THE SIERRA NEVADA RESEARCH INSTITUTE
Strategic Plan, Academic Year 2009-10

Mission

The mission of the Sierra Nevada Research Institute is to discover and disseminate new knowledge that contributes to sustaining the environment and ecosystems of California, and related regions worldwide, through integrated research in natural science, social science, and engineering. This mission is accomplished through:

- Collaborative, multidisciplinary research conducted by faculty, students, and staff from multiple schools and graduate groups at UCM;
- Strong interactions with related research units within the UC system and close collaborative relations with scientists and managers at national laboratories (particularly LLNL) and local, state, and federal agencies;
- Creation of research facilities on the UCM campus and within the Central Valley and Sierra Nevada regions of California;
- Sharing of research results, data and information with public and private stakeholders in the region through publications, fora and workshops;
- Fostering links between understanding of the natural environment, cultural understanding and management of natural resources in the region.

Background

The Sierra Nevada is known for its spectacular landscapes and its many recreational and natural resources. It both provides water that sustains the state’s $1.6-trillion-dollar economy, and houses unique biological resources. The eight-county San Joaquin Valley, part of California’s Central Valley, the Sierra Nevada watershed, is home to 5 of the 10 most agriculturally productive counties in the United States. By a wide range of indicators, the San Joaquin Valley is also one of the most economically depressed regions of the United States.

All of California is legendary for its vast natural resources, physical and biological diversity and cultural heritage. However, climate change; rapid population growth; competition for natural resources; air, water and soil pollution; human exposure to anthropogenic pollutants; and competing, unsustainable land uses pose serious threats to the sustainability of these attributes of the state.

Over the next twenty years the populations of the San Joaquin Valley and Sierra Nevada Regions are projected to increase by 2.5 million and 1 million residents, respectively; a rate nearly 20% higher than the projected statewide average. Population growth in the San Joaquin Valley could convert 20% of current cropland to urban use by the year 2040. If current development patterns continue, low density housing in the Sierra foothills would consume half of all private land in the region by 2040, fragmenting habitats and creating enormous safety concerns due to wildfire. Public lands are also under increasing pressure. For example, Yosemite
National Park now accommodates between three and four million visitors every year, including nearly one-quarter million overnight stays.

Since 1990, there have been repeated calls for a Sierra Nevada research center within the UC that could help address regional ecological and social issues by conducting and coordinating regionally focused, issue-oriented research while disseminating data, information and analytical tools to local stakeholders.¹ Moreover, population growth, land use change, and environmental sustainability are issues not just for California, but also for most areas of the globe. Thus, although regionally focused, the Sierra Nevada Research Institute pursues research in principles and theories that are applicable elsewhere. SNRI research is also promoted through comparative studies in other regions, through cooperative research and exchange programs, and through formal agreements.

The Sierra Nevada Research Institute has thus far been and will continue to be a boon to the new campus by supporting faculty recruitment efforts of the schools, while signaling UCM’s commitment to innovative, multidisciplinary research and teaching programs that are rooted in the region. Importantly, the SNRI also fosters lasting, synergistic relationships between the campus and County, State and Federal agencies, as well as the private sector.²

For FY 2008-09, SNRI faculty were responsible for 25% of the research grants awarded to UC Merced, down from 55% in FY 2007-08 (Table 1). Informal discussions with both academic colleagues and regional stakeholders suggest that in the few years since its founding, SNRI has become a recognized and respected research organization, known both for its science and its contributions to the region.

Table 1. Grant amounts for FY 2007-08 and FY 2008-09

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount, million</th>
<th>Percent</th>
<th>ICR, million&lt;sup&gt;c&lt;/sup&gt;</th>
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<tbody>
<tr>
<td></td>
<td>FY 07-08</td>
<td>FY 08-09</td>
<td>FY 07-08</td>
</tr>
<tr>
<td>Extramural grants</td>
<td>$16.4</td>
<td>$14.2</td>
<td></td>
</tr>
<tr>
<td>Research grants&lt;sup&gt;a&lt;/sup&gt;</td>
<td>$11.3</td>
<td>$14.0</td>
<td>100</td>
</tr>
<tr>
<td>Research grants to SNRI faculty&lt;sup&gt;b&lt;/sup&gt;</td>
<td>$6.2</td>
<td>$3.5</td>
<td>55</td>
</tr>
</tbody>
</table>

<sup>a</sup>Extramural funds less grants for education, small business, etc. to non-faculty
<sup>b</sup>See https://snri.ucmerced.edu/snri/people/html
<sup>c</sup>Assumed to be 30% of grant amount; may be higher.

¹ For example, in 1994 the Sierra Nevada Planning Team recommended creation of a research center that would be: independent, responsive to identified information needs, a repository for existing information, engaged in research that supports decision making, continue to develop new funding sources, and located in the region (Sierra Nevada Planning Team, 1994, “Critical questions for the Sierra Nevada: recommended research priorities and administration,” Centers for Water and Wildland Resource Report 34).

² The interdisciplinary concept of SNRI follows a recent trend in UC to design institutions that promote engagement between the natural and social sciences (e.g., Berkeley's reorganization of several departments into Environmental Science, Policy, and Management, and Santa Barbara's opening of the Donald Bren School of Environmental Science and Management).
Current research

SNRI faculty and research scientists are carrying out both basic and applied research on physical, biological, social and cultural aspects of the region. Some of this original research uses the region as a natural laboratory to understand fundamental processes governing its human and natural systems. Other research is strategically designed to build the knowledge base needed to address emerging regional problems. SNRI faculty have well-established research programs in hydrology, climate, geochemistry, ecology, anthropology and related interdisciplinary fields. Some highlights of the SNRI faculty and their research groups follow. For highlights of research published in the past year, see SNRI’s annual report (Appendix A).

