director and Research Assistant Professor Rebecca Bixby; and Program Administrator Annamarie Cordova. Together they are responsible for the day-to-day operations of the program, including advising students, supervising the academic program, and preparing and administering program budgets. A Water Resources Program Committee is responsible for setting policy and establishing the rules and regulations governing the WRP and its Master of Water Resources degree.

Accreditation

The Water Resources Program does not participate in any specialized accreditation organizations or processes.

Previous Academic Program Review

The last Water Resources Program Academic Program Review was done in 2010.

An external Academic Program Review Team visited the WRP from October 10-13, 2010 to conduct an on-site review of the program. The team consisted of:

- Ron Kaiser, Texas A & M University;
- Sudhakar Prasad, University of New Mexico;
- Mary Santelmann (Panel Chair), Oregon State University;
- Soroosh Sorooshian, University of California, Irvine

Key findings:

Creation of a Ph.D. program:

In response to a guiding question arising from the program’s self-study, the Program Review Committee recommended against the expansion of the program’s mission to offer a doctoral degree. The Water Resources Program Committee recommended against it, and the WRP concurred, reasoning that both a
lack of resources within the program, as well as a lack of demand in the workforce for the degree, argued against it.

**Creation of a MS degree in Water Resources:**

The Review Team recommended that the UNM WRP “consider development of a research-oriented MS degree in Water Resources with a thesis requirement to strengthen the research component of the WRP.”

The WRP administration concluded that such a degree was not warranted, arguing that the program and the students in it are strongly oriented toward applied work rather than academic research. Over half of the WRP students are returning to graduate school after at least five years since receiving their baccalaureate degree. They are principally interested in the program as a path toward a profession rather than its research component. It is not clear that many students would be interested in pursuing a MS thesis-focused degree.

**Area of focus:**

The Review Team recommended against expanding the program’s mission to encourage new concentrations in environmental science and sustainability. The WRP concurred in this finding.

**Curriculum:**

The Review Team recommended establishing a curriculum committee for periodic review and updating of curriculum. The WRP did not pursue this recommendation, arguing that there was not sufficient need and that the WR Program Committee could and should be charged with providing an annual review. This has not been done in recent years.

**Certificate Program:**

The Review Team recommended the WRP “explore and comment on other opportunities such as offering Certificate Programs, online and summer courses.”

The WRP has had ongoing discussions about the possibility of developing a one-year certificate program, but with budget cuts, the WRP has lacked the staff resources and capacity to pursue this expansion beyond the current core mission. In response to the Review Team’s recommendation, the WRP also commented at the time that it lacked the resources to expand course offerings.

**Administrative home:**

The Review Team concluded that University College, the institutional home for the WRP at the time of the 2010 review, was not the appropriate home for the program, suggesting it “should reside above the college level and should have a champion at the level of Dean.” In response, the Associate Provost for Academic Affairs asked WRP to prepare a proposal to relocate the program to Graduate Studies.
Such a move was completed in 2013.

**Expand externally funded research:**

The Review Team asked if WRP’s externally funded research could be expanded. The WRP responded that incentives associated with the university’s research program do not lend themselves to this approach, because “research at UNM is college- and department-centric.” The most prominent disincentive is that faculty members’ home departments and colleges receive overhead return from funded research; Deans and Department Chairs are reluctant to relinquish this revenue stream. A second factor is that one measure of faculty and department performance is graduate degree production. A professor who supports and graduates a WR student does not receive the same credit by his Department Chair and Dean as he would if the student graduated from his home department.
Teaching and Learning: Curriculum

Introduction
The Water Resources Program’s curriculum is based on a three-course core sequence intended to expose students first to a broad water resources policy framework, second to the task of integrating hydrologic and economic modeling tools into that framework, and third to incorporate basic techniques of the water measurement used in contemporary water resource management. Throughout the core series, the program emphasizes the importance of communication skills. One of the program’s core principles is the idea that the technical work is not completed until it has been successfully communicated to the people who need to use it.

Students are not required, but are strongly encouraged, to take the core courses in sequence. This is, in part, because the courses build on one another, and, in part, because of the important peer learning benefit that comes from a cohort of students passing through the program together.

In addition, students take 15 credits in their core concentration (either hydroscience or policy and management), another 9 credits in their non-core area, and 3 credits to enhance their skills in one of a number of utilities areas. Information related to coursework and professional project details is found at https://wrp.unm.edu/current-students/wrp-program-guidelines.pdf.

The Core Curriculum

WR571: Contemporary Issues in Water Management
This 4-credit course focuses on identifying, analyzing, and reporting on water issues, both individually and in groups. Students in this course will learn how to:

- Identify current water issues or problems in a particular region, river basin, or ground water system;
- Research the technical, cultural, economic, and management aspects shaping the water issue, and be able to identify possible policy options available;
- Understand the underlying institutional arrangements (both formal and informal) that both liberate and constrain choices in water management, and the associated incentives (rewards or punishments);
- Communicate issues and recommendations to different audiences in written and oral presentations;
- Prepare a written group research report addressing a water issue or problem.

The course is co-taught by an economist and a specialist in water policy and communication.

WR572: Models

Co-taught by a hydrologist, an economist, and a policy and communications specialist, this 4-credit course teaches students the fundamentals of dynamic simulation modeling as applied to water system management and decision-making. Students in this course will learn how to:
- Develop an understanding of how a quantitative representation of physical, environmental and socio-economic phenomena can be derived from a conceptual understanding of these phenomena;
- Understand basic concepts in modeling water resources systems and related social behavior;
- Learn how analytic and numerical models of water resources phenomenon are developed, calibrated, and used;
- Develop an appreciation of the utility and limitations of water resources models.
- Obtain practice constructing cross-disciplinary hybrid models;
- Understand the nature of political and policy processes in water resource and environmental management;
- Understand the roles of members of the technical community in providing expert input to political and policy processes;
- Gain experience with different types of technical communication, focused on sharing results from the modeling work done in class;
- Learn tools for the effective visual display of quantitative information, based on the results from the modeling work done in class;

Over the course of the semester, students build a dynamic simulation model of a selected river basin using the commercial software platform Goldsim, which is then used to explore policy questions regarding the system’s management. In recent years, watersheds modelled have included the Rio Grande through central New Mexico, the New Mexico portion of the Gila River, and the Lower Colorado River from Hoover Dam through the Republic of Mexico.

Students are judged on their understanding of hydrology and economics through homework and testing, and on their communication skills through written work and presentations.

**WR573: Field Problems**

WR 573 is a 4-credit intensive field experience based on watershed assessment and monitoring in the Valles Caldera National Preserve (VCNP) in the Jemez Mountains. The watershed assessment includes aspects of biological monitoring, hydrology, geomorphology, and chemistry. The course is taught by an aquatic ecologist and a hydrologist. Students in this course will learn how to:

- Design a monitoring program based on watershed disturbance and need.
- Learn specialized measurement techniques across a range of disciplines found in both academic and professional water management settings.
- Analyze data from field samples
- Critically use data to assess the state of the watershed.
- Synthesize data and analyses as both written documents via the class web site and public talk as a final group presentation.

Students spend considerable time on campus learning and practicing data collection methodology before spending three days in the field. The class is divided into sub-groups that are focused on either biology, hydrology, or chemistry. Within each sub-group, each student is given an “expert task” in which to specialize, and is expected to master the task and teach that mastery to the other students. Students are
graded on their mastery of their expert task, field techniques, data analysis and interpretation, and the integration of their work with that of others.

Students also are graded on leadership, collaboration, critical thinking, and reflective learning.

**Courses across the UNM curriculum**

To complete their coursework, as students are completing the core classes, and in the time spent after the core work is completed, they also spread out across campus to take graduate-level course work in departments across the university.

The students select an area of interest and specialization and, working with the Water Resources Program leadership, design a “choose your own adventure” curriculum that both meets the requirements of their area of emphasis (hydroscience or policy and management) while also exposing them across the disciplinary boundaries.

A number of courses are common to most of the students graduating from the WR program. The courses include:

**Water Law – School of Law**

The legal rules governing the allocation, use, and management of water resources. The focus of this course is primarily on the western U.S., although the course does devote a week to the "riparian rights" doctrine that applies in the eastern states. Much of the course deals with the prior appropriation doctrine--the basis for water law in New Mexico and other western states--including both common-law principles and statutory modifications. Another main focus is groundwater allocation and management, which is especially important in New Mexico and other states that rely heavily on groundwater. The course also briefly addresses the law of interstate waters; water rights for federal and tribal lands in the West; water supply institutions, including New Mexico's acequias; and the application of the Endangered Species Act to water resources.

**Hydrogeology - Earth and Planetary Science, Civil Engineering**

Hydrological and geological factors controlling groundwater flow, including flow to wells. The hydrologic cycle; interactions between surface and subsurface hydrologic systems; regional flow systems. Groundwater geochemistry and contaminant transport.

**Climate Dynamics - Earth and Planetary Science**

Quantitative treatment of the hydrologic cycle–precipitation, evapotranspiration, runoff and subsurface flow; global change and hydrology; catchment and hillslope hydrology; hydrologic system–ecosystem interactions; hydrology and water resources management.
Physical Hydrology - *Earth and Planetary Science*

Quantitative treatment of the hydrologic cycle—precipitation, evapotranspiration, runoff and subsurface flow; global change and hydrology; catchment and hillslope hydrology; hydrologic system–ecosystem interactions; hydrology and water resources management.

**Limnology - Biology**

Biological, physical, and chemical interactions in fresh water ecosystems. Emphasis on how aquatic ecosystems are linked to their watersheds. Application of aquatic concepts to issues of water quality, water budgets, invasive species, food web dynamics, and current water-related topics.

**Water Governance – Geography and Environmental Science**

Study of political considerations as inherent in water management. This focus on politics before technical water resource manipulation is what is called water governance, compared to traditional "water resource management".

**The Natural History of Watersheds – Community and Regional Planning**

Field course centered around environmental planning and restoration projects. Students are involved in the implementation of several community-based participatory education events in which restoration techniques are demonstrated.

**Bosque Ecosystem Monitoring – Biology**

Students train as interns with the Bosque Ecosystem Monitoring Program to mentor K-12 students and teachers in monthly data collection at field sites along the Rio Grande floodplain. Study includes ecosystem dynamics and environmental education components.

**Public Budgeting – Public Administration**

Basic management of public funds, preparation and processing of budgets, revenue projection and expenditure controls. Issues of public policy and establishment of priorities through budgeting.

**GIS in Water Engineering – Civil Engineering**

Principles and operation of geographic information systems using Arc GIS, work with surface and subsurface digital representations of the environment considering hydrologic and transportation processes.

**Advanced Data Analysis - Statistics**
Statistical tools for scientific research, including parametric and non-parametric methods for analysis of variance and group comparisons, simple and multiple linear regression, and basic concepts for experimental design and analysis.

Concerns about course options and availability at UNM

As the University of New Mexico contracts under declining enrollment and budgetary constraints, some of the key courses taken by our students are being offered less regularly. This was a concern highlighted in our survey of recent graduates (Appendix 1). Because we are dependent on other departments’ offerings, this is a challenge beyond the Water Resources Program’s control.

