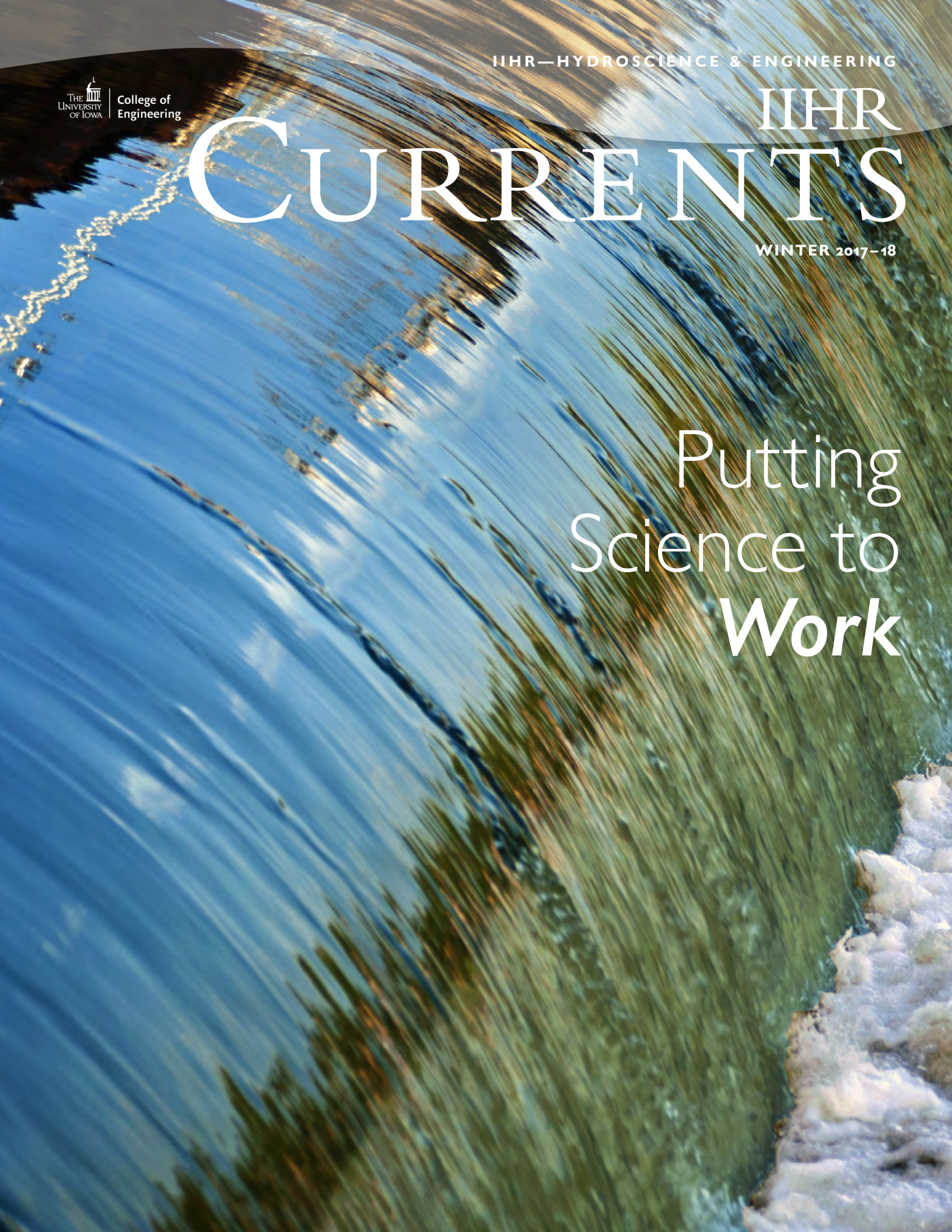


IIHR—HYDROSCIENCE & ENGINEERING

The University of Iowa | College of Engineering

IIHR CURRENTS

WINTER 2017–18

Putting Science to *Work*

CONTENTS

Follow IIHR, the Iowa Flood Center, and the Iowa Geological Survey on social media.

