College of Engineering & College of Agricultural Sciences

BIOLOGICAL & ECOLOGICAL ENGINEERING

Winter 2018

Jadene Torrent Stensland, PE, Senior Water Resources Engineering with Clean Water Services (www.cleanwaterservices.org) and OSU graduate shows students from this year's Senior Design class a field site that her team is evaluating for environmental impact. Photo credit: John Selker

Senior Design Tackles Clean Water

Non-point source pollution is the next frontier in environmental clean-up, and the 2019 Senior class is undertaking a creative suite of solutions to many of these unseen problems. This is the biggest senior class in the history of the department, with 28 students in the class. The objective of the design sequence is to provide students with hands-on experience in solving the kind of complex open-ended design problems they are likely to encounter in ecological engineering practice, including physical, legal, economic, social and environmental constraints. The class also provides the students with experience in real-world applications of mathematics, science, engineering economics, ethics and other disciplines related to engineering analysis and design, and a clearer perspective on the value of research in addressing contemporary problems in engineering design.

The 8 teams of 3-4 students are trying to develop 1-cubic meter water treatment modules based on the international standard IBC Tote (a 1 cubic meter plastic vessel contained in a metal cage). Used food-grade totes can be purchased for $50, then centrally transformed into high-tech biological treatment systems. The systems are being quantitatively designed to treat the following waste streams: roof runoff (primary contaminants copper and zinc); restaurant dishwasher waste water

Continued on page 3

Oregon State University

DONOR & ALUMNI EVENTS

Engineering Expo

When: Friday, May 17, 2019; 11-4 pm
Where: Kelley Engineering, OSU
What: See what EcoE students are doing and ask them questions about their design projects.

Spring Banquet

When: Tuesday, May 28, 2019. Appetizers at 5:30 pm, Dinner at 6 pm, followed by an awards ceremony
Where: Memorial Union Ballroom
What: Our end of the year award banquet for a chance to recognize the exceptional students in BEE.

Dinner is included

Graduation BBQ

When: Friday, June 14, 2019; 12:30-2 pm
Where: Outside Gilmore Hall
What: A potluck BBQ for graduating seniors and their families to tour Gilmore and meet the department. All students, alumni and donors are welcome.

Climate Change Impact on Streams

Q&A with PhD student Liz Jachens on Drought Implications for Baseflow Recession Analysis in the Oregon Cascades

Tell us a little bit about yourself.

I graduated summa cum lade with my Bachelor's degree in Civil Engineering and minor in Math from California St. Univ., Chico in 2015. My love of water really flourished during this time working with the campus humanitarian engineering club with water-centric projects like drinking water treatment and sanitation issues in Latin America.

I am currently a PhD candidate in Water Resources Engineering, hopefully graduating in June 2019. I am advised under Dr. John Selker in the BEE. My dissertation focuses on watershed drought behavior and characteristics. My fieldwork was performed in the Oregon Cascades and my analysis includes both baseflow recession analysis and numerical modeling. One of my favorite things about working in the water discipline in the intersection of social, ecological, and technical concerns. The interdisciplinary nature of water motivated me to pursue my Water Conflict Management and Transformation certificate in order to understand multiple perspectives about water. In addition to my research, I am keeping up with my teaching and humanitarian engineering interests as the Educational Coordinator for the non-profit TAHMO. In this role, I enjoy organizing and leading regional teacher training and developing instructional materials that emphasize STEM educations using real and local weather data. In my free time, you can find me enjoy the great outdoors, cooking and eating great food, playing with my dog, or training for my next triathlon.

What is your research topic?