The Professional Project

The Professional Project is the culmination of the student’s graduate experience and demonstrates the student’s ability to perform professional quality independent work on a topic related to water resources management (Appendix 2). The topic of the project is selected by the student in an area of his/her choosing, with guidance of a faculty advisor and graduate committee. The advisor is generally faculty member affiliated with the Water Resources Program (Appendix 3). The project can be related to a student’s employment; however, additional independent work is required for the project to serve as a UNM Professional Project. The project has many of the characteristics of a more traditional master’s thesis, but is only counted as a three-credit course and is intended to be completed in a single semester. As such, the workload and final product are more modest than a traditional thesis. The end product of the Professional Project is a formal, professional paper that is defended before a three-member faculty graduate committee in a public forum.

By design, the professional project has a number of benefits to MWR students, with the majority going on to be water professionals after graduation.

- The Professional Project allows more flexibility and is tailored toward professional water management objectives rather than academic ones, although the professional project often results in a publication associated with the outcomes.
- Often, the student’s committee includes someone from outside the university working in the water management world which allows for greater networking and often results in employment after graduation.
- This format also encourages the student to combine both aspects of hydroscience and policy/management, which, both in the short-term and long-term, benefits graduates of the program going on to the complex world of water resources.

However, there are a number of constraints associated with the Professional Project model.
Students are admitted into the WRP without the requirement of a faculty advisor commitment. This means that the student has to develop an agreement with a faculty member through classes and networking who is willing to be the advisor on a topic that aligned with the faculty interest. This places a significant responsibility on students which some students have a difficult time shouldering. With no tenure-track faculty of its own and little faculty capacity within the Water Resources Program, this approach also places a burden on faculty in other departments to volunteer their time to students who are not within their own department. This is especially challenging for younger, non-tenured faculty, who make up a key part of the university’s water resources community.

Professional Project topics must be aligned with current faculty interests and research. For example, UNM lacks faculty who work on stormwater so students interested in that topic are redirected to work in other areas related to water resources. This issue has been a bottleneck and limitation for a minority of students who have had to adjust their expectations of their Professional Project topic to fit the reality of faculty expertise. This is not unique to the WRP or any university setting, although the lack of faculty advisor confirmation at the time of admissions may exacerbate the issue. That said, the initial flexibility in classes and research interests (i.e., interdisciplinary dabbling) for students in their first semesters of the program likely far outweighs the need to set advisor in stone from the program onset.

There is no funding through the WRP to support Professional Project research. Funds are generated through associated faculty labs as well as student-initiated scholarships and grants.

There can be a mismatch between the management-themed Professional Project research that can make it difficult to publish and meet faculty’s needs to publish research for their own promotion.

Some examples of Professional Projects and the memberships of their advisory committees demonstrates the scope of the work done and its integration with outside advisors:

- Bean, Anjali. 2018. Opportunities to enhance environmental flows on the Rio Chama. Committee: Mark Stone (chair, Civil, Construction, and Environmental Engineering), Reed Benson (School of Law), and Todd Caplan (GeoSystems Analysis Consulting)
- Birt, Trevor. 2019. Irrigation Forbearance in the Middle Rio Grande: Using Remote Sensing to Improve Investments. Committee: Bruce Milne (chair, Biology), Adrian Oglesby (Utton Center, School of Law), John Fleck (Water Resources Program)
- Fox, April K. 2018. Diatom community response to an acidic, ambient temperature geothermal gradient. Committee: Rebecca Bixby (chair, Biology, UNM), Laura Crossey (Earth and Planetary Sciences, UNM, Bryan Dail, (NM Environment Department)
- Gerlitz, Sara. 2016. Where’s the water? Using geospatial tools to facilitate water wheeling for the Central Arizona Project. Committee: Robert Berrens (chair, Economics), Julie Coonrod (Dean of Graduate Studies), John Fleck (Water Resources Program)
- Herman, Jason. 2017. The cost of direct and indirect potable water reuse in a medium- sized inland community. (dual degree in Water Resources and Community and Regional Planning). Committee: Caroline Scruggs (chair, Community and Regional Planning), William Fleming (Community and Regional Planning), Mark Russell (Civil Engineering), Bruce Thomson (Civil, Construction, and Environmental Engineering)
• Tintor, Will. 2017. Remotely measured evapotranspiration of a restoration landscape at Bosque del Apache NWR. Committee: Marcy Litvak (chair, Biology), Chris Lippitt (Geography and Environmental Studies), Paul Tashjian (U.S. Fish and Wildlife Service)

• Villa, Noelani Eba-jah-mi. 2018. Bank erosion control: Rio Pueblo de Taos. Committee: Mark Stone (chair, Civil, Construction, and Environmental Engineering), Rebecca Bixby (Biology), and Phoebe Suina (High Water Mark, LLC)
Teaching & Learning: Assessment

Assessment Plans

The Water Resources Program Assessment Plan was approved in 2009. Because of concerns about its reliability and applicability, it is currently under review and revision.

Broad Program Learning Goals for this Degree/Certificate Program

A. Students will understand the physical, ecological, economic, and socio/cultural aspects of water in the human environment.
B. Students will develop skills related to measurement, modeling, analysis, and assessment of water resources.
C. Students will develop skills in field, laboratory, electronic, and library research methods for generating and acquiring data on issues of water resources management.
D. Students will develop written and oral communication skills.
E. Students will learn to work in groups.

Student Learning Outcomes Associated with Goals

Goal “A” - understanding the physical, ecological, economic, and socio/cultural aspects of water in the human environment

1. Students will be able to explain the hydrologic cycle.
2. Students will be able to explain the relationship between water characteristics and occurrence and the aquatic environment.
3. Students will be able to explain the economic consequences of water and its scarcity or abundance.
4. Students will be able to explain the administration and regulation of water resources in New Mexico and the southwestern United States.
5. Students will be able to describe the social and cultural aspects of water in New Mexico and the southwestern United States.

Goal “B” - developing skills related to measurement, modeling, analysis, and assessment of water resources.

1. Students will demonstrate the ability to formulate quantitative relationships to explain hydrology and its relation to water resources.
2. Students will demonstrate the ability to relate water resources to economic and social/cultural values.

Goal “C” - developing skills in field, laboratory, electronic, and library research methods for generating and acquiring data on issues of water resources management.

1. Students will demonstrate familiarity with field, laboratory, electronic and library methods for collecting data relevant to water resources problems.
2. Students will demonstrate their ability to analyze data and information related to water resources.
Goal “D” - developing written and oral communication skills

1. Students will demonstrate effective written communication skills.
2. Students will demonstrate effective oral communication skills.

Assessment Reports

Table 1 provides the statistical summary of the outcome assessment measures collected by the WRP administration from calendar year 2016 through calendar year 2018, for a sample of 24 WRP students.

In terms of collection procedures, the assessment is made by the Professional Project (PP) Advisor, which varies by student, along with input from the other PP Committee Members. The assessment is completed as part of the evaluation process conducted at the end of the PP public defense and examination (Appendix 4).

Insofar as the assessment process is reasonably measuring student performance, the results suggest improvement across the range of outcomes measured.

DATA

Each assessment includes a scoring on four specific measures and an overall assessment measure (Table 1). All five of these measures are scored on the following scale:

0= unacceptable
1=marginal
2=acceptable
3=exceptional

Some PP Advisors completing the scoring further differentiated with half (e.g., 2.5) or quarter measures (e.g., 1.75), and these were entered into the data as recorded and used in calculations of descriptive statistics (means and standard deviations). For all observations in the sample, assessments were made for the complete set of 5 measures. One observation was not included in the analysis because of a notation in the file suggesting the student, rather than committee members, had filled it out.
Table 1: Summary of Outcome Assessment Metrics, 2016-2018 (N=23)

<table>
<thead>
<tr>
<th>Measure 1: Knowledge of the hydrologic cycle, occurrence and characteristics of water, and its administration</th>
<th>Measure 2: Ability to formulate quantitative relationships of water and its socioeconomic value</th>
<th>Measure 3: Knowledge of field, laboratory, computational, and library methods relevant to water management</th>
<th>Measure 4: Effective written and oral communication skills</th>
<th>Overall Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>2.58</td>
<td>2.42</td>
<td>2.71</td>
<td>2.66</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.43</td>
<td>0.43</td>
<td>0.44</td>
<td>0.41</td>
</tr>
<tr>
<td>N</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
</tr>
</tbody>
</table>

With a decade of analytics since the current assessment framework was developed in 2009, we have the ability to assess outcomes over time. Table 2 and Figure 1 show the same summary statistics as reported in 2015, the previous report used for comparative purposes.

Table 2: Summary of Outcome Assessment Metrics, 2010-2015 (N=43)

<table>
<thead>
<tr>
<th>Measure 1: Knowledge of the hydrologic cycle, occurrence and characteristics of water, and its administration</th>
<th>Measure 2: Ability to formulate quantitative relationships of water and its socioeconomic value</th>
<th>Measure 3: Knowledge of field, laboratory, computational, and library methods relevant to water management</th>
<th>Measure 4: Effective written and oral communication skills</th>
<th>Overall Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>2.33</td>
<td>2.27</td>
<td>2.45</td>
<td>2.43</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.58</td>
<td>0.72</td>
<td>0.67</td>
<td>0.64</td>
</tr>
<tr>
<td>N</td>
<td>43</td>
<td>43</td>
<td>44</td>
<td>43</td>
</tr>
</tbody>
</table>
Discussion and Conclusions

Given the small sample size, the subjective nature of the evaluation process, and the fact that the evaluations are being done by a range of faculty members with different backgrounds and goals in terms of their own work with individual students, it is important to be careful about drawing conclusions based on the apparent trend of improving student scores. Most of what appear to be improvements from the first and second periods analyzed do not pass statistical significance tests. However, there are important observations in the general direction of the data.

The first is that, continuing a pattern seen in the earlier data, faculty members assigned the task of judging student performance suggest that WRP students are demonstrating a relatively strong performance at the Professional Project defense phase of their time in the program, which comes at or near the end of their 39-credit curriculum.

Shortcomings

As the program has changed since the current outcomes assessment rubric was developed a decade ago, it is unclear whether this is appropriately assessing our current goals and objectives. In addition, the three-person committee overseeing students’ professional project is not always composed of individuals with the necessary breadth of knowledge of the students’ work to properly assess all of the metrics included in the rubric.

See Appendix 4 for the full Outcomes Assessment rubric.

Primary Constituents
The Water Resources Program’s primary constituents are its students. Its primary stakeholders are the members of the New Mexico and Southwest water community - the people who will hire our graduates, and whose problems we hope are students can help solve.

The relationship between these two groups begins in the first semester of the students’ program, with guest lecturers from representatives of water agencies, environmental groups, and other stakeholder interests. The bond extends through the ongoing workforce interactions among the students and the water management and natural resource agencies. Of the 27 students enrolled as Water Resources Program students in Spring 2019, 13 were already working for government agencies and other institutions in water resources or other natural resource management-related work.
Students

Recruitment

We have no active recruitment activities. With little funding for student support and a small program budget, we lack capacity to do any formal recruitment, relying on networking and program reputation to attract applicants.