DIRECTOR OF DEVELOPMENT AND COMMUNICATIONS
Carmen Langel

EDITOR/WRITER
Jacqueline Hartling Stolze

CONTRIBUTING WRITERS
David Gooblar, Mikael Mulugeta, and Matthew McBride

GRAPHIC DESIGNER
David Herwaldt

PHOTOGRAPHERS
Aneta Goska and David Herwaldt

ON THE COVER
It's water over the Burlington Street dam near the Stanley Hydraulics Lab. Photo by Aneta Goska.

"Science in a vacuum does not reach its potential. We also need tangible applications of science to solve society's challenges and improve life for all."

Transitions

Welcome to the new issue of *IIHR Currents*! We're pleased you've chosen to spend some time with us by reading about the recent developments at our world-renowned research institute. I think you will find it as fascinating as we do.

The theme of this issue is "Putting Science to Work." As you know, the practical application of scientific principles is part of our DNA here at IIHR. For generations, we have balanced work in the fundamentals of science with the real-life application of those principles. Science in a vacuum does not reach its potential. We also need tangible applications of science to solve society's challenges and improve life for all.

For example, you will likely have seen the vintage photo (*lower left*) of plumbing research here in the 1930s. This research not only supported the lab through the difficult years of the Great Depression, it also provided essential new guidelines for plumbing safety and efficiency. This is just one example of how we've been putting science to work — there are literally dozens more. You can read about many of them in these pages or on our website, including our Engineering Services division, our ship hydrodynamics program, and the Iowa Flood Center (IFC).

The year just passed was a transitional one for IIHR that brought a change of leadership. Former IIHR Director Larry Weber stepped down to accept a position at the UI College of Engineering (see story p. 22). For those who don't already know me, my name is Gabriele Villarini, and I am the interim director of IIHR. While this is a new position for me, I am far from new to the institute.

I am a native of Rome, Italy, who became fascinated by remote sensing and hydrology. I came to IIHR and earned a PHD in civil and environmental engineering at the University of Iowa (UI) under the supervision of Witold Krajewski in June 2008. I went on to work as a researcher at Princeton University, where I was also part of the Willis Research Network. In the process, I developed an interest in climate change and extreme events — in particular, flooding and hurricanes.

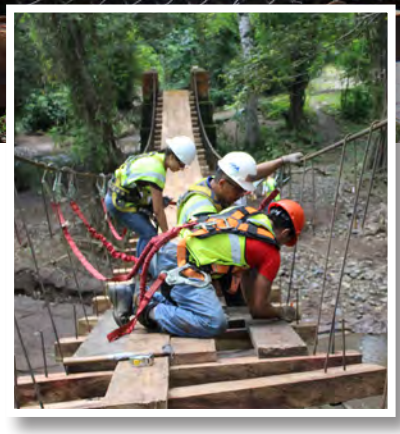
IIHR has been a significant part of my life, and I chose to return to Iowa and the institute in 2012. My family (wife Amie and two daughters, Eleonora and Camilla) is firmly rooted in Iowa City. I am an associate professor in the UI Department of Civil and Environmental Engineering. I am also completing the Executive MBA Program in the UI Tippie School of Business. My IIHR research group focuses broadly on flood hydrology, extreme events, hydroclimatology, climate predictions and projections, and the economic impacts of natural hazards. I am also a member of the IFC, the only university-based center devoted solely to flood-related research and education.

I am deeply committed to IIHR's mission and honored that I was asked to step in as interim director. I will work hard to ensure IIHR's continued success. Please contact me at any time if you have questions or comments at gabriele-villarini at uiowa.edu or 319-384-0596, or visit my personal website, www.gabrielevillarini.com.

Gabriele Villarini
Interim Director, IIHR—Hydroscience & Engineering
Associate Professor of Civil and Environmental Engineering

Bridging the Divide

by Mikael Mulugeta



ABOVE: Bridges such as this one are essential for access to schools, health care, jobs, and more.

IN THE SMALL NICARAGUAN VILLAGE OF SAMULALI, a woman carrying a basket of clothes walks along the riverbank to the bridge, which had fallen into disrepair. There, University of Iowa (UI) students and faculty worked with locals to rebuild the damaged bridge, which gives villagers access to health care, jobs, and schools in the nearby city. The woman stops to speak with Elly Martens, safety manager of the UI student group known as Continental Crossings. Much to the Nicaraguan woman's delight, she learned that the bridge would be finished in time for her daughter's wedding, so family on both sides of the river could attend.

Stories like this one keep the Continental Crossing team coming back to build bridges.