- Tony Westerling has an active research program studying climate-fire connections in the Western U.S., a field that he pioneered and that has important policy implications for resource management in the West.
- Lara Kueppers studies climate-ecosystem interactions, with projects ranging from field measurements of carbon, water and energy fluxes in mountain ecosystems to using a regional climate model to estimate ecosystem feedbacks to climate change in California.
- Peggy O’Day studies arsenic speciation and fate in the environment, carries out a number of other studies of abiotic and biotic geochemical cycling, and works on application and development of remediation technologies.
- Roger Bales is studying the Sierra Nevada snowpack and the hydrologic and biogeochemical response of mountains catchments to climate change.
- Martha Conklin studies the flow paths and residence times that water takes as it moves from high-elevation snowpacks, through soil and bedrock, and finally to downstream rivers and groundwater basins.
- Henry Forman focuses on the molecular biology and biochemistry of signal transduction and cellular adaptation to reactive oxygen species and other electrophiles relevant to the response of the lung to environmental pollution.
- Sam Traina studies carbon cycling in the Sierra Nevada region, as well as the fate and transport of emerging pollutants.
- Tom Harmon carries out a variety of projects pertaining to soil moisture, groundwater, and surface water quality, spanning agricultural, riparian, groundwater, and wetlands related problems in California.
- Kathleen Hull studies the cultural impact of colonial encounters on native people of North America, the interplay of demography and culture, and identity and ethnogenesis in pre-literate societies; she has an ongoing project in Yosemite National Park.
- Qinghua Guo develops and applies geospatial techniques to solve large-scale ecological and geographical problems, with emphasis on the effects of invasive species, climate change, and human disturbance on terrestrial ecosystems in California.
- Benoît Dayrat studies biodiversity, and he also has an NSF-supported undergraduate research program in Yosemite National Park.
- Yihsu Chen does interdisciplinary research focusing on energy and environment, with an immediate focus on the interactions of environmental policies and industry activities.
- Andy Aguilar is applying genetic analyses to evolutionary questions and species conservation, particularly the role that natural selection plays in the generation and maintenance of genetic variation at different evolutionary scales.
- Mike Dawson is continuing his research on elucidating the origins, maintenance, and loss of biodiversity.
- Jeff Wright is building information systems that serve a variety of regional applications, using open-source tools.
- Wolfgang Rogge is establishing a laboratory to study the sources, fate and transformation of air pollutants in urban, regional, and remote environments.
- Valerie Leppert studies nanomaterials for application in technology and the environment.
- Steve Hart focuses on controls on biogeochemical processes and productivity in managed and wildland ecosystems.
- David Ardell does research on computational metagenomics, and has an interest in natural systems.
- Asmeret Behre studies carbon cycling in ecosystems, including the Sierra Nevada.
- Elliott Campbell does research on the sustainability of bioenergy, and studies the global carbon cycle.
- Teamrat Ghezzehei focuses his research on flow and transport in soil and groundwater, and contaminant hydrology.
- Caroline Frank studies genome evolution in prokaryotes and yeast, and has interests in natural systems.
- Jason Raymond studies environmental genomics and has interests in natural ecosystems.
- Michael Sprague is an applied mathematician who works on fluid mechanics problems, and has interests in environmental fluid mechanics.
- Roland Winston works on solar energy, with a current emphasis on applications of non-imaging optics to solar concentration.
- Michael Beman studies biogeochemistry and ecology of oceanic and terrestrial systems.

SNRI faculty and researchers have also initiated several multi-investigator, multidisciplinary studies in the region.
- Martha Conklin, Qinghua Guo and Roger Bales are working with colleagues from UCB and UCD on a long-term, multi-faceted, forest adaptive management study in the Sierra Nevada (http://snamp.cnr.berkeley.edu). The focus is on lands under the management of the U.S. Forest Service, with the state’s Resources Agency also a major partner in the project.
- Anthony Westerling is conducting joint research projects with the USDA Forest Service’s Pacific Southwest, Rocky Mountain, and Southern Research Stations, focused on climate applications for fire, fuel and forest management, including fire climatology, seasonal forecasts, and climate change projections.
- Yihsu Chen is collaborating with Shmuel Oren at Berkeley examining the economic and emissions implications of the load-based, source-based and first-seller emissions trading programs that are now under consideration by the California Energy Commission.

- Lara Kueppers is leading a collaborative, experimental project with UCB, USFS, and other researchers on the migration of treelines in the high mountains of the Western U.S. in response to climate warming.

- Peggy O’Day, Valerie Leppert and Sam Traina were awarded a NSF Major Research Instrumentation (MRI) grant in 2004 for an Environmental Scanning Electron Microscope, and O’Day, Leppert, Traina, and Viney were awarded another NSF-MRI award in 2006 to fund the acquisition of a powder X-ray diffractometer, both in support of interdisciplinary environmental research.

- Tom Harmon and Nigel Quinn (Adjunct Researcher) have obtained two grants aimed at understanding and managing Central California wetlands to preserve this resource while reducing the impact of salinity drainage on the San Joaquin River.

- Anthony Westerling is leading the wildfire component of the Scenarios Project, a climate change impact assessment for the State of California that incorporates climate change and socio-economic scenarios. In 2010-2011, this project will focus on adaptation scenarios for the state. The Scenarios project is coordinated by the California Climate Change Center in partnership with the California Energy Commission and CalEPA.

- Roger Bales, Martha Conklin and colleagues from six other campuses have initiated an NSF-funded Critical Zone Observatory in the southern Sierra, to carry out integrated studies of water and geochemical cycles in the soils, streams and forests across the rain-snow transition, a segment of the mountains that is particularly vulnerable to climate change (https://snri.ucmerced.edu/CZO).

- Tom Harmon and colleagues from UCLA, UC Riverside, USC, and Caltech successfully renewed an NSF-funded Science & Technology Center which supports technology development in support of environmental and ecological observations in terrestrial and aquatic systems.

Research focus areas

The above existing and emerging areas of research help define some focus areas, or areas that build the Institute’s and University’s reputation and research portfolio. SNRI faculty have also identified opportunities to develop additional research foci. Four major existing, emerging and planned focus areas are described, followed by some additional smaller areas of focus that contribute to SNRI’s foundational programs.

**Climate and hydrology.** UC Merced plays a leadership role in multiple aspects of climate and hydrology within the UC system and nationwide. Our climate applications work fills a critical niche in the UC system, connecting fundamental climate science with climate impacts, mitigation and adaptation. The Sierra Nevada and Central Valley offer outstanding opportunities as natural laboratories for research. Together, they offer the research infrastructure and settings to study many of the challenges facing the nation. For example, the snow-dominated hydrology
of the Sierra Nevada makes the range particularly vulnerable to climate change. This is in part because the Sierra Nevada has relatively warm snowfall and snowpacks, and a temperature shift of even just 1-3°C would signal a major shift from rain to snow and earlier snowmelt. Process understanding, technology and predictive tools developed in the Sierra Nevada have application across the West. The vast Central Valley, heavily developed for irrigated agriculture, has extensive areas with declining groundwater levels, saline and nutrient-laden wastewater streams, contaminants leaching from soils, and crops that are sensitive to temperature shifts. The hydrology and climate of the Sierra Nevada and Central Valley have generally received much less research attention than have these topics in coastal California and the Sacramento-San Joaquin Delta, and the need for new knowledge and technology transfer is very large. UCM is beginning to fill a critical niche in the research community and the state through its hydrology, water quality and climate research in the region. Research needs that could be filled by new faculty include climate applications to water resource management, hydroelectric infrastructure management, public health and infectious diseases, air pollution management, and agriculture and forestry. Climate applications include climate-sector interactions, forecasting climatic influences by sector at monthly, seasonal and interannual timescales, climate change impact assessment, and strategies for climate change adaptation and mitigation. Faculty currently involved in climate and hydrology research: Bales, Campbell, Chen, Conklin, Duffy, Ghezzehei, Guo, Harmon, Hart, Kueppers, O’Day, Traina, Westerling.