Admissions

The admission requirements for the MWR degree program are:

- A Bachelor’s degree from an accredited college or university
- A GPA of at least 3.0 out of 4.0 for the last two years of undergraduate work. A student with a GPA under 3.0 may be admitted if he/she has other exceptional qualifications indicating their likelihood of success in the program.
- Three references from individuals qualified to assess the applicant’s academic and/or professional qualifications. At least one of these letters must be from a former professor.
- A letter of intent describing the student’s background, interests in water resources, experience in the field, objectives, desired concentration, and future plans.
- A current resume or curriculum vitae (CV).
- Successful completion of the MWR prerequisites in the student’s intended area of study (see below).
- Note: the Graduate Record Examination (GRE) is not required for admission.

Generally, it is recommended that students should not apply until all prerequisites have been completed (or are in the process of being completed). However, students with a strong academic preparation may, upon occasion, be admitted with one unfulfilled prerequisite.

Hydroscience prerequisites

- Calculus I, Calculus II, and Statistics
- Introductory Microeconomics or Intermediate Microeconomics
- Three semesters of introductory (or higher) science courses from at least two different disciplines

Policy/Management prerequisites

- Calculus I and Statistics
- Introductory Microeconomics or Intermediate Microeconomics
- Two semesters of introductory (or higher) science courses
- One introductory or higher course in: sociology, political science, or psychology

Data: Enrollment, Retention, and Graduation

Within the Water Resources Program, we measure:

- First year student attendance (the number of students who enroll in the program and begin classes)
- Total program enrollment (the total number of Water Resources Program students enrolled in the University of New Mexico each fall semester)
- Median time to graduation of those graduating each year
- The proportion of each incoming class graduated or still actively enrolled in the program

**Student population and program attendance**

![Graph showing WR student enrollment, 2011-2019](image)

Figure 2: WR student enrollment, 2011-2019

The program saw a decline in enrollment in the early teens, consistent with the counter-cyclical nature of student enrollment and employment levels in the general economy. Since 2013, the periods spanning the tenures of the most recent two directors, new student enrollment has averaged 12 new student starts per year (Figure 2).

Through experience, the faculty and staff have found that ~12 students is an optimal size for the program’s entering classes, given the capacity of the core classes, and the capacity of the program staff and participating university faculty in other departments to assist students as they progress through the program. In particular 2016, with 19 entering students, stretched the program’s ability to serve the students well.
Total student enrollment has generally declined, a function of both declining initial student enrollment since the early teens and a reduction in median time to graduate for students (Figure 3)(see below). The decline in enrollment also is consistent with an overall decline in University of New Mexico enrollment during this time frame (Figure 4).
Minority enrollment in the Water Resources Program has declined in recent years (Figure 5).

**Median Time to Graduation**

Median time to graduation – moving the students to success quickly – is one of the program’s management goals, but remains one of its great challenges. With most students unfunded, many work part or full time while attending school. This can be a problem. But many of those students are already working in water agencies. In those cases, we do not view an increased time to graduation as a problem.
In recent years, median time to graduation has decreased to less than three years (Figure 6). By way of comparison, the program’s time to graduation is comparable to or shorter than similar professional graduate degrees at the University of New Mexico:

- Masters of Business Administration: 3 years
- Public Administration: 3.5 years
- Community and Regional Planning: 5 years

**Continued Program Activity or Successful Completion**

One measure of success is student retention and completion of the program. For each incoming class, we have measured the percentage of students who have either graduated or remain in active pursuit of their degrees (Figure 7).
Advisement Practices

The advisement for students has been improved by hiring a new part-time Associate Director with greater involvement and responsibilities (and financial compensation) associated with advising students, especially in the Hydroscience concentration. Both the Director and Associate Director have been advising students in terms of strategic planning for coursework required for professional project needs and post-degree employment. Efforts have also been made to help students identify suitable faculty to approach for professional project opportunities. Overall, the WR administration strives to maintain a strong local and regional community of professionals, academics and practitioners. The connections to this network result in endless opportunities (e.g., seminars, volunteer opportunities, public meetings, job openings) for the students in the program.

Student Support Services

We lack the capacity for active student support services.

Graduate Success

When Albuquerque’s municipal water agency, New Mexico’s largest, in 2017 began development of its comprehensive Rivers and Aquifers Protection Plan, it turned to a recent graduate of the University of New Mexico Water Resource Program. The process required skills lying at the core of what the WRP teaches—the intersection of the technical work of water contamination risk, combined with the complex governance of aquifers and watersheds that span geographies and governmental jurisdictions. The
resulting plan “emphasize(d) the need and importance of collaboration with local, state, and federal entities to protect source water.”

When the agency responsible for ensuring that New Mexico meets its obligations under the Rio Grande Compact to deliver water to downstream states, while also complying with the federal endangered species act, it turned to the New Mexico Water Resources Program. The agency hired a student that the agency said brought together the technical skills need for the tasks with the understanding of the complex institutional environment in which the agency must operate.

These are two of many examples of recent Water Resources Program graduates who are becoming part of the next generation of the state’s water management. They illustrate two important characteristics of the program’s success. First, the interdisciplinary curriculum is giving successful graduates the tools to, echoing the words of the program’s founding mission, “solve the multifaceted water management problems of today.” This means the combination of technical skills and a grounding in the functioning of water governance, a combination not offered in a narrower disciplinary silo. This mix was nicely captured by one of our recent graduates who responded to our Academic Program Review Survey (Appendix 1):

> My job requires a general if not in-depth knowledge of NM water management policy, groundwater dynamics, and water law. I use information I learned in Water Law, 571, hydrogeology, and public lands management regularly.

Another recent graduate wrote:

> Professional science folks these days seem to be expected to be naturalists, biologists, computer hackers, engineers, policy wonks, budget hawks and lawyers. Spreading out the credit load to other skills goes a long way into preparing a student for the myriad of things they will encounter in their career.

A second characteristic captured by the two examples above is the functioning of the Water Resources Program’s “network” – the connections among faculty, current and former students, and working water managers in the state. In taking seriously its role as a “boundary organization”, the Water Resources Program’s participants have created a community that extends beyond the university.

The result is that WRP graduates are ubiquitous among the water and natural resources management communities in the state of New Mexico.

---

4 Albuquerque Bernalillo County Water Utility Authority, Rivers and Aquifers Protection Plan, December 2018
Faculty

The Water Resources Program has no faculty members of its own. As an interdisciplinary program, it draws on faculty resources from across the university for the three core program courses offered during students’ first year as well as faculty to serve as advisors and committee members for professional projects.

Water Resources Program Director John Fleck holds an appointment of Professor of Practice in Water Policy and Governance in the university’s Department of Economics. He has a bachelor’s degree in philosophy, and spent a career as a journalist. He has written extensively on water politics and policy, including three books on climate science and the politics and policy of water governance in the Colorado River Basin and the western United States. He co-teaches courses as part of the program’s introductory sequence with faculty members holding doctorates.

Water Resources Program Associate Director Rebecca Bixby holds an appointment of Research Assistant Professor in the Department of Biology. She has a doctorate in natural resources. Her research group focuses on the ecology of aridland rivers and examines the impact of disturbance on river ecology and biology while assessing implications of water management on these dynamic aquatic ecosystems. She co-teaches the program’s summer field course (WR 573) (with Mark Stone, Civil Engineering).

The program draws on faculty in other departments to co-teach the core courses - currently from the departments of Economics and Civil Engineering, as well as adjuncts working in real-world water management (Appendix 3).

Course Load

Water Resources Program Director John Fleck, who has a half time appointment with the program teaches, as part of his directorship duties, two classes (WR 571 Contemporary Issues in Water Management, WR 572 Models). Water Resources Program Associate Director Rebecca Bixby, who has a quarter time appointment with the program, teaches one course (WR 573 Field Problems).

Professional Development

The overall goal of the program is to teach students, rather than conduct research, although there is much collateral success with professional project research. The program has supported some attendance of professional meetings for the Director and Associate Director, which have been opportunities to present professional project data and recruit students. Ultimately, the budget of the WRP have not allowed for much professional development.
Research, Scholarship, & Service

With its small budget and limited resources, the Water Resources Program has no structures in place to promote active engagement in research, scholarly, and creative works among the faculty. Through their coursework and Professional Projects, the students are encouraged to engage in research, scholarly activities, and creative works. But the program has no capacity to support students in doing this beyond the required coursework and Professional Projects.

Scholarly & Creative Works

The program’s half-time director and quarter time associate director are active in scholarly work in their lives outside the Water Resources Program. The Program benefits from this non-WRP work, but does not provide direct support for it.

Water Resources Program Director John Fleck

With a background in journalism, Fleck’s primary output - done in the half of his time that is not spent overseeing the Water Resources Program - is books. He is the author of two significant books on the science, management, and governance of the Colorado River:

- Kuhn, Eric, and John Fleck. *Science be dammed: How ignoring inconvenient science drained the Colorado River*. University of Arizona Press, 2019

A peer reviewer of Fleck’s most recent book wrote: “This book (along with Fleck’s first book) is part of a new—and much needed—wave of scholarship that addresses overlooked and forgotten aspects of the field.”

With a focus on the interplay between science and water governance, Fleck’s work plays a prominent public role in regional discourse about arid lands water management in the United States, especially in the Colorado River Basin. He is a frequent speaker at both academic and water management conferences. His prolific non-academic output - in opinion pieces, newsletters, blogs, and on social media - places him squarely in the role of academic “boundary work”.

Fleck’s work is consistent with the underlying program goal to act as a “boundary object” between academia and the world of working water management. It also keeps him in direct and routine contact with the water management community, which is invaluable in understanding their needs, and the needs of students who will leave the university to work for them.

Importantly, however, this research and scholarship are done outside of the time funded by the University of New Mexico and spent managing the Water Resources Program.

Water Resources Program Associate Director Rebecca Bixby

---

5 Gieryn, “Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists.”
With a PhD in Natural Resources, Bixby’s research addresses questions at the intersection of aquatic ecology and water management. Her lab’s work centers around the impacts of natural and human-related disturbance on aquatic biological organisms in a variety of aquatic systems (streams, rivers, springs, wetlands, reservoirs). In addition to her research program, Bixby also serves on local and national committees including a working group headed by the New Mexico Environment Department (NMED) to develop Biological Condition Gradient models for aridland rivers, committees for the international Society for Freshwater Science, and as Associate Editor for the journal Diatom Research. Bixby is also committed to public engagement and outreach related to her lab’s work and local water issues. In recent years, she has served as the science lead for water and algae-centered exhibits at the New Mexico Museum of Natural History and Science, the Albuquerque Biopark, and the Bradbury Museum (Los Alamos). She also serves as a frequent speaker on water themes (e.g., food webs, algae, rivers, algal biofuels) in the community including local elementary schools.