The students and faculty traveled to the Nicaraguan communities of Guadalupe and Samulali last summer to repair two local bridges. The organization builds and repairs Nicaraguan bridges to minimize rural isolation and make travel during the rainy season less dangerous. The nonprofit organization Bridges to Prosperity provided support and arranged the six-week service trip. Continental Crossings members follow Bridges to Prosperity's technical guidelines for cost-effective and safe pedestrian bridges.

Anthony Emigh, now an IIHR graduate student, was one of six UI undergraduates on the trip. Emigh joined Continental Crossings in 2013 as a freshman because he wanted to make an immediate impact on the world using his engineering skills. He has served in various capacities, including project manager.

In just eight years since their construction, the Samulali and Guadalupe bridges had badly rotted. Working with a local mason, students did the bulk of the construction, including cutting lumber, bending rebar, and dismantling the rotted wood, working side-by-side with community members. By the end of their trip, they had fully repaired both bridges with more resilient lumber and developed a new maintenance plan with local technicians and community members. The scheduled maintenance will prevent weathering and damage from insects, extending the life of the bridge.

IIHR's Ricardo Mantilla, an assistant professor of civil and environmental engineering (CEE), was one of three faculty members on the trip. The Colombian-born Spanish-speaker first traveled with the group to Matapalo in 2015. Mantilla was impressed with the group's responsibility and leadership.

"The students run the meetings, do all the fundraising, and lead the construction work," says Mantilla. "They are a hard-working, dedicated group."

Some of the students joined through the new Engineering Service Project course taught by IIHR's Craig Just, an assistant professor of CEE. Just, who also traveled to Nicaragua in 2017, designed the three-credit course around the service trip. Students apply engineering principles to international engineering service projects and gain valuable field experience.

Little Town, Big Flooding

THE FLOODWATERS POURED INTO PLAINFIELD, IOWA, from all directions. Rare fall flooding in September 2016 inundated Plainfield's flat landscape with river flooding on the east, and flow under the Highway 218 bypass to the west. Residents also got overflow from Lake Plainfield north of town (where the outlet flows into the city's storm sewers), and local runoff from nearby farm fields.

Dan Gilles, an Iowa Flood Center (IFC) water resources engineer, is working to help the city find solutions for its water problems. Besides flooding, Plainfield also faces a drinking water problem — nitrate levels in the city's source water are creeping toward the Environmental Protection Agency (EPA) limit of 10MG/L.

Plainfield is a town of about 450 people. "For these small towns, it's a lot to take on," Gilles says. Fortunately, the IFC is committed to serving Iowans, along with partners at the Iowa Geological Survey (IGS), the Natural Resources Conservation Service (NRCS), the Iowa Department of Transportation (IDOT), and the Iowa Department of Natural Resources (IDNR).

In response to Plainfield's request, the IFC sent Gilles to model the flow of water through the community. Stormwater management modeling software allowed him to incorporate all the elements affecting flow in Plainfield, including ditches, culverts, and more. He also used LiDAR (laser radar) data to create a model of overland flow. Gilles then wrote a report recommending mitigation projects based on the results. With this information, the city will have a better chance of finding funding for these efforts.

To address the nitrate problem in Plainfield's drinking water, IGS Research Specialist Mike Gannon conducted a hydrologic evaluation of the city's wellfield. Gannon found that most of the nitrate was coming from the Cedar River floodplain east of town, and he recommended the use of agricultural conservation practices in this part of the well's capture zone. This approach reduced the size of the well's recharge zone by about 90% and will likely produce results.

Plainfield is only one of the small towns that have benefitted from the expertise of the IFC and the IGS. IFC engineers have also worked with officials from Kalona, Clarksville, and other communities to solve complex water issues.

THIS PAGE: Bremer County Emergency Manager Kip Ladage says that "IFC assistance has been instrumental in moving forward with possible mitigation efforts to prevent and minimize future flooding." Ladage also made these photographs of flooding in Plainfield.

Getting Muddy with Friends

IT WAS AN AMAZING SIGHT—a flotilla of canoes floating down the Upper Cedar River. Every now and then, one of the paddlers would yell, "Stop! I see a tire!" Then forward progress would halt, and they'd splash out into the water and begin the laborious process of excavating the tire and loading it onto the canoe.