Ecology and ecosystem science. UC Merced is poised to play a leadership role in the ecology and ecosystem science community in California and the nation. Again, the Sierra Nevada and Central Valley offer outstanding opportunities as natural laboratories for research. Ecosystems are undergoing rapid change, in response to the dual pressures of climate change and land use change, both driven by aspects of population growth. Sierra Nevada forests, which are both critical habitats for diverse fauna and the source of much of California’s water supply, are now especially vulnerable to catastrophic wildfire. Extended dry periods under a more variable and changing climate will further stress these ecosystems, through reduced evapotranspiration, greater susceptibility to pests and disease vectors, and shifting fire and recovery patterns. Over the next few decades the Central Valley will undergo extensive and enormous ecosystem restorations activities, involving investments of several billion dollars. Water now used for agriculture will be diverted to sustain wetlands and riparian areas, and new entities will be established to manage these large tracts of land. In both the Sierra Nevada and Central Valley, the scientific knowledge base for ecosystem management is weak. Yet the potential ecosystem services to be derived from these areas is enormous and absolutely critical to the state’s economy and quality of life. UCM has talented junior faculty who had established research projects in other parts of the world before joining UCM, and would like to develop research in this region when the opportunity arises. Additional hires of tenured faculty are needed, both at UC Merced and in the UC system; however, we are unaware of efforts by other UC campuses to add faculty who will use the SNRI region as a base for their research. Current SNRI faculty: Aguilar, Ardell, Beman, Berhe, Dawson, Dayrat, Frank, Guo, Hart, Kueppers, Raymond.
**Air pollution and public health.** The San Joaquin Valley shares the distinction, with the Los Angeles region, of having the worst air quality in the nation. The population of the region is growing more rapidly than in any other air basin in the state, bringing with it increases in vehicle miles traveled and urbanization. Climate change impacts are also expected to worsen air pollution in the region. These factors counteract progress in emission reductions, threatening to give the San Joaquin Valley the nation’s worst air quality. Without further action, the problem will only get worse. Poor air quality is affecting the region’s public health, economy and general quality of life. These problems make the Central Valley and Sierra Nevada region an excellent natural laboratory for air pollution and environmental health research. Further, research has the potential to have important and direct impacts on public policy. Air pollution sources are diverse and only partially understood. While there is a good general knowledge of health effects in the region, details of causes, mechanisms and impacts of mitigation are poorly known. Two additional connections between health and the environment are important in the region and nationwide: climate-health links, and water-health links. UCM has a pivotal role to play in building the knowledge base on the science of air pollution, its health effects and engineering solutions. Current SNRI faculty contributing to this focus: Forman, Leppert, O’Day, Rogge, Traina.

**Environmental economics, policy and management.** Social science aspects of ecosystems and the environment also offer multiple, unique opportunities for research in the Sierra Nevada-Central Valley region. Again, the combination of population growth, land use change, land-cover change and climate warming interact to place unprecedented stresses on existing infrastructure and institutions. While Sierra Nevada forests have traditionally been managed for timber, recreation and habitat, two main economic issues are water supply and hydropower, and a major new issue now on the policy agenda is management of Sierra Nevada forests for sustainable carbon sequestration. Hydropower generates considerable direct revenue, and the Sierra Nevada water supply is essential for the state’s economy. Research in environmental and resource economics, policy and management is sorely needed to develop and explore valuation issues, markets, incentives, institutions, capacity building, social attitudes and ecosystem sustainability. Sustainable development of the Central Valley in response to population pressures poses multiple challenges, for transportation, air quality, public health, land use, energy, cultural heritage, and their intersections with political, social and cultural values. UC Merced is poised to develop research programs that will both build a knowledge base that will benefit regional decision makers, and also provide general insight into issues relevant across the nation. Current SNRI faculty contributing to this focus are: Campbell, Chen, Hull, Westerling, Wright.

**Additional foundational areas and opportunities.** In addition to the above four major areas of focus for the institute, SNRI faculty are known (inter)nationally for research in biogeochemistry, environmental engineering, anthropological archaeology, environmental fluid mechanics, glaciology, renewable energy, soil science and materials science.
Organization

SNRI personnel include a faculty director (appointed by the Chancellor), affiliated faculty, researcher scientists, support staff, postdoctoral researchers, and student researchers. Note especially that researchers supported by grants play a critical role in defining breadth and depth of SNRI’s programs. Visiting scholars are also expected to play an important role. SNRI is designed to support the overall development of UC Merced. This requires close coordination with other UCM campus development efforts, and has included recruiting some established leaders for the SNRI faculty. These individuals are helping to build programs in their respective disciplines, thereby ensuring that the Institute is integrated into the larger intellectual enterprise of the campus.

The SNRI is organized around an integrated systems model. This model combines the earth sciences (hydrosphere, cryosphere, lithosphere, atmosphere), with biological sciences (biosphere, ecology, molecular biology, genomics), engineering (environmental, systems, computer) and social science (economics, policy, sociology, anthropology) in integrated studies of multi-faceted problems at the systems level. Through these balanced research efforts, SNRI aims to serve as a source of objective scientific information as California faces the growing challenge of sustaining the integrity and quality of its human and natural resources into the future.

The Institute functions as an Organized Research Unit (ORU), in which the Director (a tenured faculty member) holds a fulltime appointment, and whose ladder-rank faculty researchers hold full appointments in their respective Schools. SNRI has adopted bylaws governing membership in and affiliation with SNRI.

SNRI has a formal advisory committee appointed by the chancellor, an internal users committee for its Environmental Analytical Laboratory, a membership committee, and plans for an external advisory committee:

− SNRI advisory committee: This committee, required by UC policy, is primarily comprised of faculty, but may also include members from the professional research series or from outside the university. The committee provides counsel to the Director and Executive Vice Chancellor on all matters pertaining to the unit, including budgetary matters and personnel.

− Environmental Analytical Laboratory (EAL) users group: This ad hoc committee is appointed by the SNRI director from among the SNRI members to provide oversight of the EAL. It is open to any active user of the EAL.

− Membership committee: This committee is appointed by the SNRI director from among the SNRI members to provide screening and approval of requests for SNRI membership.

− External Advisory Committee: It is planned to form an External Advisory Committee comprised of individuals from the public and private sectors to provide the Director with advice on research issues of relevance to the region, and resource issues.

University-supported positions. The memo of December 17, 2007 from the UCM Chancellor establishing SNRI as an organized research unit (ORU) envisioned a transition to a budget level based at least in part on indirect cost return. At present SNRI operations are largely supported by state funds. Some fraction of SNRI operations are beginning to be supported by recharge and user fees, but delays in consolidating SNRI facilities and in establishing recharge accounts and
procedures for the campus has made that source of revenue quite limited in the past. It is expected to ramp up that source of revenue in the FY 2010-11 budget.

The success of research and educational activities nurtured by SNRI depends on adequate staffing to cover administrative, laboratory and operations support: Current SNRI staff consist of:

- SNRI director: Roger Bales
- Management Services Officer: Sandra Steaples
- Administrative assistant to the director: vacant
- Field station director: Eric Berlow
- Environmental analytical lab director: Liying Zhao (0.5 FTE state support, 0.5 FTE lab startup grant)
- Field station maintenance manager: Tim Rumble (0.5 FTE)

With the formation of SNRI as an ORU and scope of program building activities underway, the demands for administrative support continue to greatly exceed what SNRI staff can provide. The level of administrative support needed for coordinating meetings, scheduling appointments, handling correspondence, tracking vehicles, supporting facilities, assisting with hiring, assisting with financial transactions, managing business operations and operating the SNRI office have all grown. New initiatives include expansion of SNRI field facilities, establishment of some as UC Natural Reserves, setting up policies and procedures for SNRI, addition of new faculty to SNRI, and increases in the level of most other SNRI activities. Two positions are needed to further support the research expenditures and research accounting of SNRI faculty, research scientists and students. Both positions are justified given the level of research activity associated with SNRI faculty and research scientists. SNRI provides research support to faculty, research scientists and students for purchasing and travel. Additional university-supported positions needed, in order of priority, include:

- Environmental analytical lab director (0.5 FTE): The 0.5 FTE supported by a lab startup grant from NSF ends in spring 2010. State support is needed to replace this 0.5 FTE in order to continue operation of the EAL.
- Administrative specialist (2 FTE). See above.
- Sequoia/Kings Canyon station manager (0.75 FTE). This position was proposed in the original SNRI prospectus.
- Education and Outreach Coordinator (0.5 FTE minimum). This position was proposed in the original SNRI prospectus.