The professional connections that Bixby has at the local, state, and national levels have provided a vast network which benefit the WRP students. For example, Kate Mendoza ’17 had numerous emails with the global expert on algae in springs, Marco Cantonati (Italy), when Kate was interpreting her interesting results from springs in the Sandia Mountains. Similarly, April Fox ’18 utilized Bixby’s connections at the NMED to access data that placed her localized data on episodic stream acidification in NM streams into the context with state water standards (and included a NMED scientist on her committee) These connections have been fruitful in terms of tangible research ideas and funding for Professional Project outcomes, but also less tangible benefits like networking and professional development.

Research Expenditures

Given its interdisciplinary nature and teaching mission, the Water Resources Program does little research of its own. The research of affiliated faculty is done under the auspices of each faculty member’s home department.

Research Involvement

While the WRP unit, in general, does not have many research activities, the program’s influence is evident at the local, state, and regional water issues because of our students and alumni. The Program has successfully slotted itself all over the region via our students who continue to be sought after interns and pre-graduation employees at the Albuquerque Bernalillo County Water Utility Authority, US Bureau of Reclamation, US Forest Service, US Geological Survey, Middle Rio Grande Conservancy District and others. These internships often involve research that leads to Professional Project ideas, funding, and permanent employment.

WRP Director Fleck is a regular source for New Mexico news media, both print and broadcast, on water issues.

Student Opportunities

Students in the Water Resources Program engage in practical, professionally focused research through the completion of their Professional Project, which links the students with real world water management problems. As an example, the Audubon Society has hired a new staff member to find ways to begin implementing work completed by recent graduate Trevor Birt. Birt’s project identified remote sensing datasets that could be used to identify agricultural areas where large quantities of water are being applied but generating relatively low crop yields. Those areas might be advantageous for discussions about
temporary, voluntary, compensated fallowing programs could be developed to provide water for environmental instream flows.
Resources & Planning

Budget

Budget of the Water Resource Program since 2015.

Figure 8: Budget for Water Resources Program, 2015-2019

The Water Resources Program budget has been stable over the past five years, but remains substantially smaller than in the program’s early years. In inflation-adjusted terms, the program’s budget has declined 3.5% since 2015 (Figure 8). Since the 2007-08 school year, the program’s budget has declined 13% in inflation-adjusted terms, while still serving approximately the same number of students.

The majority of the budget – 74% in the most recent budget year – goes toward the salaries of the administrator, the associate director, and the director. Other major expenses include costs for non-Water Resources Program faculty teaching in the core curriculum, office expenses, and other general overhead.

Staff

Director

- One half FTE
- Administration of the program’s academic activities and financial responsibilities
- Recruitment and initial advising of all students until a formal academic advisor is selected
- Work with the Water Resources Program Committee to develop and implement policy regarding curriculum and management of the WRP
- Coordination of WRP cores classes
- Co-teach two of the core classes
- Provide faculty support to the Water Network, the program’s student group
- Supervise the WRP administrator
- Facilitate communication and connections for water-related faculty and students across UNM
- Implement Water Resources Graduate Student Outcomes Assessment plan and reporting the results to Graduate Studies on a yearly basis.

**Associate Director**
- One quarter FTE
- Ensure representation of the hydroscience concentration in any program planning for this interdisciplinary program at UNM
- Help advise MWR students with questions about their program of study, appropriate hydroscience classes and professional project ideas
- Assist in decisions about course substitutions and the evolution of our WRP course requirements as course offerings in the various departments offering hydroscience classes change
- Assist in the review of new student applications to the WRP
- Support selected students in selection, advisement, and completion of their professional projects
- Teach field problems course in WRP core

The Associate Director’s position was expanded, and increased to one quarter FTE, in Fall 2016. This filled a significant gap in advisement and other program support activities. This was enabled without a budget increase because both the current director and associate director have FTE salaries lower than previous directors.

**Administrator**
- One FTE
- Manage prospective student application process
- Oversee program budget
- Process student progress and graduation paperwork
- Basic student advisement
- Miscellaneous program management activities

**Director’s Time**

In preparation for this report, the Water Resources Program Director undertook a time tracking study to better understand program capacity issues.

Nominally funded for 20 hours of work per week, the director, during the months of May-August 2019, the summer semester, worked 26 hours per week on routine Water Resources Program management duties. Because the tools used did not capture everything, this is likely an underestimate. Time spent working on this Academic Program Review is not counted in that number, as it is an atypical activity.

The major categories of work and time percent of time spent:
- General administrative tasks, 22%
- New Mexico water study – tracking state water policy issues and networking with the water management community, 22%
- Preparation for teaching workload, 15%
- Student assistance, 13%
• Project development, primarily work preparing for the program’s participation in the USGS Climate Adaptation Climate Center grant, 7%
• Prospective student contact and application review, 4%
• The remaining time in miscellaneous tasks with no obvious category, 17%

The time tracking did not count the Director’s substantial work outside his job duties on west-wide water governance activities, which contribute to the program’s visibility and success but are not a core part of the program director’s duties.

This workload for what is nominally a half time job creates a significant bottleneck for the Water Resources Program, constraining its capacity to engage in many activities important for a robust academic program. Among the opportunities missed or pending and on hold because of lack of capacity:

• Development of a work study program with State of New Mexico water agencies to employ career track University of New Mexico students
• Participation in the University of New Mexico’s “Grand Challenge” water initiative
• Collaboration in state-level water-related academic activities, including the work of the Water Resources Research Institute
• Engagement with the Middle Rio Grande Endangered Species Collaborative Program
• Active recruiting and outreach
• Pursuit of funding for student and institutional support

In the past, the problems posed by this bottleneck have been lessened by the fact that the Director was a full-time faculty member, meaning that insofar as the workload extended beyond the nominal half time position, the program was subsidized by the director’s home department. This is no longer the case with the current director who is only employed at UNM half time as the WR Director.

While the Water Resources Program Associate Director has not tracked her hours related to her WRP activities, her time is similarly constrained, and especially centered around student advisement. She is on soft money as research faculty with a similar situation as the Director but strongly committed to the Program success and absorbs extra time as pro-bono hours.

**Advisory Board**

The WRP Program Committee consists of the WRP Director and Associate Director, six faculty members from the university’s water faculty representing departments that work on water issues at the University of New Mexico, and an alumni representative. The committee meets at least once per year, and is responsible for setting policy and establishing rules and regulations governing the WRP and the Master of Water Resources degree. The committee’s members also serve regularly as informal advisors to the program, working closely with the Director and advising students and serving on student Professional Project committees. The 2018-2021 Water Resources Program Committee members include: Reed Benson (School of Law); Rebecca Bixby (Biology); John Fleck (Economics); Kathy Kambic (Landscape Architecture); Kate Mendoza (Alumni Representative, Albuquerque Bernalillo County Water Utility Authority); Bruce Milne (Alumni Representative, Sustainability Studies Program, and Biology); Caroline Scruggs (Community and Regional Planning); Mark Stone (Civil Engineering); and Ben Warner (Geography and Environmental Studies).
Facilities

Current Space

The Water Resources Program occupies five rooms in the University of New Mexico Economics Building, for a total of 765 square feet of space:

- Room 1048, administrator’s office, 156 sq. ft.
- Room 1044, director’s office, 159 sq. ft.
- Room 1040, student lounge, 193 sq. ft.
- Room 1038, graduate student/faculty office, 100 sq. ft.
- Room 1036, student computer lab, 157 sq. ft.

The WRP also has use of one desk in Room 1041, shared with economics graduate students.

The facilities are listed in UNM’s space management system as Economics Department spaces. We currently have no unmet space needs. No facility issues were raised or noted in the last Academic Program Review.

Future Space Needs

The University is planning to renovate the Economics Building, where the Water Resources Program is housed, during Fall 2020. Current plans call for remodeling of a single hallway area that currently accommodates economics faculty and graduate students to create a shared space for the Water Resources Program and the Masters in Public Policy Program. Both programs are interdisciplinary and both are currently housed within the Economics Building, and the directors of both programs have their faculty appointments in economics. It is hoped that housing the two together will create programmatic and peer group synergy among faculty and students. The remodel will include shared work space for students from both programs.
Comparable Programs

Recognizing the importance of water resources management and its fundamentally interdisciplinary nature, a number of other U.S. universities have developed programs similar to the University of New Mexico Water Resources Program.

Oregon State University

Oregon State University’s Water Resources Graduate Program is the nation’s largest and most well-known, with more than 60 students currently enrolled. It confers masters of science and doctoral degrees in three areas of specialty:

- Water Resources Engineering
- Water Resources Science
- Water Resources Policy and Management

Students earning a MS are required to complete 37 credits of coursework. Students are required to complete either a thesis or final graduate project. The program draws on faculty from across the university’s colleges. Its institutional home is within Oregon State University’s Graduate School.

University of Arizona

The University of Arizona offers a Masters of Science in Water, Society, and Policy. The degree program is housed in the university’s School of Natural Resources and the Environment, drawing on faculty advisors in that school, the School of Government and Public Policy, the College of Architecture, the School of Geography, and the Department of Hydrology and Water Resources. It has a graduate coordinator, but is not a stand-alone program.

Students complete 32 credits for their degree, including a 6-credit masters final project. Coursework is spread across the university’s water-related programs, including law, economics, geography, ecosystems, and arid land hydrology.

University of Wisconsin-Madison

The University of Wisconsin-Madison’s Masters in Water Resources Management program is housed within the university’s Nelson Institute for Environmental Studies. Their curriculum requires students to take classes in natural science and technology, as well as water resources institutions and public decision-making processes. They also require tools-based courses in such areas as programming, statistics, cartography, and technical writing. Students also take 15 credits of classes in an “area specialty”, ranging from agricultural economics to limnology.

No thesis is required for graduation. Instead, all students complete a summer practicum – a student-faculty team project focused on a contemporary problem in water resources. The practicum and a related planning course comprise 6 credits’ work.
The program offers two graduation tracks – a 45-credit course of study, most commonly taken by students, and a shorter 30-44 credit version tailored to working professionals and students who already have completed a related master’s degree.
Conclusions

Managing water systems – ensuring that supplies are safe, clean, and reliable – is a challenge anywhere. It is especially a challenge in arid geographies like New Mexico’s, where scarcity has been one of the defining constraints on human and natural systems. That challenge was at the heart of the University of New Mexico’s decision nearly three decades ago to create a Water Resources Program.

In hindsight, we now know that the program’s founders were making their decisions during unusually wet times. That has changed. Fourteen of the 21st century’s 18 years have seen below-average flows in the Rio Grande through the central part of the state. In 2019, even as the river flowed with volumes not seen since the mid-1990s, human water use drained the river such that, by late summer, nearly 20 miles of the Rio Grande south of Albuquerque went dry. Water managers scrambled to put in place plans to meet New Mexico’s obligation to deliver water downstream to Texas in the midst of a bitter legal fight before the U.S. Supreme Court between Texas and New Mexico over the river’s disputed waters.