The Iowa Department of Natural Resources (IDNR) sponsors Project AWARE (A Watershed Awareness River Expedition), a week-long canoe-based river clean-up project held every July. Project AWARE moves to a different Iowa river each year, bringing hundreds of volunteers eager to find and extract what shouldn't be there.

This year, IIHR and the Iowa Flood Center (longtime Project AWARE co-sponsors) sent more than a dozen volunteers to Northeast Iowa to join in the clean-up for a day. "The whole day felt magical," says IIHR's Ashlee Johannes.

Johannes and her canoe partner Breanna Shea "punched their ticket" by wrestling a tire out of the water—one of 368 tires Project AWARE pulleded from the river.

The IDNR organizes the event so well, participants have little to worry about. "They made the whole experience very fun and stress-free," says Shea, an Iowa Flood Center (IFC) staff member.

Near the end of the 12-mile paddle, volunteers found an old garbage dump including farm machinery, tractor tires, pots and pans, and more. Canoes clustered around, and volunteers jumped into the water, which was concealing barbed wire and other rusty metal. Iowa Geological Survey geologist Ryan Clark says he and his canoe partner pulled out parts of a corn picker.

"The whole side of the river bank was covered with trash," says IIHR's Blake Rupe. One by one, the canoers dug out what could be moved and loaded it onto canoes.

"The best feeling was getting out of the canoe and watching the

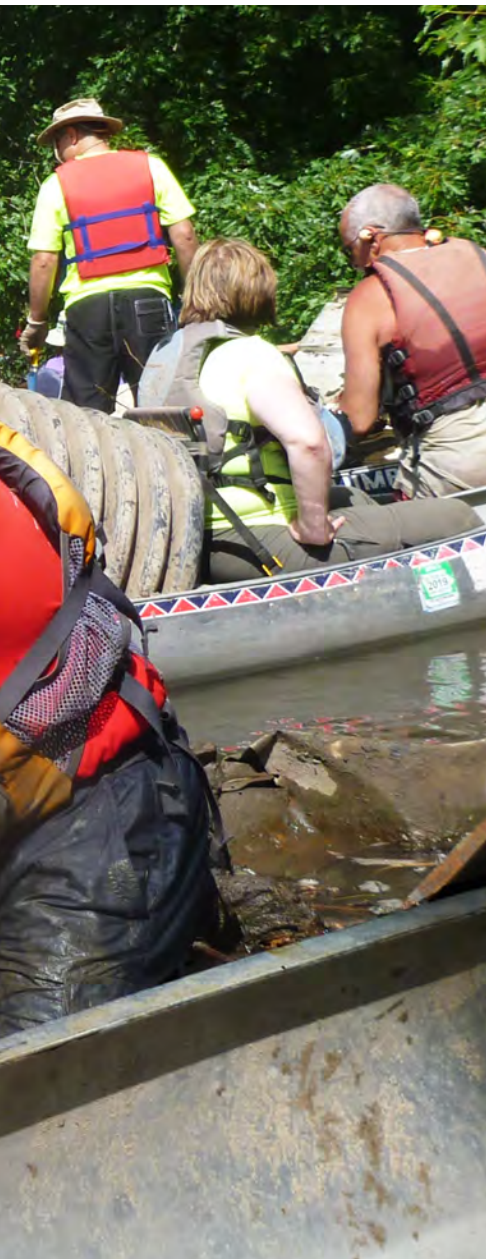
IIHR's Dan Ceynar (*above, red shirt*) cuts open a tractor tire to extract the heavy, wet mud within so the tire can be pulled from the river. Ryan Clark (*IGS, far left*) and Jeremy Davis (*center*) lend assistance.

volunteers empty out our trash," says Rupe. "We made a huge difference."

Statistics bear that out: 469 volunteers (ranging in age from 2 to 77) removed 28 tons of trash, including 14.9 tons of scrap metal and 2.5 tons of recyclables.

Rupe says she's already looking forward to next year. Ceynar, Clark, and many others will likely be there too. Clark says he enjoys "working hard, getting wet and muddy with friends and strangers, and then feeling the sense of accomplishment when the week is done.

"I'm not stopping anytime soon!"



Just Another Day at the Fish Rodeo

by Mikael Mulugeta

WADING IN KNEE-HIGH WATER and temporarily stunning fish with an electric current may not be what most students imagine when they picture summer classes. (No fish were harmed!) But for students in IIHR's Water-Quality class, it was just another day of fieldwork.