Additional positions are planned from other sources of funds:

- Environmental analytical lab assistant (recharge position)
- Campus Reserve director (campus reserve funds)

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3 Discussions continue as to how these services should be organized campuswide. An informal poll of SNRI faculty suggests that there is a strong preference for these services to be provided by SNRI for contracts and grants, rather than by staff assigned to a school dean’s office.
Research positions. As an ORU, SNRI offers an academic home for research scientists who are not tenure-track faculty and offers appointments to project-related personnel, career-track research scientists and scientists from outside UC Merced. Project-related personnel will include post-doctoral researchers and research staff with appointments of one or more years. SNRI also serves as home for a select group of career-track researchers who provide important continuity and breadth to SNRI research programs. These researchers are largely supported by contracts and grants, with supplemental support for teaching selected courses. They are also involved in supervising graduate students, supported on their grants. One immediate challenge concerns how SNRI and UC Merced can be a professionally attractive home for these individuals, and provide the continuity of resources needed for them to be successful. Scientists whose primary position is outside UC Merced but who desire an affiliation with SNRI also contribute to our breadth and strength. These include both courtesy (unpaid) and paid appointments. For example, researchers with federal or state agencies, or research industrial affiliates, often complement the disciplines and perspectives of full-time UCM personnel by providing research breadth or research-applications partnerships. It is expected that these affiliates will serve as research collaborators, e.g. co-investigators on grants, co-supervisors of graduate students, supervisors of undergraduate research, and may also contribute to graduate education through workshops or co-teaching courses.

Facilities

The Institute’s offices are in the first Science and Engineering (SE1) building, at the UC Merced campus. SNRI has a well-developed field station in Wawona, in Yosemite National Park, a developing field station in Sequoia-Kings Canyon National Parks, and is planning is underway for additional field facilities elsewhere in the Sierra Nevada and Central Valley. SNRI-affiliated faculty offices, labs and space for research groups are currently in SE1, at Castle, and in the first classroom building. Some SNRI faculty share a small field staging facility located at Castle. SNRI research projects use several field sites in the Central Valley and Sierra Nevada region. In order to sustain its research activity, SNRI must look for opportunities for campus research space to supplement that available through the schools. We recommend that in addition, space in one or more of the modular buildings be designated for SNRI-affiliated research offices and laboratories, beyond what is currently assigned or can be accommodating in SE1. This space would accommodate faculty and researchers from all three of UCM’s schools who would benefit by being co-located. SNRI is also exploring opportunities to secure donor-supported space on campus.

SNRI operates the EAL, which was recently relocated to campus and consolidated in SE 201. This is a campus-wide multi-user facility dedicated to elemental and speciation analyses of liquid, solid, and gas environmental samples. There are currently eight major items of instrumentation in this laboratory, plus supporting sample-processing equipment (Table 2). Currently, partial support for the laboratory director’s salary is provided by a three-year National Science Foundation (Earth Sciences Division) technician support grant. User fees will soon

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4Strategic Plan for Field Facilities, Sierra Nevada Research Institute, UC Merced. August 2008.
begin to offset some of the operating and maintenance costs of these instruments, but ramp-up of recharge to a significant revenue stream will require several years. SNRI-affiliated faculty are working on NSF proposals to add analytical equipment to the EAL. Over the next five years, they envision acquisition of a liquid chromatography-mass spectrometry (LC-MS) instrument, a capillary electrophoresis-MS and one or more mass spectrometers. These and other instruments will be added to the EAL as grant dollars and/or gift money become available. There are also plans to establish a stable isotope facility, either as part of or in parallel with EAL.

Table 2. EAL equipment

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<thead>
<tr>
<th>Equipment</th>
<th>Description</th>
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<tbody>
<tr>
<td>ICP-MS</td>
<td>For trace multi-element analysis (~ mid-ppt to ppb range) in water, sediment, soil and other environmental/biological samples.</td>
</tr>
<tr>
<td>ICP-OES</td>
<td>For multi-element analysis (~ mid-pb to ppm range) in water, sediment, soil and other environmental/biological samples.</td>
</tr>
<tr>
<td>AA-GF</td>
<td>For inorganic analysis of major and trace elements.</td>
</tr>
<tr>
<td>GC-MS</td>
<td>For quantification and characterization of trace levels of low MW organic compounds in environmental and biological samples.</td>
</tr>
<tr>
<td>TOC/N</td>
<td>For total organic and inorganic carbon and nitrogen determination in water and solid samples.</td>
</tr>
<tr>
<td>FIA</td>
<td>For determination of major nutrients, including nitrite, nitrate, ammonia, silica, phosphorous, etc. in water samples.</td>
</tr>
<tr>
<td>Isotope Analyzer</td>
<td>For measurement of hydrogen and oxygen isotope ratios in liquid water samples.</td>
</tr>
<tr>
<td>IC (2)</td>
<td>For analysis of major anions and cations in river, snow and rainfall water samples.</td>
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<tr>
<td>Automated microwave digestion system</td>
<td>For solids digestion and muffle furnace.</td>
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In May 2004 the UC, NPS and USGS dedicated the SNRI field station at Wawona. The first Station Director was hired in February 2006. This station has recently been admitted to the UC Natural Reserve System as the Sierra Nevada Research Stations, Yosemite Field Station (YFS). The mission of the Yosemite Field Station is to facilitate multiple synergistic links among science, education, resource management, conservation, and the arts. For example, the educational value of a student doing science is likely to be greatly enhanced if that project has immediate, real applications to resource management and conservation. Similarly, the conservation applications of an academic research project will be much more effective if a visual artist helps creatively communicate the results to a general audience. To achieve this mission, the YFS provides logistical support (office space, high-speed internet access, lab and classroom space, and housing) for research, education, and collaborative workshops inside Yosemite National Park. It also provides programmatic support by acting as a liaison between the university and the science and education divisions of Yosemite. User days at YFS averaged 224, 364, and 376 per month, and totaled 2,511, 4372, and 4512 per year for the 2006-2007, 2007-2008, and 2008-2009 fiscal years, respectively. Current facilities include:

- Office building – This 1,420 ft2 historic building (built in 1934) has office space for 8 people and additional temporary space for 2-3 more. It also houses a small laboratory space, and a communal kitchen.
- Detached classroom and workshop – This historic stable contains one class/meeting room space and a general use workshop and storage space. The class/meeting room can accommodate groups of 20-25 people. It can also be used for temporary office space.
– Station director's residence – This 3-bedroom, 3.5-bath house was refurbished in the spring/summer of 2006.