If there was a need for a diverse and talented pool of water resource specialists to respond to the challenges of the 1990s, the challenge has only grown.

Questions for the Review Committee

- Does a Professional Project remain appropriate?
  - Should the program offer a coursework-only option?
- Has the move to Graduate Studies as the program’s academic home been successful?
- Is it appropriate to have a non-tenure/tenure track/research faculty member as the program’s director?
- Does the university offer the appropriate mix of course offerings to support the degree’s goals?
## Appendix 1: Survey of Water Resources Alumni, September 2019

1. Why did you choose the UNM Water Resources (WR) Program?

<table>
<thead>
<tr>
<th>Reason</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>To continue my studies about water resources in the southwest.</td>
<td>I chose WR because my gut told me to. I knew I wasn’t going to relive some of the cutthroat academia culture I had seen in my undergrad so I had a good feeling coming in.</td>
</tr>
<tr>
<td>I am passionate about water policy and advocacy around protection of New Mexico’s natural resources, and the WRP offered a flexible approach to this incredibly complex subject area. The program allows students to study water from multiple angles: scientific, political, geographical—and engages students with the decisionmakers and longtime water advocates of New Mexico for classes grounded very much in the real world.</td>
<td>I wanted to get a master's in some type of environmental resources and decided water was the best resource to focus on. I choose this program because it seemed to offer the type of classes I was most interested in.</td>
</tr>
<tr>
<td>Passion for conserving water resources</td>
<td>Courses that were offered played a big factor. Price of attending was also a factor. Admissions was important, i.e., no GRE. The location was another aspect, I wanted to stay in the southwest mountain region.</td>
</tr>
<tr>
<td>It was suggested by my supervisor and by a former graduate of the program who also worked at my employer</td>
<td>It offered an interdisciplinary approach to water science that provided me with the best opportunity to further my education.</td>
</tr>
<tr>
<td>I am a native New Mexican, and have family here. I was also able to secure funding from the biology department to pay for tuition.</td>
<td>I had several reasons. Moving back to NM appealed to me, and the price was definitely right. I also very much liked the focus on institutional complexity, science communication, and the social capital aspects of water management.</td>
</tr>
</tbody>
</table>
2. When you were applying to the WR Program, what other schools were you considering?

| University of Utah, University of Arizona, and University of Colorado - Boulder | I'd looked into Oregon's program but for a variety of reasons it didn't work. | none | Arizona natural resources program, Indiana university school for public and environmental affairs | N/A, I chose the WR Program because I was working in Albuquerque | UNM biology, I was accepted to UC Berkeley and ultimately decided to go to UNM because it was much more affordable. | U of Michigan, CU Denver, UC Santa Barbara. |
3. What were your favorite aspects of the WR Program?

<table>
<thead>
<tr>
<th>I liked the core classes taken with the same cohort of students. I also enjoyed the freedom of putting together my schedule for coursework that was interesting to me and would apply to my future career or professional project.</th>
<th>First, I wasn't going to be indentured to some ancient professor who wanted a two-year study done on some arcane, self-indulgent topic, I got to pick what I spent my time on. And I got to shop it around to people I liked, respected, and enjoyed working with. Second, the final thesis (prof project) was limited in scope from the usual 9 credits to 3, opening up room for some extra classes. Professional science folks these days seem to be expected to be naturalists, biologists, computer hackers, engineers, policy wonks, budget hawks and lawyers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The directors of the profits and faculty teaching relevant coursework were amazing and approachable and offered tons of support, including employment opportunities within a research lab—a fantastic experience. Working with my cohort was also great! Everyone came from diverse academic, professional, and regional backgrounds and I learned so much from them.</td>
<td>The interdisciplinary approach. I enjoy taking a variety of classes from different departments in order to develop a broader perspective.</td>
</tr>
<tr>
<td>Applied courses (modeling and summer field course)</td>
<td>The variety of courses offered. You could go down the science track or the policy track.</td>
</tr>
<tr>
<td>The collaborative approach to water management, and the development of skills that would be valuable in a real-world context.</td>
<td>The bond that I established between classmates, and the affordable education that I was able to receive. Also the friendships with professors.</td>
</tr>
<tr>
<td>I really liked the access you have to both water professionals in the area and with research faculty on campus. It seemed like if you were an enterprising and dedicated student, almost any door could be opened for you in terms of connections and research.</td>
<td></td>
</tr>
</tbody>
</table>
Spreading out the credit load to other skills goes a long way into preparing a student for the myriad of things they will encounter in their career.
4. What were your least favorite aspects of the WR Program?

<table>
<thead>
<tr>
<th>Least Favorite Aspect</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of funding, but this is part and parcel with the non-indentured servitude. Freedom isn't free, or at least isn't automatically funded.</td>
<td></td>
</tr>
<tr>
<td>The core classes covered so much material that I often felt we weren't able to tackle subjects in depth—too much breadth! I would have liked to have more directed, case-specific project work in the core classes rather than trying to cover years of hydrology and economics in one semester.</td>
<td></td>
</tr>
<tr>
<td>I wish more classes were offered more frequently.</td>
<td></td>
</tr>
<tr>
<td>Confusion among advisors when graduating, coordinating the professional project, report submissions, etc...</td>
<td></td>
</tr>
<tr>
<td>Some of the group work in the courses were my least favorite...although practical and still prepares you to work with interdisciplinary teams</td>
<td></td>
</tr>
<tr>
<td>The lack of dedicated faculty in the program and the limited selection of classes that might pertain to the WR Program</td>
<td></td>
</tr>
<tr>
<td>The ill-defined track, and semi-rigidity of the coarse structure for some courses.</td>
<td></td>
</tr>
<tr>
<td>I wish more classes were offered more frequently.</td>
<td></td>
</tr>
<tr>
<td>I found it frustrating how many grad/undergrad classes there were at UNM, and more generally how little effort some students put into classes while still remaining in school.</td>
<td></td>
</tr>
<tr>
<td>The lack of dedicated faculty in the program and the limited selection of classes that might pertain to the WR Program</td>
<td></td>
</tr>
<tr>
<td>I would have preferred an R class taught for water resources/planning students. The modeling in 572 felt outdated and not useful to my growth as a student. I feel that using python or R could have been much more beneficial since we are constantly using ArcGIS and statistics.</td>
<td></td>
</tr>
</tbody>
</table>
university with lack of staff or other reasons, but that could be improved.

Additionally, I think that it's odd the Master's of Water Resources program is not an M.S. or M.A. degree. It makes it slightly weird when listing the degree on job applications, future academic programs, etc. It would be nice to have the option of a M.S., especially for some professional projects completed in the WRP that would qualify.
5. What parts of the Program have been most useful in your current job?

<table>
<thead>
<tr>
<th>Part of the Program</th>
<th>Useful Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>The network I've built has been extremely valuable in job searching.</td>
<td>The field work, the scientific principles, general knowledge of New Mexico water law and policy.</td>
</tr>
<tr>
<td>Everything!</td>
<td>The summer field class and the connections you build in the Program.</td>
</tr>
<tr>
<td>The network I've built has been extremely valuable in job searching.</td>
<td>Not currently in water resources anymore</td>
</tr>
<tr>
<td>The field work, the scientific principles, general knowledge of New Mexico water law and policy.</td>
<td>Courses with hands on experience were the most useful, instead of just theory. Courses that used modeling techniques and GIS were what I use the most at work. The WR Field course was also very useful. Working as a Hydrologist for a land management agency, this was perfect for prepping me for some of that work.</td>
</tr>
<tr>
<td>The summer field class and the connections you build in the Program.</td>
<td>The introductory course covering water management, resource economics and introductory hydrology.</td>
</tr>
<tr>
<td>Not currently in water resources anymore</td>
<td>The engineering, law, and attention to detail regarding models and technical reading and writing.</td>
</tr>
<tr>
<td>Courses with hands on experience were the most useful, instead of just theory.</td>
<td>GIS for water resources helped me a lot. 571 and 573 seemed to have given me a good basic understanding of water issues in New Mexico.</td>
</tr>
<tr>
<td>Courses that used modeling techniques and GIS were what I use the most at work.</td>
<td>My job requires a general if not in depth knowledge of NM water management policy, groundwater dynamics, and water law. I use information I learned in Water Law, 571, hydrogeology, and public lands management regularly. I also really benefited from the mediation training from the Law School and use those skills almost daily.</td>
</tr>
</tbody>
</table>

Since I ended up working in New Mexico, the connections I made with professors and other professionals at UNM have been most useful to me. I also took courses at UNM that I thought would help me in my career and those have also been useful to me in my current job.
6. What could we, as a Program, do better to improve the opportunities for our graduates once they’ve left the program?

| I think professors in the Program already do well at making a point to connect students with job opportunities. However, it might be good to require students to get internship credits as part of the Program to make connections in the professional world. Also, if there's interest, it might be cool to have alumni of the Program check in with recent graduates to see where they may need support to get a job and help connect them with opportunities. | Some people are just bad at looking for jobs, and I think they might benefit from some extra help in 'what comes next'. Or even being mindful that during the program, it will soon end, and they need to be thinking of finding a job. On orientation, they should be looking at job posts and finding skillsets to target for coursework and experience. They should be building networks early while they're students and not think it'll magically happen after. | Alumni gatherings would be great, but I hear regularly from John about job opportunities which is really helpful. Hold more alumni events in Santa Fe and Abq. It is a great way to network. Provide references and resources for employment other than the Water Authority. | Other advanced professional development courses would be useful. Specific topics that might address other skills needed at work. Develop a database of recent graduates employed in the WR-type businesses or local, state, and federal WR-related agencies. Have this network available for job opportunities and for help with research projects. Have an online forum where people can chat and post job opportunities, like Texas a&m bio board. | I think having better internship opportunities could be beneficial. Some students that graduate and are unable to find jobs or end up working in a field that is unrelated to their degree. I think having more opportunities to interact with future employers could be helpful in securing a job in water resources. I would happily participate in more alumni events, both to keep in touch with fellow graduates as my career progresses and to interact more with current students as we expand our own networks. Similarly I would have liked to see more networking events planned as part of the program, to introduce students to working professionals in the area. I eventually was able to do this on my own, but it took about a year to really begin meeting people. |
Appendix 2: Professional Project guidelines, Water Resources Program

THE PROFESSIONAL PROJECT

Introduction
The Professional Project is the culmination of the student’s graduate experience and demonstrates the student’s ability to perform professional quality independent work on a topic related to water resources management. The topic of the project is selected by the student in an area of his/her choosing, and with guidance of a faculty advisor and graduate committee. The project can be related to a student’s employment; however, additional independent work is required for the project to serve as a UNM Professional Project. The end product of the Professional Project is a formal, professional report that is defended before a faculty graduate committee in a public forum.

Identifying a research topic, performing the appropriate research and writing a Professional Project is one of the most underestimated requirements associated with a graduate degree. This requirement demonstrates the student’s ability to independently formulate a research question, develop an appropriate scope of work, generate information to address the question, communicate the ideas and conclusions in a written document and defend the work before a committee of experts.