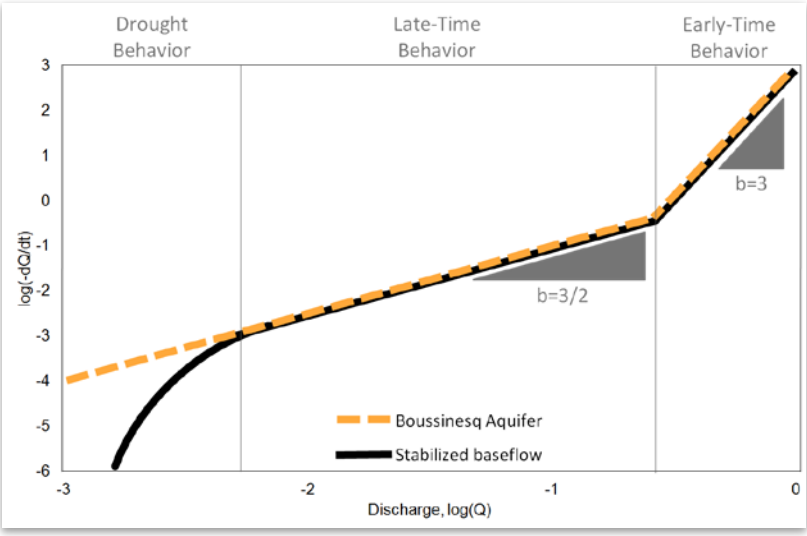
Drought Implications for Baseflow Recession Analysis in the Oregon Cascades

I jumped in on the project the first summer of the NSF Rapid Grant in 2015. The first summer mainly consisted of field work. The NSF Rapid Grant provided 1 year of funding which provided the spring board for entirely of my research.

Why is this project important?

The NSF Rapid Grant has a primary objective of looking at streamflow response in the 2014-2015 winter which was historically warm and had historically low snowpack, analog to a 4°C warming scenario. Using the Oregon Cascades as a landscape laboratory, we set out to test fundamental hypothesis about how montane hydrologic systems will respond to anticipated and dramatic changes in amount and timing of recharge. Specifically, we measured and explored variations in the hydrologic response of headwater systems with different geologically- mediated drainage properties to this unprecedented low snow year, with resulting implications for our fundamental understanding of hydrologic recession. Baseflow recessions were monitoring using USGS main stem gages and project stage height and stream discharge measurements. Significant results from our fieldwork included new empirical data showing how stream networks respond to diminished snowmelt recharge in different geologies. Specifically, observations of streamflow recession in watersheds with large groundwater systems correspond to rivers with long characteristic timescales and thus reveal streamflow behavior that is more stable for drought flows compared to traditional theory.

Liz taking stream cross section on the McKenzie River Basin in Oregon



Graph depicts behavior in drought flow at different times. The normal recession is depicted by the yellow line but what is being seen by researchersis depicted by the black line.

Tell us more about your project.

Much of my work has built off of the realization that streamflow recession

Continued on page 5

Senior Design continued from page 1

Senior Design teams working on the build phase of their design projects to give their systems time to run while they are away for winter break.

(primary effluents grease, starch, nutrients); nursery runoff (pesticides, nutrients); and landfill leachate (nitrogen, metals, dissolved organics). The students have developed sequential reactors employing plants, soils, mulch, bio char, shrimp-shell chitin, activated carbon, sand, gravel, and compost. Combining the power of chemical, biological (plants, bacteria and fungus), and physical processes the students are seeking to satisfy a panel of professional environmental engineers working in each of these settings. The presentation of engineering designs was December 4, and the boxes were made and planted in the first two weeks of December.

The year started with a field trip to visit each of the client sites where the students could see the nature of the problem, and learn about the real-world constraints faced by the clients. The Port of Vancouver pioneered the idea of using the totes as treatment units, and the class was able to meet directly with the authors of this design, who are now volunteering on the evaluation panel for the seniors. The pressure is on!

The students will then implement their systems, tested using pumped solutions of real-world waste. Can they treat the complex mixtures to achieve their target levels? Will the plants survive? Will the solutions be durable and cost effective? Our clients are thrilled with what they saw in the designs, and we are all on the edge of our seats as the students turn their ideas into functioning solutions to these important non-point source pollution problems. Who know? Maybe you will see the Eco-Cubes on the market in the coming years!