– 6 Guest Houses – The 2-bedroom, 1-bath Vincent house was refurbished in the spring/summer of 2006. The spacious 5-bedroom, 3-bath Livingston house was refurbished in 2009 and sleeps up to 16 people. It has a very large kitchen/living room and an expansive deck that can accommodate large groups (e.g., 30-40 people). Both the Vincent and Livingston houses are furnished to accommodate professors and research families in addition to students or research crews. Two other 3 bedroom, 2 bath houses (Joyce and Dull) have 9 beds each, mostly as bunks or twin beds, and serve to house students participating in summer programs. Two other 1-bedroom, 1-bath houses (Bruce and River Rd cabins) are being refurbished this winter. All houses except the last two (Bruce and River cabins) have phone and wireless internet access.

– Through a partnership with the Yosemite Association, the Yosemite Field Station has access to one additional two-bedroom house in Wawona that is designated for student use.

– Through a partnership with the Wawona Elementary School, the Yosemite Field Station has access to camp sites, showers, a kitchen, and classroom space for 10 students that participate in a SNRI-sponsored summer high school English literacy and leadership training program in the park.

– Through our partnership with Yosemite National Park, for larger gatherings (e.g., lectures), SNRI has access to the Wawona Community Center, which can accommodate ~80 people.

Together, the guest housing capacity by spring 2010 will be enough to house a critical mass of high school students, undergraduates, graduate students, researchers, professors, and field crews to create a vibrant learning community in Yosemite.

UCM also renewed its MOU with Sequoia and Kings Canyon, and Yosemite National Parks, which provides for establishment of a SNRI field station in Sequoia and Kings Canyon National Parks. Like YFS-Wawona, the field station proposed for Sequoia and Kings Canyon will be available for use by faculty, staff and students of the University of California, as well as the larger academic community. The current annual operating costs for YFS are about $150,000. User fees to offset some to the operating costs of field facilities have been proposed, and will be implemented when administrative review within UCM is completed.

In fall 2007, SNRI submitted a proposal to gain NRS designation for YFS, along with a broader plan for development of field facilities on the west slope of the Sierra Nevada. The proposal was favorably received by the UC-NRS committee, approved by the UC Regents, and the facility is now part of the NRS.

SNRI prepared a separate strategic plan for field facilities, outlining an integrated network of facilities along both North-South and East-West in the Sierra Nevada and Central Valley:

– **North-South transect** – SNRI will focus on establishing facilities on the west slope of the Sierra Nevada. There already exists a strong network of field stations in the Eastern Sierra and in the Central Valley. SNRI field stations will fill a critical gap in research facilities on the west slope of the Central and Southern Sierra. Facilities along this North-South gradient will span important gradients in regional climate, precipitation, and air pollution patterns.
- **East-West transects** – each field station will provide a base for research along elevation gradients that span from grassland to chaparral to montane to sub-alpine communities. A vernal pool reserve near the UCM campus will complete a larger East-West transect from the Central Valley to the Sierra crest. Research foci will be established by investigator-defined priorities of critical environmental and socio-economic issues facing the broader Sierra Nevada Eco-Region.

  Discussions with land owners/managers are ongoing, and it is planned to develop four more facilities over the next few years, in addition to YFS, SNRI will seek NRS designation for some of these facilities. Sites include:

  - Sequoia National Park: The goal is to develop a field station in the park, incorporating the current work space with high-speed internet and telephone and a cabin at Wolverton.
  - Kings River Experimental Watershed (KREW): in the Sierra National Forest: The Pacific Southwest Research Station (PSW) of the U.S. Forest Service (USFS) is planning a new year-round research building along Dinkey Creek Road, at the Dinkey Mill site. With a major UCM research program now starting at KREW, plus a NEON presence proposed for the site, the goal is for SNRI to develop UC research space in conjunction with the PSW expansion.
  - San Joaquin Experimental Range (SJER): Proposed as the NEON core site for California, SJER is currently operated by the USFS and Fresno State. Discussions with UC colleagues planning NEON in California, and PSW are ongoing. SNRI is taking the lead role in planning and eventually managing the NEON facilities, when funds become available from NSF.
  - Campus Reserve: The goal is to enhance research opportunities in the vernal pool ecosystems that are being preserved as part of the campus development. The Trust land is over 6,000 acres, with an adjacent 4,000-acre parcel also protected.

  There are two further research infrastructure projects that provide substantial and unique opportunities for research in the region, both of which are in the early stages of implementation:

  - CalEON: The California Ecological Observatory Network (CalEON) is a regional network of field sites, natural history museums, and university labs (http://www.caleon.org). One proposed new component of CalEON is near the UC Merced campus. The National Ecological Observatory Network has designated a central California site for a major research infrastructure investment, with SNRI taking responsibility for developing and managing the facilities. While research will be carried out by researchers from other UC campuses and around the world, the close proximity of the CalEON facilities in the region offers special opportunities for ecological and related research.
  - Sierra Nevada-San Joaquin Hydrologic Observatory. SNRI faculty are working with colleagues from other campuses and governmental researchers to build research infrastructure for hydrologic and related research in the Sierra Nevada and San Joaquin Valley. We have established five instrumented research sites on the west slope of the Sierra Nevada and two in the San Joaquin Valley.
Educational activities

Although SNRI will not offer graduate or undergraduate courses, it does nurture a number of educational activities. SNRI faculty contribute to multiple undergraduate degrees and graduate groups. Three-fourths of the SNRI faculty are also members of the Environmental Systems graduate group; overall, SNRI faculty are drawn from six of UCM’s nine graduate groups.

The Environmental Analytical Laboratory (EAL) is engaged in the educational mission of UC by providing access to instrumentation for relevant laboratory courses and supporting graduate and undergraduate research. Now that the EAL is consolidated on campus, SNRI faculty plan to offer an upper division/graduate course in Instrumental Methods in Environmental Systems (ES 206/ESS 106) based on EAL instruments and supporting facilities.

While the Yosemite Field Station was originally intended to be primarily a physical space that facilitates investigator-initiated projects or class field trips, we have established several funded programs to encourage K-12, undergraduate, and graduate education and research at SNRI. The broader vision for these educational programs is an integrated, inter-generational youth leadership program that creates a pipeline of students at different stages from early high school to recent graduates and graduate students. High School programs in AY 2008-09 include:

- **Adventure, Risk, Challenge (ARC)** – ARC is a year-round educational outreach program that partners UCM and Yosemite National Park with public high schools and underserved communities of the Central Valley to engage English language learner (ELL) high school students. A 6-week immersion summer course at the field station integrates a rigorous curriculum of outdoor education, leadership training, English literacy, and science. ARC addresses the needs of at-risk ELL students and enables them to be successful high school students, highly competitive college applicants, and ultimately our next leaders.

- **Yosemite High School** (Oakhurst, CA) AP Environmental Science program – The class is conducting a long-term fire ecology study to investigate the effects of prescribed fire on forest soil and invertebrates. SNRI and the park fire ecologist assist with the study design and the research permitting process.

- **Environmental Science Academy** (Merced Union High School District, MUHSD) – Under this program 25-35 high school students come every summer and study a range of topics inside Yosemite. Classes are provided by park scientists and resource managers as well as by UCM SNRI scientists. Already, some of the graduates of the program have gone on to UCM and have returned to Yosemite as summer interns and as seasonal park rangers.