There are nearly as many ways of conducting graduate research as there are university faculty. Nevertheless, experience has allowed identification of some common attributes that can provide guidance to students in developing their own research proposals, then performing the work needed to complete the project.

Identifying a Topic
Identifying a topic for one’s Professional Project research is, perhaps, the single most difficult task in all of graduate school. The difficulty lies in selecting a topic that satisfies many different criteria. For example, the project must be interesting and meaningful to the student and his/her advisor, and there must be adequate resources available to perform the work. The resources that are needed include intellectual resources (i.e. expertise from one’s advisors), financial resources, laboratory/library/computing resources, and time; the project must be something that can be accomplished within the time constraints available to the student. Under the best circumstances the graduate student is working as a Research Assistant (RA) for a professor on a funded research project, the professor becomes the student’s advisor and the project, or some component of it, forms the basis of the student’s Professional Project. These few lucky students often enjoy the additional advantage that the professor has already written a research proposal. In this case the structure and ideas from the proposal can be incorporated into the student’s own research program.

Before selecting a topic, the student should understand the attributes of a good research proposal. These include:

- The proposed project has a clear and concise title.
- The proposed project has a clearly stated hypothesis or clearly articulated research question.
The proposed project has a clear statement of objectives. The statement of objectives is important because once they have been achieved, the research for the project is finished.

Resources should be available to assist in conducting the project. These include time, library resources, laboratory or field access, and most importantly, one or more faculty members knowledgeable in the topic and willing to work with you.

There are two approaches one can take to identify a research project referred to here as the Traditional Approach and the Inverse Approach. Clearly there is some overlap between the two, but it is useful to describe them as it can lead a student to new ideas for developing their proposal.

**Traditional Approach to Identifying a Project**
The traditional method for identifying a research project is for the student to develop a research hypothesis or question in their field of interest after extensive reading, analysis, careful thinking and discussion with their advisor. A clear statement of this hypothesis or question then leads to a research program that is designed specifically to answer that question. The student performs the scope of work, collects the data, analyses it to answer the hypothesis or question then writes it up to complete the Professional Project. Thus, the traditional approach to identifying a research project follows the following steps:

- Develop a research hypothesis/question
- Develop a plan of study to address the hypothesis/question
- Follow the research plan to generate data or information
- Analyze the data or information to test the hypothesis or answer the question
- Write and defend the Professional Project

It is called the traditional approach because historically most graduate students were full time students and had the luxury of using some variation of this method. The really lucky students are those supported by research projects where the professor has already formulated a research hypothesis or question in the grant proposal and the student simply joins the project and is given guidance on what needs to be done.

**Inverse Approach to Identifying a Project**
Most part time or unsupported grad students cannot use the traditional approach for selecting a research project because they don’t have the time or financial resources needed to address an academic topic. Nevertheless, many of these students work professionally and often have access to large amounts of interesting information that, with proper analysis, can tell an interesting story. In the inverse approach the research project follows these steps:

- Consider and conduct a preliminary analysis of information or data to determine if it is of suitable quality and sufficient quantity to answer a well formulated research question.
- Using the data, develop a research hypothesis/question that can be answered by the data.
- Develop a plan of study to address the hypothesis/question.
- Analyze the data. Generate more data/information if needed.
- Write and defend the Professional Project.
The inverse strategy is frequently used by part time students who have employment in a field closely related to their area of study. Most employers are very willing to support this kind of research because it provides information or analysis that can benefit their firm or agency, as well as providing additional training and credentials to their employee.

Regardless of the strategy one uses in identifying a research project, the student should expect to work closely with their advisor; the enthusiastic and willing participation of the advisor is essential to the success of the project. It is equally important that the student recognize that identifying a research project is very challenging. It will almost certainly require multiple iterations in which an idea is proposed, some preliminary information is gathered on the topic and a scope of work is developed, then the ideas are discussed with the advisor. It is not uncommon for students to take 6 months or longer to develop a proposal for a Masters project or thesis.

**Bad Research Statements**

One of the most common problems encountered with student research proposals begins when the student states “I want to look at …..” While this might be appropriate for a career goal it offers no guidance towards developing a scope of work that will lead to completion of a Professional Project. “Looking at” a topic might be as simple as reading a couple of papers, or as complex as devoting the next five years of one’s life to become a world class expert. A much better proposal might starts with “I believe that the following will occur if…..,” This constitutes a hypothesis that can be tested, at least in principle. Properly phrased it will lead to articulation of a set of objectives. The student will then devise a way of generating data or information to achieve those objectives, thereby testing the hypothesis. A clear ending point is achieved when the hypothesis has been successfully tested. Then the student graduates, has a big celebration party, and everybody lives happily ever after.

<table>
<thead>
<tr>
<th>Bad Research Proposal Statements</th>
<th>Better Research Proposal Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>I want to look at methods of removing arsenic from water</td>
<td>I believe that better removal of arsenic from water can be achieved through adsorption onto amorphous ferric hydroxide</td>
</tr>
<tr>
<td>How does bosque restoration affect ground water?</td>
<td>Will bosque restoration cause reduced measurable evapotranspiration losses from shallow ground water?</td>
</tr>
<tr>
<td>Evaluate the effectiveness of various water conservation measures.</td>
<td>The following water conservation measures can successfully be implemented to achieve at least XX% reduction in water use.</td>
</tr>
</tbody>
</table>

**The Research Proposal**

As the student develops a research topic in conjunction with her advisor, she/he needs to begin thinking about preparing a research proposal. Graduate research proposals are formal documents and should be written as though they were to be submitted to a funding agency. There are two objectives to be accomplished in the research proposal:
• Clearly identify the problem or issue to be addressed and convince the graduate committee that it is a topic worthy of investigation. Provide a clear statement of objectives that will be accomplished in the research.

• Develop a research plan that will accomplish these objectives and present it in sufficient detail that the graduate committee has confidence in the project’s success.

The research proposal is written as a formal document; all statements of fact are referenced, tables and figures have captions, and the language is careful, concise, and to the point. The body of the research proposal should not exceed 15 pages. The organization of a research proposal is usually very simple. It should have the following components:
Title Page
Abstract (1 page)
Introduction
• General description of the problem under consideration
• Clear statement of the research question or hypothesis to be addressed
• Clear statement of the research objectives
• General summary of the methods that will be used to achieve the objectives

Background or Literature Review
• Provide a thorough review of relevant information that has been done on the topic. This should include a summary and analysis of published literature and reports. If the topic involves a field study, maps, diagrams and photos should be included. This chapter will draw heavily on previous work by others and other sources of data and should be extensively referenced.
• It is suggested that references be cited as Last Name (date). For example (Smith, 1995; Jones and Allen, 2002; Sanchez et al., 2005). Remember, you’re citing the paper not the individuals. List the references in alphabetical order at the end of the paper.
• This section will almost certainly form the basis of the second chapter of the Professional Project, and therefore should have the same organization as expected in the final document.

Research Methods
• Describe how the research will be conducted. Identify methods of collecting data. Provide diagrams of experimental equipment to be built. Identify analytical methods to be use (give references). Provide maps showing locations of field sampling stations. Develop the theory of modeling studies. Identify sources of information.
• Provide a research schedule with specific tasks and specific milestones that can be used to track the progress of the project.

Expected Results and Methods of Analyses
• Describe the data or information expected to be generated by the research. Identify its form (statistical data from questionnaires, tables of data from instruments, papers from library & internet searches, computer model results, etc.).
• Describe how the data will be processed, summarized, or analyzed. Identify statistical methods to process the data. Describe how literature, interviews, or other non-quantitative information will be assimilated and interpreted.

References
• References should be presented using the same formatting style as will be used in the final Professional Project.

Students should expect to put a lot of work into their research proposal. Keep in mind that the proposal constitutes the first draft of the Professional Project. In this respect, the research proposal establishes the organization for the final document. Indeed, if done well, nearly every bit of material contained in the proposal will be used in the final Professional Project. Thus, extra effort devoted to producing a high-quality research proposal will be recovered in the form of a more efficient and productive research process, and ultimately, a better final document.

The Graduate Committee
Throughout this document emphasis has been placed on the need for close collaboration between the student and their advisor. It is important to remember that the student’s graduate committee is also an integral part of the process and should be utilized as a resource to assist in all phases of the research project. Most university faculty members choose this career because of a desire to help students learn. Assisting with a productive and successful research project is one of the more rewarding parts of the job because not only do you have the opportunity to play a role in the professional development of a bright young person, but there is the additional satisfaction associated with the intellectual rewards of contributing new knowledge to one’s profession. Conversely, one of the most difficult situations a faculty member can be in is to be added to a student’s graduate committee after most of the work has been completed, only to find the project is weak. In such cases, the committee member’s role is limited to that of gate keeper – a person who is forced to make the very difficult decision as to whether a weak piece of work is nevertheless good enough to allow the student to graduate.

Choosing the Committee
Committees for masters students at UNM require a minimum of three members, two of which must be regular or research faculty. The third member must be have qualifications appropriate for the student’s area of study. Ph.D. committees must have four members, three must be regular or research faculty, and one of these must be from a different graduate unit than the student’s major department (i.e. a different department at UNM or a different university). All committees must be approved by Graduate Studies. Specific guidance on the composition of graduate committees is given in the UNM catalog.

Generally, students pick a committee based on faculty they know and/or people they work with. The characteristics of an ideal committee member are: 1) they are knowledgeable in the field of interest, 2) they are available and willing to serve on the committee, and most importantly, 3) the student has confidence that they will provide constructive assistance during the course of the project. Part-time students who have selected a topic related to work are encouraged to select a supervisor or other senior member of the organization for their committee. Senior staff from work are beneficial because they have frequent contact with the student, usually have good knowledge of the subject, understand the constraints the student faces, and can provide immediate suggestions when questions arise. Furthermore, because the student’s project is work-related, a supervisor can sometimes make resources available to assist in completing the project.

Working with the Committee
Students are strongly encouraged to take full advantage of the expertise, knowledge, and experience of their entire graduate committee by involving them in the research project from the beginning. At the same time, this involvement must be balanced against the challenges of obtaining meaningful input from very busy people. In other words, most committee members do not want to have weekly reports on the student’s progress. But neither is it appropriate for the student to simply show up one day after months or years without contact, plop a document on the desk and say, “here’s my Professional Project, let me know what you think.”

It is suggested that during the research project the student arrange two formal meetings of their full committee. The occasion of these meetings and their objectives are:
• 30% Completion Meeting – Obtain Committee Buy-In. This meeting should be held when the student has completed roughly one third of the proposed research. The objective of this meeting is to obtain the committee’s agreement that the research project is well framed, the methods are appropriate, and the project has a high chance of success. The student will formally present their research proposal to the committee, describe the project objectives, the scope of work and the research methods.

• 70% Completion Meeting – Identify Fatal Flaws. This meeting occurs after the student has collected most of the information needed for the project. The objective is for the committee to consider this information and the student’s preliminary conclusions and determine whether the work has been done with sufficient care and the results have been interpreted by proper methods to support these conclusions. It is important to have this meeting while the research is still in progress so that if new data is needed, or new experiments must be conducted, it can be accomplished with minimal additional work.