Nate Young, an IIHR research engineer, taught the three-week University of Iowa summer course, along with his IIHR colleague Chris Jones and Iowa Geological Survey researcher Keith Schilling. The class ran from May until early June and emphasized hands-on fieldwork. Students learned to use common tools and methodologies of engineering and natural resource management.

One of these field exercises was the "fish rodeo" — a favorite of both instructors and students.

State Hygienic Laboratory inland water scientist Todd Hubbard demonstrated electro-fishing in Clear Creek using a backpack shocker. The device temporarily stuns fish and macro-invertebrates, making them easier to catch, examine, and count. Meanwhile, students held nets and buckets to capture and count the creatures living in the stream. The exercise helps assess stream health by documenting the number and types of fish and other aquatic organisms present before returning them to the water.

Students also used Stream Visual Assessment Protocol (SVAP) to judge stream health based on visible factors including water clarity and bank stability.

The class also visited the Mississippi River, which offered greater diversity of fish species. Instructors spoke about the environmental problems common in large rivers.

The class offers valuable experience for students from several majors, Young says. "They'll have to collaborate with people from different fields of expertise, so understanding the tools and standards of practice across disciplines is important."

Each week of the course focused on different concepts. Topics included water quantity, pollutant sources and transport, and water-quality management.

Ben Bergquist, an environmental science major from Milwaukee, Wis., who plans to work in water-quality management in the future, calls the class a great experience.

ABOVE: Students are ready to catch, count, and release stunned fish and other aquatic organisms to gauge stream health.

Happy Together

Two painted turtles enjoy the sunshine and each other's company on a log somewhere in Iowa.

PHOTO BY KIP LADAGE

Powering Up: *Streamlining Wind Energy*

by Mikael Mulugeta

Corey Markfort, who earned a master's and PHD in civil engineering from the University of Minnesota, joined IIHR as an assistant research engineer in fall 2014.

EARLY ON A FRIDAY MORNING, MOHSEN Vahidzadeh stands under a radio tower in the southwest corner of the Kirkwood Community College campus. Overhead, more than a dozen sensors on the 350-foot tower track wind speed and direction, humidity, temperature, solar radiation, and even CO_2 concentration. Vahidzadeh, a second-year PHD student at IIHR, will collect the data and compare it to operational information from similar sensors affixed to Kirkwood's nearby 2.5 MW wind turbine.

Using these data, Vahidzadeh and IIHR's Corey Markfort, his faculty supervisor, hope to better understand how weather conditions affect the performance of wind turbines. That information will be crucial to build more accurate turbine flow models and optimize turbine operations. They plan to make the data publicly available online and use it in coursework for the University of Iowa's (UI) Wind Energy Certificate program.

ENVIRONMENTAL FLOWS

Markfort, who is also an assistant professor of civil and environmental engineering (CEE), studies environmental flows and wind energy. Environmental flows have two significant features that complicate measurements and forecasts. First, variations in topography and density because of varying temperatures at different depths cause a modeling challenge. Second, turbulence causes chaos. Markfort says we can see examples of turbulence in our daily lives, such as smoke rising from a smokestack or swirling flows in rivers. However, the technical problems stratified turbulence can produce are less obvious.

Turbulence is a recurring problem in physics and engineering, says Markfort. "My wind energy research, which is about capturing kinetic energy from natural flow, takes these other factors into account."

Markfort's focus on wind energy grew out of his PHD studies of the atmospheric boundary layer — the layer closest to the Earth's surface. While investigating how energy from the atmosphere mixes with lakes, he discovered a fascination with the complexities of harnessing wind energy. By understanding how land surface and complex terrain affect the wind, Markfort says we can better place wind turbines.

This is where the sensor data collected at Kirkwood comes into play. Understanding how weather affects turbines is one of several projects Markfort oversees. He hopes to improve wind power plant performance and forecasting, and to better understand and mitigate the environmental impacts of turbines.