You can hear more about the student's final projects at the Spring Engineering Expo on May 17 from 11-4 outside Kelley Engineering at the OSU Campus.

If you would like to make a tax-deductible donation to this year's designs, visit the OSU Foundation's donation page at www.campaignforosu.org/bee and put "Senior Design" in the comments.

BEE 101: First Year Students

This year the Ecological Engineering undergraduate program admitted 8 freshman and 7 transfer students. Every student in the program is required to take BEE 101 with Dr. Roger Ely, which is an introduction to engineering course with an Ecological Engineering focus. The students study Microsoft Excel, engineering analysis and problem solving, the design process and teamwork. They test their knowledge of these topics at the end of the term with a final group irrigation project.

Irrigation projects around the world often require that water be raised to a higher elevation and in developing regions water lifting devices are often hand powered. Their final project was to research, design, plan, construct, demonstrate and report on a hand-powered water lifting device with limited available resources, a typical issue many developing countries face.

The learning objectives of the project were to improve engineering teamwork and problem solving skills; to engage in practical creativity; and to practice writing a report, preparing plans, and documenting construction and testing. The teams compete at the end of the term to see which team can raise the most water the highest

with the least amount of materials.

Dr. Ely also had a smaller challenge for the class earlier in the term, the Marshmallow Challenge (made popular by Tom Wujec's TED Talk: Build a tower, build a team). Students were given 20 sticks of uncooked spaghetti, 1 yard of tape, 1 yard of string and 1 marshmallow. Using just these supplies, the teams attempted to build the tallest tower. The catch - the marshmallow has to be at the very top of the tower and the whole tower must stand with no help for five seconds. Roger said the challenge really helps the students work together and come up with more efficient designs, partly because they learn the value of prototyping.

Ecological Engineering Student Society

By Jordan Laundry, EESS President

The Ecological Engineering Student Society (EESS) of OSU was founded in 2009 by a group of motivated students in EcoE. The club allows students to be involved with a wide range of ecological engineering applications that aren't necessarily available in the classroom such as design, construction, and data collection. Since its humble beginnings, the club has grown in number and diversity and now has over 50 active members from 10+ majors across the university.

EESS Members our Agrivoltaics Cover Crop Planting Party November 2018

Past Projects and Events:

EESS has been very busy for the past two terms. Last spring, the club worked with the Oregon State University Landscape Management department to complete a bioswale restoration project near the intermural fields on campus. We planted 770 sedges and rushes in the bioswale that will filter contaminants from the runoff from nearby parking lots.

EESS was also active in the OSU community and beyond. This term we tabled at the OSU Sustainability Fair. We educated the 100+ people who stopped at our booth about the Urban Heat Island Effect and how green roofs and other alternative building materials can help save energy and cool cities.

The club participated in the Go Green, Go Team competition hosted by the University of Washington. As the only team from OSU, we competed against three UW teams to see which school was doing the most for sustainability. Our work in aquaponics and agrivoltaics brought home the win for EESS and OSU with the judges describing our efforts as "creative, bold, big picture ideas" with "promise for lasting impact."

Current Projects:

EESS is working on two different, but equally exciting projects this year. The first is a new take on our previous aquaponics endeavors. Design and construction of a vertical aquaponics system began last year and continued into the fall.

New Vertical Aquaponics System in Final Stage of Construction

maximize plant growth in a small space while avoiding problems with root mats that horizontal systems face. The system will be up and running at the beginning of winter term and the club can begin to experiment with growing different plants in various conditions to maximize plant health and growth. We will also be expanding our hydroponic efforts to growing rice in our Weniger Greenhouse.