In addition to these formal committee meetings, it is important to continue regular meetings with the student’s advisor. It is suggested that biweekly progress reports is an appropriate frequency if there is not regular personal contact. Similarly, monthly reports to the rest of the committee are helpful. These reports need not be overly detailed and in many cases can be one-page bulleted lists of Accomplishments and Planned Activities. The purpose is to maintain regular contact and avoid surprises.

Conducting Research and Writing the Professional Project
It is difficult to provide generic guidance to students conducting research projects because each project, each advisor, and each discipline is so different. Thus, a strategy that works well for lab-oriented engineering research is likely of limited value for a project investigating cultural characteristics. Listed below are some ideas that may appropriate for some projects.

Prepare a Schedule and Regularly Update It
A detailed scope of work and research schedule should be part of the research proposal. Periodically go back to this schedule and consider your scope of work and the progress made towards completing it. Revise as appropriate.

Keep a Project Notebook
Science and engineering students are strongly encouraged to keep a project notebook, a recommendation that has value to students in other fields as well. Project notebooks should be bound (not 3 ring binders) and the pages numbered. Entries should be made in ink. Errors are crossed out by a single line through the erroneous material. The notebook thus becomes a combination of diary and repository of information collected in the library, field or laboratory. While data files might be stored on a computer, the procedures used to collect the data, any hand written notes or information, and the name of the data file should be written in the notebook.

Backups
Back up your work and data. Back it up frequently. All of it.

Writing
Writing a Professional Project is always much more time consuming than students estimate. The rule of Pi should be used in predicting how long it takes to write the final document: Estimate the time required then multiply by Pi.

The Professional Project is a formal academic document and should be written as such. It is generally written in the third person impersonal tense and should be clear and succinct. Adjectives should be used sparingly and superlatives are almost never used. In my experience the style editor in MS Word has apoplexy when analyzing most well written projects/theses/dissertations.

Most academic documents including papers/projects/theses/dissertations as well as technical reports should be written in the past tense to the extent reasonable because the document describes work that has been done. While it sometimes makes sense to write in the present tense, six months, a year or a decade later it won’t make any sense at all (unless you’re still working on the darn project).

The Professional Project should follow the formatting and organization criteria set by the UNM Office of Graduate Studies (www.unm.edu/~grad). The report should be double-spaced, with 1” (1.50” left-hand) margins, and generally contain the following:

- A title page including student name, month and year of graduation, and the citation that this document is submitted in partial fulfillment of the requirements for the degree of Master of Water Resources, Water Resources Program, University of New Mexico. A sample title page can be downloaded from the WRP web site.
- A signature page, signed by all committee members. The signature page can be downloaded from the WRP web site.
- A table of contents and separate lists of tables and figures.
- Acknowledgements page.
- An abstract stating the problem or hypothesis, its significance, results, summary and conclusions. The abstract should not exceed two pages.
- An introductory chapter or section identifying the problem/hypothesis, previous work, etc.
- Other chapters or sections, as cited in the table of contents.
- A glossary of terms.
- Appendices (where appropriate).
- Literature cited (references). Because of the diversity of water resources disciplines, citation styles vary. Choose one style that is dominant in the particular field and stick with it. For water resources, the Journal of the American Water Resources Association (JAWRA) is a good reference. The student’s committee can provide guidance.

For issues of style, references, and formatting there are numerous books on writing academic papers. One is: A Manual for Writers of Term Papers, Theses and Dissertations by K. Turebian, 6th ed., University of Chicago Press. There are many others.

**Web Site with Good Information**
The Oral Exam/Professional Project Defense
Once the student has finished the report, they submit a draft to the committee for their comments. Usually the Chair reviews it before submitting to the rest of the committee. The committee may require corrections to the draft prior to scheduling the oral exam. The student should provide a Draft Final copy of their report to the committee at least two full weeks prior to the defense.

Students must inform the WRP office by December 1 (Spring graduation), May 1 (Summer graduation), July 15 (Fall graduation) of their intention to graduate in the following semester. No form is required.

The oral exam is open to the public and Graduate Studies must be notified two weeks before it occurs by submitting an Announcement of Examination form (https://grad.unm.edu/resources/gs-forms/announcement-examination.html). The student and the committee should decide on a time and date for the examination. After the student and their committee have agreed on a date and time, the WRP Administrator must be notified who will help fill out the proper forms. The student should also reserve a room and audio-visual equipment for the defense (usually a projector and a laptop computer).

During the exam, the student makes a formal presentation lasting 30 minutes or less. The presentation should follow the same organization as the written report and should emphasize work done by the student and especially their analysis, interpretation and conclusions. Following the presentation, the graduate committee and the audience will be encouraged to ask questions about the project.

After the presentation and public questioning, the committee may close the meeting to the public and continue the examination. At the conclusion of the examination the committee and student will discuss the results.

On the final exam, the student can receive a grade of “Pass”, “Fail”, “Pass with Distinction”, or “Conditional Pass”. Almost always the committee will identify some changes needed to the written report. Depending on the nature of the changes, the final report may need to be re-reviewed by the entire committee or simply by the advisor. Obtaining the committee members’ signatures their indication that the student has submitted a report satisfying the requirements of the MWR program.

Final Copies of the Professional Project Report
An electronic copy of the final, committee-approved report will be submitted to WRP Office for filing, along with a coversheet signed by the committee’s members. It will be archived in the UNM Library.

The submitted project report will be in PDF format. The submitted material also may contain supporting data, spreadsheets or computer results, photographs, PDFs of important references or other information the student believes is relevant to the project.

The title page (see the end of this document or the WRP web site) is the first page of the report and the signed signature page follows that page. The student may use the title page as the cover or can design their own cover, perhaps with a picture or drawing. At a minimum, the cover should display the title, degree name and option, and student’s name, with the following at the bottom:
A Professional Project Report Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Water Resources
Hydroscience or Policy/Management Concentration
Water Resources Program
The University of New Mexico
Albuquerque, New Mexico
Month Year

The month and year will be that month (May, August, or December) and year in which the student will 
graduate, not the month in which the student defended. As a matter of courtesy, the student should 
provide each committee member with a copy of the PP. A final grade in WR 598 will not be issued until 
the WRP Office receives the final report signed by all committee members.

Some Common Pitfalls
Below are some of the common problems associated with professional projects.

- Waiting too long to identify a project.
- Poor topic definition or too broad a topic.
- Inadequate resources (time, financial, faculty or other intellectual assistance) to complete the task.
- Failure to seek committee help, especially during the initial stages of project development.
- Inadequate data to complete the project.
- Believing one draft will be sufficient.
- Underestimating the amount of time that it will take. This is especially true of projects involving 
a field and/or lab component. In the field or lab, things rarely go as planned; Murphy’s Law (“If 
things can go wrong, they will.”) often controls.
- Leaving school before turning in a first draft of the report. Students may leave school before 
completing all requirements, often to accept a job. Keep in mind that doing so will, in most cases, 
greatly prolong the amount of time (perhaps by a factor of 3 – 6 times) it will take a student to 
finish the degree. It is not uncommon for a student to leave, thinking he or she is just a few 
months away from finishing up and; before one knows it, a year has gone by. The demands of a 
new job often preclude work on a professional project. If a student must leave before finishing, 
he/she should endeavor to turn in a first draft of the Professional Project report to their 
committee.

If a student experiences problems, he/she should promptly discuss them with their advisor and then their 
graduate committee. An informed advisor and committee is the student’s best ally in completing their 
degree.

Publishing Your Professional Project
WRP students are strongly encouraged to publish their PP work in journals and/or present their results at 
regional and national professional meetings. The following language should be included to provide 
recognition for the program.
“This work is based upon the Professional Project of (your name), submitted in partial fulfillment of the requirements for the degree of Master of Water Resources at the University of New Mexico.”
Appendix 3: Affiliated Faculty, Water Resources Program

There are approximately 60 UNM continuing faculty members, or emeritus, who are affiliated with the Water Resources Program. They constitute a diverse group of individuals from six different schools or colleges with expertise in just about every aspect of water resources. The schools or colleges represented by the faculty are Arts and Sciences, Architecture and Planning, Engineering, Law, Medicine and the UNM Libraries. Affiliation with the program is on a voluntary basis and there are no specific selection criteria nor are there any specific responsibilities required. Faculty who are members of the 2018-2021 Program Committee are indicated by an asterisk (*).

**Biology**

Rebecca Bixby*, Research Assistant Professor  
505-277-3411, bbixby@unm.edu  
Ph.D., University of Michigan. Aquatic ecology, impacts of disturbance

Clifford N. Dahm, Professor, Emeritus  
505-277-2850, cdahm@sevilleta.unm.edu  
Ph.D., Aquatic Ecology, Oregon State University.  
Aquatic ecology, stream/groundwater interactions, microbial ecology, nutrient cycling, microbial and chemical processes in volcanic environments.

Marcy Litvak, Professor  
505-277-5580, mlitvak@unm.edu  
Ph.D., University of Colorado.  
Plant physiological ecology.

Kelly Miller, Professor  
505-277-2496, kbmiller@unm.edu  
Ph.D. Cornell  
Arthropod systematics and taxonomy

Bruce Milne*, Director, Sustainability Studies Program, Professor  
505-277-5356, bmilne@sevilleta.unm.edu  
Ph.D., Rutgers University.  
Botany and plant physiology.

Esteban Muldavin, Research Associate Professor, Division Leader, Natural Heritage NM  
505 277-3882 muldavin@unm.edu  
Ph.D., New Mexico State University.  
Conservation biology, community ecology, vegetation mapping.

Thomas Turner, Professor, Associate Dean, Arts and Sciences  
505-277-7541, turnert@unm.edu  
Ph.D., Florida International University  
Conservation genetics, southwestern fish
Chemistry
Stephen E. Cabaniss, Professor and Dept. of Chemistry Chair
505-277-4445; cabaniss@unm.edu
Ph.D., University of North Carolina.
Environmental chemistry, molecular spectroscopy, HPLC, stochastic and deterministic programming.

Civil Engineering
Jose Cerrato Corrales, Associate Professor
505 277-2722, jcerrato@unm.edu
Ph.D. Civil Engineering, Virginia Tech
Water chemistry, chemical treatment.

Julie E. Allred Coonrod, P.E., Professor, Dean, Graduate Studies
505-277-6062, jcoonrod@unm.edu
Ph.D., Environmental and Water Resources, University of Texas at Austin.
Water resources, GIS applications.

Ricardo Gonzalez-Pinzon, Associate Professor
505 277-2621, gonzaric@unm.edu
Ph.D. Water Resources Engineering, Oregon State.
Surface water quality modeling.

Kerry J. Howe, P.E., Associate Professor
505-277-2702, howe@unm.edu
Ph.D., Civil Engineering, University of Illinois at Urbana-Champaign.
Environmental engineering, water treatment processes and design, membrane technologies.