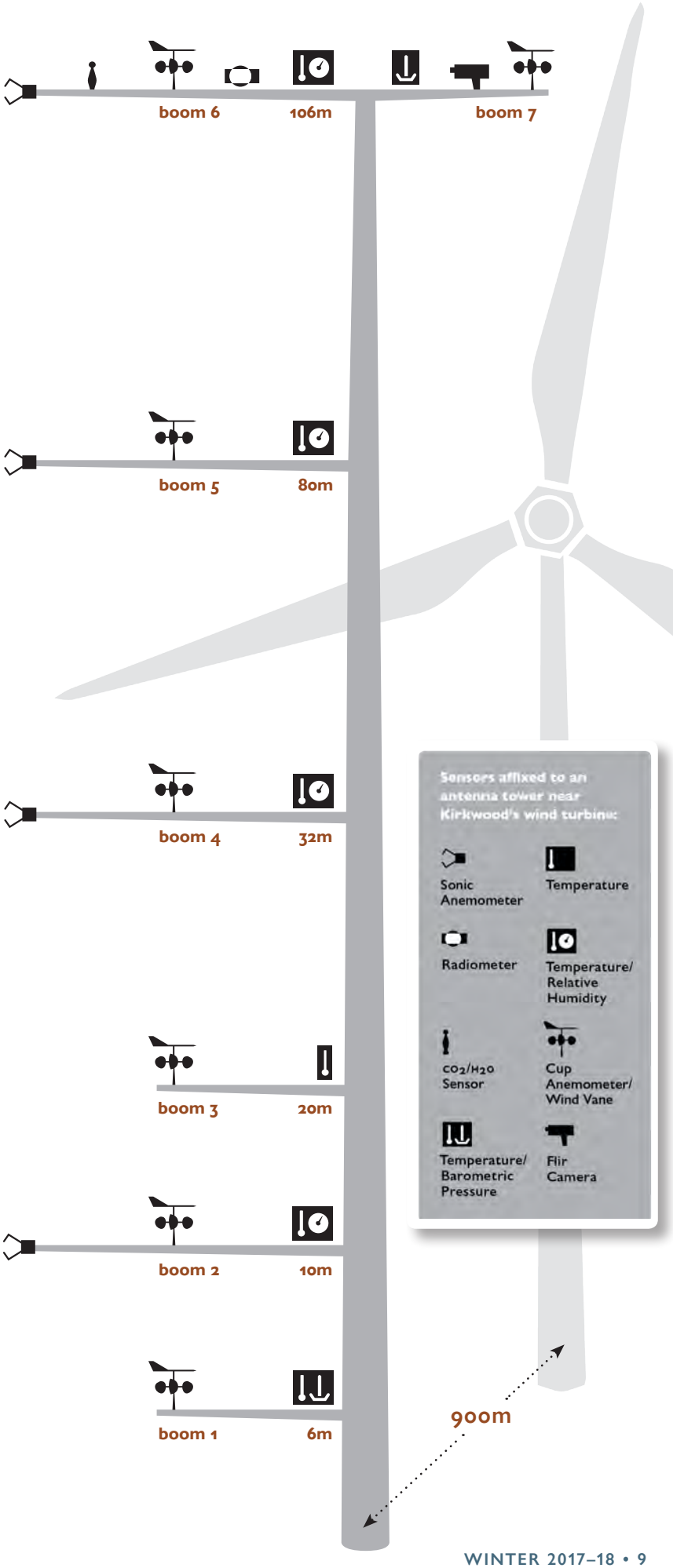
THE WIND ENERGY BOOM

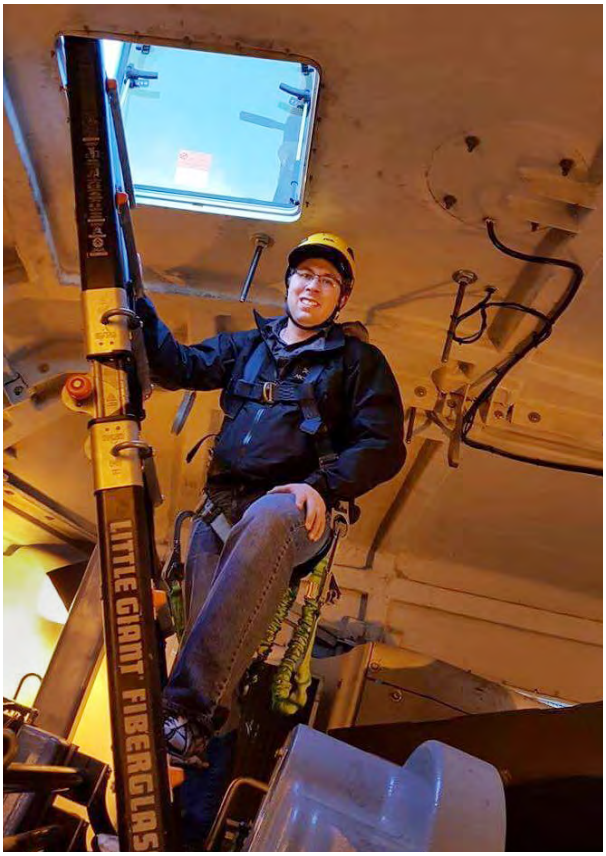
In 2008, the Obama administration set a goal to double renewable energy production in the United States. This spurred new funding for wind energy research. "That's a large part of what gave me the opportunity to research the interaction between wind and turbines, and how wind energy extraction affects the atmospheric boundary layer," Markfort says.