The club has also taken on an exciting agrivoltaics project. Agrivoltaics is the practice of combining renewable energy with agriculture in economically feasible ways. Specifically, the club is working toward growing valuable shade crops under a solar panel array. This term we planted 25 lbs of cover crop seed under two rows of panels in preparation for cultivation beginning in the spring. We will spend winter term designing and installing an irrigation system under the panels. The club would like to thank our advisor, Chad Higgins, for arranging this opportunity for us!

Continued on page 5

Mission Statement:

"An interdisciplinary assembly of students focused on facilitating student engagement in campus and community opportunities, promoting professional growth and development, and to stimulate student reasoning towards the design of diverse, adaptable, and resilient engineering solutions."

Faculty Advisor: Chad Higgins
President: Jordan Laundry
Vice President: Nolan Thomas
Greenhouse Mngr: Tom DeBell
Project Mngr: Brooke Bennett
Event Coord.: Laurel Shepard
Treasurer: Rose Johnson
Secretary: Jessica Chaplen
Webmaster: Lillian Peters

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www.campaignforosu.org/bee

www.campaignforosu/beescholarship

EESS Continued from page 4

Looking Forward

As the club moves forward, we are constantly looking for new projects to take on and events to attend. Next term EESS will be hosting its 2nd annual Alumni Panel where recent graduates of the program will reflect on their own experiences and give advice to current students on how to excel as professional engineers. The club will also be partnering with local sustainability and environmental groups to get hands on volunteer experience with restoration project.

How you can help

EESS is constantly looking to grow and improve. Please contact the club President (laundryj@oregonstate.edu), the Event Coordinator (sheparla@oregonstate.edu) or the Project Coordinator (bennetb2@oregon state.edu), if you wish to propose a project, present research or professional work, or believe that your job location would make for an informative and practical field trip. Finally, thank you for all your work and involvement within the realm of ecological engineering and beyond to make this world a better place.

A Mix of Cereal Rye and Crimson Clover Seed Ready for Planting Under the Agrivoltaics Solar Array

Find EESS online: sites.google.com/a/onid.oregonstate.edu/eess/home and on Facebook: www.facebook.com/groups/EcologicalEngineeringStudentSociety/

Drought and Streams continued from page 2

behavior for drought flows may be more stable in certain watersheds and trying to identify physical mechanisms for that may explain this behavior.

Utilizing water height instead of discharge to perform recession analysis. This method utilizes the easily measured water height and mathematical transformation of the traditional recession analysis axis in order to gain insights about watershed properties without the need for extensive fieldwork required to collect discharge measurements and create a rating curve. This method is particularly useful in smaller watersheds where USGS maintained gages are not available and resources are not available for a complete study.

Since many watersheds can be analyzes with this method very quickly and cheaply, one implementation of this method could be look a large number of watersheds in a region, characterize them based on their response, and then select a few watersheds of interest based on preliminary results in order to research further.

Baseflow recession analysis for watersheds in the Oregon Cascades. Using both small watersheds from the NSF Rapid Grant and larger USGS watersheds, we will look at watershed properties based on climate region. Our study region includes Western Cascades watersheds representing a flashy streamflow regime with rapid baseflow recession and very low summer flows, in contrast to the High Cascades representing a slow-responding streamflow regime with a long and sustained baseflow recession that maintains late summer streamflow through deep-groundwater contributions to high-volume cold-water springs. Aquifer properties and river timescales are analyzed in order to characterize watershed response.

Numerical modeling of a 3D watershed. This model implements a basic unconfined aquifer that is hydraulically connected to a stream. The purpose of this model is to describe the physical controls to baseflow recession analysis for drought behavior and how this is different that the processes used in modeling normal conditions.

What are you plans after graduations?

My dream job would be working on the California Groundwater Management Act. Managing ground-water and Surface-water as a single resource is a key to sustainable management and planning and I'm excited that is it new and challenging!