- **Robert Fore Fellowship** (Merced Union High School District, MUHSD) – This program provides training for 16 high school science teachers in the MUHSD. The teachers learn about ongoing research by SNRI, U.S. Geological Survey (USGS) and Yosemite National Park researches. They discuss issues at the interface of science and conservation, and share ideas about how to incorporate new material into their lesson plans.

Undergraduate and other programs in AY 2008-09 included:
Future faculty needs

SNRI draws faculty from all of UCM’s schools. The research initiatives that we are pursuing, and the graduate and undergraduate degree programs associated with them, span the university. Thus, long-range planning requires a university-wide view of programmatic development and needs. The faculty hiring plan is derived from the need for balanced growth among the thematic areas described above, graduate and undergraduate teaching demands, and identification of cross-school and cross-discipline hires that support multiple degree programs and research areas. The following are the SNRI priorities for faculty hiring. Table 3 lists priorities and maps these positions onto undergraduate teaching in the schools, and possible graduate group affiliations. SNRI faculty especially recommend broadening the disciplinary base of SNRI, to include areas not currently represented.

Recommended positions are grouped in four areas, with approximate priority ranking within each area. Ranking is approximate, because while SNRI faculty did express preferences, we did not try to achieve an absolute priority ranking. That is, the positions higher in the list are highest

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**SNRI strategic research opportunities**

**Ecosystem restoration in Central Valley & Sierra Nevada**: The recommended positions in ecological engineering, and all of the ecosystem science positions could contribute.

**Climate applications**: Most of the recommended positions could contribute to UCM’s growing strength and visibility in this cross-cutting area.

**Public health**: Air pollution is perhaps the greatest public health issue in the region & several positions could address this need.

**Environmental management**: Several of the recommended positions will contribute to the development of a broad-based management program at UCM.
priority for filling immediately, while ones lower in the list could be deferred to a later year. In each area two highest priority positions are identified. Nevertheless, all positions listed would make important contributions toward building our vision of a vigorous, balanced and relevant research portfolio at UCM. We hope that through strategic partnerships with undergraduate majors, graduate groups and planned institutes we can achieve this.

Table 3. Summary of faculty hiring priorities

<table>
<thead>
<tr>
<th>Area^a</th>
<th>Possible undergraduate teaching</th>
<th>Possible grad group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate &amp; hydrology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>→ Ecological engineering or ecohydrology</td>
<td>x</td>
<td>ES, BEST</td>
</tr>
<tr>
<td>→ Climate: paleoclimate or atmospheric dynamics</td>
<td>x</td>
<td>ES</td>
</tr>
<tr>
<td>Earth surface processes</td>
<td>x x</td>
<td>ES</td>
</tr>
<tr>
<td>Hydrometeorology</td>
<td>x x</td>
<td>AM, ES</td>
</tr>
<tr>
<td>Ecology &amp; ecosystem science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>→ Ecological or ecosystem modeling</td>
<td>x</td>
<td>ES</td>
</tr>
<tr>
<td>→ Global change ecology or paleoecology</td>
<td>x</td>
<td>ES</td>
</tr>
<tr>
<td>Wildlife conservation biology</td>
<td>x</td>
<td>ES</td>
</tr>
<tr>
<td>Ecology of infectious diseases</td>
<td>x</td>
<td>QSB, ES</td>
</tr>
<tr>
<td>Air pollution and public health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>→ Air pollution, modeling, management &amp; control</td>
<td>x x</td>
<td>ME, ES</td>
</tr>
<tr>
<td>→ Environmental health or epidemiology</td>
<td>x</td>
<td>ES, BEST, QSB</td>
</tr>
<tr>
<td>Environmental toxicology</td>
<td>x</td>
<td>QSB</td>
</tr>
<tr>
<td>Environmental health policy</td>
<td>x x</td>
<td>SCS</td>
</tr>
<tr>
<td>Environmental economics, policy &amp; management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>→ Natural resources management</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>→ Environment and society</td>
<td>x x</td>
<td>SCS, WC</td>
</tr>
<tr>
<td>Sustainability &amp; land use planning</td>
<td>x x x</td>
<td>SCS, ES</td>
</tr>
<tr>
<td>Environmental ethics</td>
<td>x x</td>
<td>SCS, WC</td>
</tr>
</tbody>
</table>

^a arrow indicates position is highest priority; see also Appendix B, tables in CAPRA format.

Brief description of highest priority areas:

→ **Ecological engineering or ecohydrology.** We recommend an assistant or associate level search for a faculty member who uses engineering principles to design sustainable systems that integrate human activities with the natural environment, with particular emphasis on the linkage between hydrologic and ecological systems. Possible areas of research emphasis include interactions among hydrologic, biogeochemical, physiological, and soil processes; hydrologic ecosystem services, integrating water quality, water cycling; spatial analysis and scaling. Use of remote sensing, field-based measurements, laboratory experiments and modeling are all of interest. As a discipline, ecohydrology addresses the bi-directional regulation of hydrologic and ecological processes, e.g., the flow regime and pollutant levels.
of water in wetlands regulate the species and the populations that live in the ecosystem, while ecological processes in the wetland regulate the timing and magnitude of water and nutrient fluxes through the system. Ecological engineering involves the design, construction, restoration and management of aquatic and terrestrial ecosystems that have value to both humans and the environment, using principles from engineering, ecology, economics, and natural sciences. The extensive and large-scale ecosystem restoration efforts planned in the Central Valley provide excellent opportunities for both natural laboratories, and research support through applications partnerships with local landowners and conservation entities. Similar efforts are being carried out across the Western U.S. This position would have collaborative opportunities and synergy with Campbell, Bales, Conklin, Harmon, Guo in SoE and Aguilar, Dayrat, Kueppers, O’Day, Traina in SoNS.

→ **Climate: dynamics or paleoclimate.** We recommend an open rank search for a faculty position with research on climate and environmental changes on a variety of time scales, but with particular emphasis on the Holocene. Research could focus on paleoclimate data analysis, climate dynamics/modeling, field/laboratory studies or some combination. In the modeling area, research could address theoretical or modeling aspects of synoptic and/or mesoscale processes, or could combine knowledge of atmospheric dynamics with expertise in global or regional climate modeling. The position is also central to sustaining and building our strength in climate applications. This position would have collaborative opportunities and synergy with Bales, Campbell, Westerling in SoE, Kueppers in SoNS, and Hull in SSHA.

→ **Ecological or ecosystem modeling.** We recommend an assistant or associate professor search in the area of ecological or ecosystem modeling. Mathematical models and systems analysis are frequently used to describe population, community, and ecosystem dynamics, and for the control of environmental pollution and management of resources. Research areas could include population and species interactions, ecological responses to global change, forest ecosystem dynamics, or agroecosystems. This position would provide a strong complement to other positions emphasizing field observation and experimentation, including searches in progress, ecohydrology, restoration ecology, global change ecology and others. This position would have collaborative opportunities and synergy with Campbell and Westerling in SoE and Aguilar, Behre, Beman, Dawson, Dayrat, Hart, Kueppers in SoNS.