Andrew Schuler, P.E., Associate Professor
505-277-4556, schuler@unm.edu
Ph.D. Civil Engineering, University of California, Berkeley.
Environmental engineering, wastewater microbiology & wastewater treatment.

Mark Stone*, P.D., Associate Professor
505-277-0115, stone@unm.edu
Ph.D. Civil Engineering, Washington State University.
Water resources, arid hydrology, hydraulics.

John C. Stormont, P.E., Professor
505-277-6063, jcestorm@unm.edu
Ph.D., Geological Engineering with minor in Civil Engineering, University of Arizona.
Vadose zone hydrology, geotechnical engineering.

Bruce M. Thomson, P.E., Regents’ Professor, Emeritus, and Research Professor
505-277-4729, bthomson@unm.edu
Ph.D., Environmental Science and Engineering, Rice University.
Environmental engineering, water management, chemistry and treatment.
Community and Regional Planning
Claudia B. Isaac, Associate Professor
505-277-5939, cisaac@unm.edu
Ph.D., University of California-Los Angeles.
Community and regional economic development, social theory, gender and development, Latin American studies.

Theodore Jojola, Professor
505-277-6428, tjojola@unm.edu
Ph.D., University of Hawaii.
Community development, environmental design, indigenous rights, tribal economic development, microcomputer applications in education and planning.

James R. Richardson, Professor
505-277-6460, jrich@unm.edu
M.Arch./A.S., M.C.P., Massachusetts Institute of Technology.
Land-use planning, community development, citizen participation, negotiation and environmental dispute resolution, urban design.

Caroline Scruggs*, Associate Professor
505-277-5050, escruggs@unm.edu
Ph.D. Stanford University.
Environmental planning.

Lani Tsinnajinnie, Assistant Professor
505-277-5050, lanimits@unm.edu
Ph.D., Earth and Environmental Science, New Mexico Tech
Mountain and watershed hydrology

Earth and Planetary Sciences
Abdulmehdi Ali, Senior Research Scientist I
505-277-1637, mehdiali@unm.edu
Ph.D. Chemistry, University of Arizona.
Water chemistry, analytical methods.

Yemane Asmerom, Professor
505-277-4434, asmerom@unm.edu
Ph.D., Geochemistry, University of Arizona.
Applications of radiogenic isotopes (U-Series, Nd-Sr-Pb-Hf) to the study of the solid earth, oceans and climate through time.

Laura J. Crossey, Professor
505-277-5349, lcrossey@unm.edu
Ph.D., Geochemistry, University of Wyoming.
Clastic diagenesis and organic geochemistry, with emphasis on interaction of organic and inorganic constituents of sedimentary rocks during progressive burial, and diagenetic model development.

Peter J. Fawcett, Associate Professor  
505-277-3867, fawcett@unm.edu  
Ph.D., Paleoclimatology and Sedimentology, Pennsylvania State University.  
Long-term evolution of the climate system and patterns of past global change, quaternary paleoclimatology, and climatic influences on sedimentation.

Joseph Galewsky, Associate Professor  
505-277-2361, galewsky@unm.edu  
Ph.D., University of California - Santa Cruz.  
Interactions between meteorological and land surface processes, climate dynamics, orographic precipitation.

David S. Gutzler, Professor  
505-277-3328, gutzler@unm.edu  
Ph.D., Climatology and Meteorology, Massachusetts Institute of Technology.  
Data analysis and modeling of interactions between the atmosphere, ocean, and land surfaces and climatic variability of Southwestern North America.

Grant A. Meyer, Professor, Emeritus  
505-277-5384, gmeyer@unm.edu  
Ph.D., Earth and Planetary Sciences, University of New Mexico.  
Hillslopes and fluvial systems; climatic, tectonic and environmental geomorphology; Quaternary geology and ecosystem processes.

Leslie D. McFadden, Professor  
505-277-6121, lmcfadnm@unm.edu  
Ph.D., Quaternary Geology, University of Arizona.  
Soil development in arid and semiarid regions; applications of soil studies to geomorphology, paleoclimate, environmental research, and geohazard evaluation.

Louis A. Scuderi, Professor  
505-277-2644, tree@unm.edu  
Ph.D., Geography, University of California-Los Angeles.  
Paleoclimatic reconstructions utilizing dendrochronology, climatology, geographic Information Systems (GIS), image processing, global positioning systems (GPS), creation and analysis of historical and paleoclimatic databases.

Zachary D. Sharp, Professor  
505-277-2000, zsharp@unm.edu  
Ph.D., University of Michigan.  
Stable isotope geochemistry, with application to paleoclimate reconstruction, metamorphic and igneous petrology and structural geology.
John W. Shomaker, Adjunct Professor  
505-345-3407, jshomaker@shomaker.com  
Ph.D., University of Birmingham (England). 
Hydrogeology, water resources planning and management.

Gary A. Smith, Professor  
505-277-2348, gsmith@unm.edu  
Ph.D., Sedimentology and Physical Volcanology, Oregon State University. 
Sedimentology related to rift tectonics, aquifer heterogeneity, and volcanism, physical volcanology of 
pyroclastic deposits and composite volcanoes.

Gary Weissmann, Professor  
505-277-3636 weissman@unm.edu  
Ph.D., University of California, Davis. 
Hydrogeology, sedimentology, and basin analysis. Research focuses on a basin analysis approach to 
characterizing and modeling groundwater flow and contaminant transport.

Economics  
Robert Berrens*, Professor  
rberrens@unm.edu,  
Ph.D., Agricultural and Resource Economics, Oregon State University. 
Environmental economics, nonmarket valuation, sustainability and ecological economics, environmental 
equity, institutional economics, riverine and public lands management, survey research, wildfire and 
watersheds.

David S. Brookshire, Distinguished Professor Emeritus, and Research Professor  
505-277-1964, brookshi@unm.edu  
Ph.D., Economics, University of New Mexico. 
Environmental and resource economics, policy issues associated with endangered species, natural hazards 
and water resources.

F. Lee Brown, Professor Emeritus  
505-277-1092, flbrown@unm.edu  
Ph.D., Economics, Purdue University  
Water resources economics, planning, and management.

Janie Chermak, Professor and Chairperson  
505-277-4906, jchermak@unm.edu  
Ph.D., Mineral Economics, Colorado School of Mines. 
Environmental economics and natural resources, applied microeconomics, empirical testing of the theory 
of exhaustible resources, exhaustible resource production.

Catherine (Kate) Krause, Dean, University College, Professor  
505-277-3429, kkrause@unm.eduhttp://www.unm.edu/~econ/faculty/krause/krause_home.html  
Ph.D., Economics, University of Wisconsin.
Public finance, law and economics, experimental and behavioral economics, economic learning and behavior in children, economic issues for children and families, law and economics, sustainable resource use.

Jingjing Wang, Assistant Professor  
505-277-2035, wangj@unm.edu  
Ph.D., Environmental and Resource Economics, University of California-Riverside. Environmental and agricultural economics, water resource economics, computational modeling

**Family & Community Medicine (Public Health)**  
Kristine Tollestrup, Associate Professor  
505-272-9555, ktollestrup@salud.unm.edu  
Ph.D., University of California, Berkeley. Public health, epidemiology

Floyd Frost, Research Assistant Professor  
505-348-8776, ffrost@salud.unm.edu  
Ph.D. University of Washington Epidemiology

**Geography and Environmental Studies**

Ben Warner*, Assistant Professor  
505-277-5041, bpwarner@unm.edu  
Ph.D., Arizona State University

Paul Zandbergen, Associate Professor  
505-277-3105, zandberg@unm.edu  
Ph.D., University of British Columbia, Geographic information systems.

**Landscape Architecture**

Kathleen Kambic*, Assistant Professor  
kambic@unm.edu  
Master of Landscape Architecture, University of Virginia water, infrastructure, landscape theory, landscape architecture, architecture, urban design, political ecology

**Law**

Reed Benson*, Professor  
505-277-2146, rdbenson@unm.edu  
J.D. University of Michigan. Water law
Adrian Oglesby, Director
Utton Transboundary Resources Center, UNM School of Law
505 277-1767, oglesby@unm.edu
J.D. University of New Mexico.
Drought resilience, water policy and management, water and economic development

Public Administration

Santa Falcone, Professor
505-277-4934, falcone@unm.edu, http://www.unm.edu/~spagrad
Ph.D., Syracuse University. Administrative behavior, science policy and administrative and environmental issues.

Mario A. Rivera, Professor
505-277-3312, marivera@unm.edu, http://www.unm.edu/~spagrad
Ph.D., University of Notre Dame. Program policy evaluation, and comparative public management systems.

Water Resources

John Fleck, Professor of Practice in Water Policy and Governance, Department of Economics; Director, Water Resources Program
505-277-0124, fleckj@unm.edu
Water resources governance; science communication
Appendix 4: Master of Water Resources Outcomes Assessment Rubric

Student: ________________________ Date: _______________________

Upon completion of the public defense of the Professional Project, the student’s Examination Committee will prepare an assessment of the student’s knowledge and abilities in four general areas recognized by the Water Resources Program as learning goals. This assessment is based both on the Professional Project as well as other knowledge of the student’s abilities and performance gained by the Committee members through their association with the student.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Unacceptable (0)</th>
<th>Marginal (1)</th>
<th>Acceptable (2)</th>
<th>Exceptional (3)</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Knowledge of the hydrologic cycle, occurrence &amp; characteristics of water &amp; its administration</td>
<td>No evidence of fundamental knowledge.</td>
<td>Rudimentary knowledge exhibited in written document, oral presentation and overall preparation</td>
<td>Knowledge of fundamentals evident in written document, oral presentation and overall preparation</td>
<td>Demonstrates mastery of appropriate fundamentals for the discipline.</td>
<td></td>
</tr>
<tr>
<td>2) Ability to formulate quantitative relationships of water &amp; its socioeconomic value</td>
<td>No evidence of quantitative understanding of water resources &amp; its management</td>
<td>Some quantitative understanding of water resources &amp; its management</td>
<td>Able to formulate quantitative relationship relevant to water resources &amp; its management</td>
<td>Excellent quantitative abilities regarding water resources &amp; its management.</td>
<td></td>
</tr>
<tr>
<td>4) Knowledge of field, laboratory, computational &amp; library methods relevant to water management</td>
<td>Rudimentary knowledge of research methods in water resources &amp; its management.</td>
<td>Some knowledge of research methods in water resources &amp; its management.</td>
<td>Able to design program for generating &amp; interpreting information related to water resources &amp; its management</td>
<td>Excellent knowledge &amp; application of methods for generating information on water resources &amp; its management.</td>
<td></td>
</tr>
<tr>
<td>Overall Assessment</td>
<td>Unacceptable (0)</td>
<td>Marginal (1)</td>
<td>Acceptable (2)</td>
<td>Exceptional (3)</td>
<td></td>
</tr>
</tbody>
</table>

Comments:
What curricular or process changes can you suggest to improve student performance in these areas?

Committee Members:

_________________________  ____________________________
Chair                      Date                       Member       Date

_________________________  ____________________________
Member                    Date                       Member       Date