Miner Scholarship Recipients

The Ron Miner Memorial Scholarship honors the memory of J. Ronald Miner, an Agricultural Engineering professor at OSU from 1972-2003. Dr. Miner was an internationally recognized expert on livestock waste management, water quality and odor control. At the same time, he served as an endlessly supportive coach and mentor to his graduate students and is remembered for his charm, enthusiasm for life and love for teaching.

Tessa Artuc is a Water Resources Engineering MS student and one of two recipients of the Ron Miner Memorial Fellowship.

Tessa is originally from Rochester, New York and graduated from the University of New Hampshire last spring with a bachelor's in Environmental Engineering. She is working on her degree under Dr. Desiree Tullos, BEE Professor, with a focus on modeling geomorphic responses to dam removals.

Tessa grew up on a small farm with an outdoorsy family, which led her to appreciate how interconnected water resources is to every day life. When studying abroad in New Zealand she learned how engineered projects can create relationships between different groups, and wanted to work with stakeholders to solve problems. Outside of school, she loves to go backpacking, running, and enjoy local seafood.

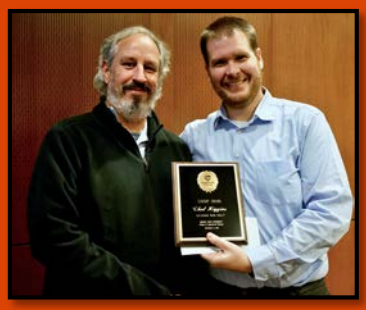
In the future, she hopes to work on collaborative stream restoration projects and design living shorelines for climate change adaptation.

Kyle Proctor is a PhD Water Resource Engineering. He is working under advisor Dr. Ganti Murthy.

Kyle received his bachelor's from the University of San Diego in 2017. Kyle's undergrad research focused on understanding the role of marine algae within the global carbon cycle. During this time he also spent a semester working and studying at the Center for Sustainable Development in Atenas, Costa Rica.

These experiences provided Kyle with a passion for improving access to water. Kyle is working with BEE Professors Dr. Murthy and Dr. Chad Higgins to explore some of the implications of Agrivoltaic systems (systems which combine agriculture with Photovoltaic solar panels by growing crops under the panels). The objectives of his work are to determine if conventional crop growth models are applicable to Agrivoltaic systems; and then to model the environmental and economic impact of these systems across the state of Oregon. Examining how resilient these Agrivoltaic systems would be to climatic and economic disturbances. Kyle hopes to turn the skills and experience he is gaining here at OSU into a career related to water security and availability.

Dr. Chad Higgins and Jennifer Cohen receive CAS awards



Congratulations to Dr. Chad Higgins, the 2018 College of Ag Sciences Savery Outstanding Young Faculty Award recipient, which recognizes outstanding contributions through teaching, research, international, and/or extended education activities.

Chad joined BEE in 2011 after completing his PhD in Environmental Engineering at Johns Hopkins University and post-doctoral work in Lausanne, Switzerland.

At OSU, he has taken on a number of research efforts related to the nexus of Energy, Water and Agriculture, establishing the NEWAG Lab to develop strategies for sustainable agricultural production.

Chad blends deep intellect, an endlessly curious mind, and a friendly engaging approach to his academic career, bringing cutting-edge theory to solve practical problems in agriculture and the environment. His contributions to science, the college and the university are exciting and we are eager to see what he does next.

Congratulations to BEE Office Manager, Jennifer Cohen, one of the 2018 CAS Professional Faculty Award recipients.

Jennifer joined BEE in 2013 after a 10-year career with the Navy where she served as a journalist and Station Manager at award winning broadcast stations in Sicily and Puerto Rico. After leaving the military, she attended OSU, receiving her BS in New Media Communication.

She not only provides all HR and accounting support, but also is heavily involved in the advising and development of the undergraduate program. Jennifer also produces video and print materials for BEE. In addition to her department role, Jennifer is also on the CAS Safety Committee, the Professional Faculty Leadership Association board and the Administrative Appointments Committee for the Faculty Senate Executive Committee.