→ **Global change ecology or paleoecology.** We recommend an open rank search, with an emphasis on ecophysiology, invasive species or ecosystem processes. Agroecology is another possible area of emphasis. Paleoecology provides necessary context to ecological management, and paleoecological field methods are a critical component for graduate programs in environmental systems and ecology. Someone who works on the effects of human activities on remaining grassland systems would also be of particular interest. The Sierra foothills and San Joaquin valley offer tremendous natural laboratory opportunities, including research infrastructure, linkages with research by land management agencies and applications partnerships. This is a particular opportunity within the UC system. This position is an excellent complement to research by Berhe, Guo, Hart, Kueppers, Westerling, Bales, Conklin, Guo, Campbell.
→ **Air pollution modeling, management and control.** We recommend an assistant or associate professor position, preferably someone with both a management and technology focus in the area of air quality engineering. A background in mechanical engineering is desirable. This position could focus on engineering design of systems, technology for air pollution control, or modeling and impacts of air pollution. California’s Central Valley offers an excellent natural laboratory for research to devise air pollution control systems. Organic and inorganic particulates, persistent organic pollutants, and precursor gases for ozone formation are produced during routine agricultural practices and weekday commutes. These pollutants are lofted into the atmosphere to interact with other chemicals or microbes and are eventually deposited in the respiratory systems of humans and animals, as well as on plant leaves. The resulting effects on human and ecosystem health are devastating. A significant air pollution-related research effort aimed at the understanding and mitigating the escalating air quality problems in the Central Valley, Sierra Nevada, and elsewhere has already been initiated in the Environmental Systems graduate group. This new position could also be helpful in understanding the effects of air quality on climate and of climate policy on air quality. This position is central to our developing strength in the air pollution area, and is an excellent complement to research by Rogge, Traina, Westerling.

→ **Environmental health or epidemiology.** This position contributes to an environmental health/air pollution focus. This person should be either a biostatistician/epidemiologist and/or molecular epidemiologist. Priorities would be for research focusing on asthma, lung cancer or cardiovascular disease as these are major problems associated with air pollution, which are the leading causes of health problems with major financial impact on the San Joaquin Valley. This position is an excellent complement to research of Forman, Traina, and Leppert, and as well as the two other proposed environmental health positions. The teaching role for this person could be in statistics, molecular biology or physiology dependent upon their expertise. As this would be the first epidemiologist, a senior position is recommended.

→ **Natural resource management.** It is recommended that a tenured faculty member at the full or associate professor level be hired in this area. It is expected that this person would help lead the planning for a natural resources management track within the proposed management program and eventual School of Management. A research emphasis on water, forest, or range would complement existing faculty and help fill an important niche in the UC system. This person could also contribute to planning for a Center for Spatial Analysis that is being investigated by faculty in SoE and SSHA, contribute to developing a Geography degree at UCM, and contribute to refocusing of the Earth Systems Science degree in the School of Natural Sciences. At the graduate level, a number of discussions have taken place around starting a program in Public Lands Management, with linkages to the NPS, USFS and other land-management agencies; and this person could also anchor that program. This position should complement Hart, who has some expertise in this area, having been on the faculty in natural resource programs for 19 years before coming to UCM; Hull, who has 20 years experience in cultural resource management, and potentially UCM’s World Heritage program.
Environment and society. Natural disasters and ecosystem change are fundamental processes that occur without human influence, but most environmental process are affected by and affect humans and their social organizations. Technical solutions currently exist for many environmental problems, but they cannot be implemented without consideration of the human dimensions of the environment, including the diverse values, understandings, and perceived needs of various constituencies. A mid-career or senior faculty member in the area of environment and society would be invaluable to the SNRI, providing leadership in our research and educational efforts in this area. As noted in the Sierra Nevada Ecosystem Project, such research might encompass approaches to integrative adaptive management, or alternatively, consider diverse issues such as environmental justice and the place of “clumsy institutions” in environmental politics and policy. Collectively with Professors Chen, Hull and Westerling, this position in SSHA would build the social sciences core at UC Merced in the broad area of environmental social sciences. This combination of positions would create a core of excellence that could contribute to the research agenda of SNRI as well as the management program. Finally, this position would contribute greatly to the development of a cross-school undergraduate minor and/or major in the environment.

Brief descriptions of the second priority positions:

- **Earth Surface Processes.** Quantitative study of physical processes at and near the Earth’s surface, including areas such as process geomorphology, landform/landscape evolution and forecasting, land surface geochronology, sediment transport/hydrogeology, and land use-ecosystem interactions. Many individuals in this field are employing remote sensing and GIS methods, as well as surface age dating and other geochemical approaches that would interface well with SNRI initiatives, as well as supply much needed expertise in physical surface processes. This is a critical area that can help provide integration among current SNRI strengths in hydrology, geochemistry/biogeochemistry, ecosystem science and spatial analysis. This type of individual would strongly contribute to graduate research in Environmental Systems and to the development of an interdisciplinary cross-school major. The position could also be central to our strengths in climate applications. In its AY 2006-07 strategic plan, SoNS listed Earth surface processes as one of its future priorities.

- **Hydrometeorology.** We recommend an assistant professor position with a research emphasis on precipitation processes, boundary-layer meteorology, meteorological hazards, environmental/atmospheric fluid mechanics and/or climate change impacts on extreme hydrologic events. Due to the extensive coupling between the atmosphere and hydrosphere, it is necessary to consider the entire system in order to understand the role of individual components. Research in hydrometeorology is expected to focus on environmental prediction, at scales that are relevant for engineered systems such as dams, levees, drainage networks, transportation networks and urban development. This position could build our strength in climate applications for the region’s water resources.

- **Wildlife conservation biology.** We recommend an open rank search, with an emphasis on research opportunities in the Sierra Nevada and/or Central Valley. The need for an ecologist who can bring modern techniques to the study of wildlife populations is great, and not being
met by other campuses. The timing is particularly critical, given the habitat changes that will result from climate change and land use change, plus the active restoration activities in the region. Priority research areas include: population biology, behavioral ecology, conservation, behavioral endocrinology and evolutionary ecology. We should seek an individual whose research is based on field studies (including GIS), generally using observational rather than experimental methods. This position is an excellent complement to research by Aguilar and Dawson.

- Ecology of infectious diseases. We recommend an open rank search for a person who will focus on understanding the ecological and biological processes that govern relationships between human-induced environmental changes and the emergence and transmission of infectious diseases. This is an interdisciplinary research area that will draw upon both ecological and biomedical methods to study how environmental events—such as habitat alteration, biological invasion, climate change and pollution—alter the risks of emergence and transmission of viral, parasitic, and bacterial diseases in humans and other animals. Prediction and control are of primary importance. Infectious disease agents affect all living organisms, can have complex life histories involving multiple species, and can be specialists or generalists in terms of host preference. The interface between humans and both domestic and wild animals is a region ripe with opportunity for emerging diseases—those that were not pathogenic in the original host, but are in the new host (e.g., Hantavirus, SARS). Evolution of infectious agents and their plant and animal hosts is also a critical component of research for understanding the ecology of infectious disease. UCM is uniquely positioned for research in this area, literally located in the transition zone between suburban, agricultural and natural ecosystems. Migratory birds use Central Valley agricultural fields as stopover points, and human migration supports the agricultural industry. Air pollution can make stressed organisms more susceptible to infection. This position was identified in prior AY SoNS strategic plans.