Her contributions to her department and to her community are countless and truly represent excellence in the college.

Thank you

By Dr. John Bolte, Department Head

As Fall term comes to an end, we wanted to take the time to thank you for your continued support and contributions to the Department of Biological & Ecological Engineering. We are very excited about the growth that has taken place within the department this year, and are proud of the meaningful work and research conducted by our students, faculty, and staff.

This year, Oregon State University is celebrating its 150th anniversary and the significant expansion and growth that has occurred since 1868. The BEE department has also experienced considerable change since its start over 100 years ago.

Early tractor course in Gilmore Hall

In the early 1900's, OSU offered lectures and laboratories about horse-drawn machines, steam engines, and farm structures. Many of these classes were held in Gilmore Hall (then known as the Farm Mechanics Building) which was built in 1912. In 1915, Agricultural Engineering was created as a new department within the School of Agriculture with William James Gilmore serving as the first department head.

Gilmore Hall was heavily damaged in a fire in 1938 and was rebuilt and expanded in its original location. Today, in place of tractors and farm equipment, our facilities house offices, laboratories, and computing equipment to support the work of our 15 faculty members, 7 staff members and research associates, 30 graduate students, and 110 undergraduate students.

Gilmore Hall after the fire in 1938

Gilmore Hall 1951

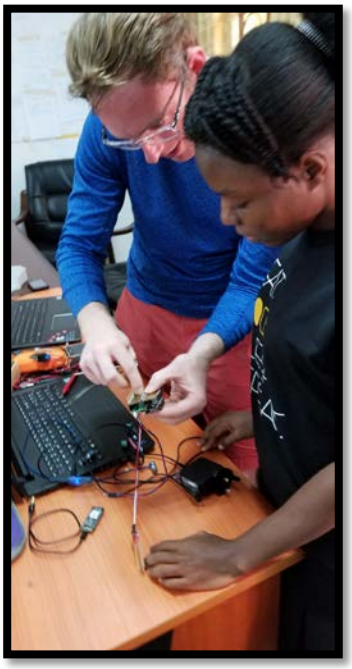
Please feel free to stop by and check out our historic building if you are ever on campus. We welcome the opportunity to visit with you and discuss our goals for the future of the BEE department.

From everyone in Biological & Ecological Engineering, we wish you and your families a Happy Holidays and a Wonderful New Year!

Sincerely,

John P. Bolte

BEE Research



Dr. Chet Udell, Director of BEE's Openly Published Environmental Sensing Lab (OPEnS), works with a student during a joint hackathon with TU Delft, Kwame Nkrumah University of Science & Technology (KNUST), and OPEnS.

Seven teams of students and professors built weather sensing and precision agriculture technologies that address a particular challenge in the region. To accelerate prototyping, they used the Loom IoT sensor systems developed at the OPEnS lab to enable the teams to quickly plug and play different sensors together. A team of business graduate students from TU Delft also worked with these teams to take their projects a step further by translating them into a service. A team from Nigeria created an early warning system for river flood monitoring, which annually causes hundreds of casualties in the region and a KNUST team created a smart irrigation valve controller that is sensitive to soil moisture.

Find out more at open-sensing.org.

Dr. Liangang Chen, Senior Research Engineer and visiting scholar from the Nanjing Hydraulic Research Institute in The Ministry of Water Resources of China, worked with Dr. Desiree Tullos sampling dissolved oxygen downstream of Fall Creek Dam when the USACE was conducting drawdown operations to promote passage of outmigrating juvenile salmon.

Brett Stoddard, EcoE Undergraduate, practices his American Geophyiscal Union Conference poster presentation. Brett joined the OPEnS lab after receiving the URSA Engage Scholarship and DeLoach Honors College Works Scholarship. He is working under the guidance of Dr. Chet Udell designing a new sensor hub.

Biological & Ecological Engineering
116 Gilmore Hall
Oregon State University
Corvallis, OR 97331

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