- Environmental toxicology. This position contributes to an environmental health focus. This person should be either a biochemist/molecular biologist or pathophysiologist. Priorities would be for research focusing on air- and water-borne toxicants as these are major issues in the San Joaquin Valley. This position is an excellent complement to research of Forman, Traina, Leppert, Rogge and O’Day as well as the two other new environmental health positions. The teaching role for this person could be in biochemistry/molecular biology or physiology dependent upon their expertise. An open search is recommended.

- Environmental health policy. This position contributes to an environmental health/air pollution focus. This person should be a health economist/political scientist. The greatest obstacle to implementing the clean air act in the San Joaquin Valley is probably not the availability of technology. Rather, understanding and resolving the economic and political implications of compliance appears to be the major problem. Balancing the economic, political and health implications while interacting with scientists and engineers (such as Forman, Traina, Leppert, Rogge and the other two new environmental health recruits, as well as Westerling), who are bringing new information to the table would be the goal of this
individual. The teaching role for this person could be in economics or political science dependent upon their expertise. A senior search is recommended as this is a new area.

- **Sustainability and land use planning.** We recommend an open-rank search for an individual who will contribute to an emerging focus at UCM in sustainable development, with this focus on community development and land use. Land use planning will play an important role in both climate change adaptation and mitigation strategies, and this position could help to build climate applications capacity at UC Merced that supports policy making in the state and nationally. This position could link to the proposed restoration ecology, conservation biology, air pollution management, environmental health policy, and resource management positions, as well as to current faculty. There are multiple opportunities for applications partnerships in the region, particularly associated with the recently initiated, long-term valley-wide planning activity.

- **Environmental ethics.** A cross-disciplinary position intended to foster interdisciplinary understanding of human life in relation to the natural world. Such a position might identify and analyze ways in which culturally constructed representations of Nature (e.g., in literature, the arts, popular culture, scientific and social scientific rhetoric, environmental discourses, and everyday common sense) shape the ethics of human interactions with the natural environment and shape perceptions of environmental problems and solutions. Specific areas might include environmental law, diplomacy, trans-national activism, natural resource use, global change, sustainable development, biodiversity, and transboundary pollution control, even extending to consider cultural assumptions and social models embedded in the language of environmental science and the policies and practices surrounding the term environmental justice.


Appendix B: Faculty hiring priorities in CAPRA format (attached)
<table>
<thead>
<tr>
<th>Priority</th>
<th>Position</th>
<th>Level</th>
<th>Primary ug major</th>
<th>Secondary ug major</th>
<th>Primary grad group</th>
<th>Secondary grad group</th>
<th>Startup costs</th>
<th>Space needs</th>
<th>Special needs &amp; strategic issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ecological engineering or ecoproductivity</td>
<td>Assistant or associate</td>
<td>Bioengineering</td>
<td>Environmental engineering</td>
<td>ES</td>
<td>BEST</td>
<td>$300-500k</td>
<td>Office + 1,200 sf wet/dry lab</td>
<td>Possible use of GIS or field facilities</td>
</tr>
<tr>
<td>1</td>
<td>Climate: paleoclimate or atmospheric dynamics</td>
<td>Open rank</td>
<td>Earth system science</td>
<td>Environmental or mechanical engineering</td>
<td>ES</td>
<td></td>
<td>$200-300k</td>
<td>Office + 800 sf dry lab</td>
<td>Possible use of GIS facility</td>
</tr>
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<td>Ecological or ecosystem modeling</td>
<td>Assistant or associate</td>
<td>Biology</td>
<td>Earth system science</td>
<td>ES</td>
<td>QSB</td>
<td>$200-300k</td>
<td>Office + 1,200 sf dry lab</td>
<td>Possible use of GIS facility</td>
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<tr>
<td>1</td>
<td>Global change ecology or paleoecology</td>
<td>Open rank, full if possible</td>
<td>Biology</td>
<td>Earth system science</td>
<td>ES</td>
<td>QSB</td>
<td>$300-800k</td>
<td>Office + 1,200 sf wet/dry lab</td>
<td>Possible use of GIS or field facilities</td>
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<td>1</td>
<td>Air pollution, modeling, management &amp; control</td>
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<td>Mechanical or environmental engineering</td>
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<td>ME</td>
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<td>1</td>
<td>Environmental health or epidemiology</td>
<td>Senior associate or full</td>
<td>Biology</td>
<td>Earth system science</td>
<td>QSB</td>
<td>ES</td>
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<td>1</td>
<td>Natural resources management</td>
<td>Senior associate or full</td>
<td>Management</td>
<td>Earth system science</td>
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<td>SCS</td>
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<td>Possible use of GIS or field facilities</td>
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<td>1</td>
<td>Environment and society</td>
<td>Senior associate or full</td>
<td>Anthropology, Sociology or political science</td>
<td>Management</td>
<td>SCS</td>
<td>WC</td>
<td>$100-200k</td>
<td>Office</td>
<td>Possible use of GIS facility</td>
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<tr>
<td>Priority</td>
<td>Position</td>
<td>Level</td>
<td>Primary ug major</td>
<td>Secondary ug major</td>
<td>Primary grad group</td>
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<td>Startup costs</td>
<td>Space needs</td>
<td>Special needs &amp; strategic issues</td>
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<td>Earth surface processes</td>
<td>Assistant or associate</td>
<td>Earth system science</td>
<td>Environmental engineering</td>
<td>ES</td>
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<td>$300-500k</td>
<td>Office + 1,200 sf dry lab</td>
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<td>Earth system science or math</td>
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<td>2</td>
<td>Wildlife conservation biology</td>
<td>Open rank, senior if possible</td>
<td>Biology</td>
<td>Earth system science</td>
<td>ES QSB</td>
<td></td>
<td>$200-300k</td>
<td>Office + 1,200 sf dry lab</td>
<td>Possible use of GIS or field facilities</td>
</tr>
<tr>
<td>2</td>
<td>Ecology of infectious diseases</td>
<td>Open rank, senior if possible</td>
<td>Biology</td>
<td>Earth system science</td>
<td>QSB ES</td>
<td></td>
<td>$300-800k</td>
<td>Office + 1,200 sf wet lab</td>
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</tr>
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<td>Environmental toxicology</td>
<td>Open rank, senior if possible</td>
<td>Biology</td>
<td>Chemistry</td>
<td>QSB</td>
<td></td>
<td>$200-300k</td>
<td>Office + 1,200 sf dry lab</td>
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<td>2</td>
<td>Environmental health policy</td>
<td>Open rank, senior if possible</td>
<td>Biology</td>
<td>Management</td>
<td>SCS QSB</td>
<td></td>
<td>$200-300k</td>
<td>Office + 800 sf dry lab</td>
<td>Possible use of GIS facility</td>
</tr>
<tr>
<td>2</td>
<td>Sustainability &amp; land use planning</td>
<td>Open rank, senior if possible</td>
<td>Management</td>
<td>Political science or environmental engineering</td>
<td>SCS ES</td>
<td></td>
<td>$200-300k</td>
<td>Office + 800 sf dry lab</td>
<td>Possible use of GIS facility</td>
</tr>
<tr>
<td>2</td>
<td>Environmental ethics</td>
<td>Open rank, senior if possible</td>
<td>Sociology or political science</td>
<td>Management</td>
<td>SCS WC</td>
<td></td>
<td>$100-200k</td>
<td>Office</td>
<td>Possible use of GIS facility</td>
</tr>
</tbody>
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