Iowa already produces more than a third of its electricity from wind, and the state's major electric utilities are on track to hit 80 percent within a decade. The national trend is also promising; the U.S. Department of Energy (DOE) projects that the United States will meet 20 percent of its electricity needs with renewable wind power by 2030. This will require a workforce of approximately 380,000, up from the current estimate of 73,000.

Markfort says scientists are rapidly overcoming the remaining challenges of wind energy. One of the most pressing issues is to prevent wind turbines at the front of a wind farm from reducing the effectiveness of turbines behind them. Utilities typically arrange wind turbines in rows. However, when wind flows past a turbine, the region behind it experiences lower wind speeds. Power generation depends on high wind speeds. This can lead

BELOW: The view of Cedar Rapids at sunset from the top of the turbine is stunning.





to significant losses. Markfort wants to understand why.

"Each turbine is designed to capture as much energy as it can, even to the detriment of neighboring turbines," says Markfort. "We're researching how to optimize the entire group so overall energy production is greater."

Another persistent issue is geographical. The strongest wind blows through the central United States, but the highest demand for energy is on the coasts. Although offshore wind energy potential is substantial, challenges persist, including the cost. Nevertheless, offshore wind is becoming a focus in the United States, especially off the East Coast and on the Great Lakes.

To study offshore wind farming, IIHR recently developed a new boundary layer wind-wave tunnel. In this facility, researchers conduct controlled experiments using state-of-the-art laser-based anemometry techniques to learn how offshore wind farms perform in the presence of surface waves and how they affect mixing at the Great Lakes and surface coastal oceans. Markfort is hopeful this research will help move offshore wind farming forward.

By most measures, the future looks bright for renewable energy — wind, hydro, bio, and solar. These energy sources offer opportunities for significant improvements in air and water quality, public health, and the reduction of carbon emissions. Renewable energy is also a booming industry requiring a skilled workforce. Institutions such as the UI play a critical role in training this workforce.

Markfort's research, and the work of others at IIHR and around the country, could help change how we generate electricity forever.

PHOTOS THIS PAGE: Markfort *(above; and center, below)* says that Kirkwood's 2.5-megawatt wind turbine, seen here, provided 5,600,000 KWH of clean electricity for the campus between 2012 and 2015, worth more than $1M.

Also pictured (*left to right*), IIHR team members Pablo Carrica, Marcela Politano, Markfort, Shivendra Prakash, and Ezequiel Martin.

Illustration Credit: enercast GmbH

Protecting Bats

by David Gooblar

IIHR HELPS MINIMIZE THE ENVIRONMENTAL IMPACT OF WIND TURBINES

ABOVE: IIHR researchers developed a model to help us understand how bats interact with wind turbines, with the goal of reducing bat fatalities.

We know wind turbines can be fatal to bats, but the exact number of bat fatalities at wind turbines is unknown. Because bats are an important part of our ecosystem—they are voracious insect eaters, saving farmers billions of dollars in pest control—and because some species of bats are threatened or endangered, the U.S. Fish and Wildlife Service (USFWS) and energy companies like MidAmerican are working to minimize the negative impact of wind farms on bats. That's where IIHR comes in.

Knowing of IIHR's long history of investigating the impact of hydropower on salmon, the USFWS and MidAmerican asked the institute for help in estimating the number of bats affected by wind turbines. IIHR's Corey Markfort, Pablo Carrica, Marcela Politano, and Ezequiel Martin took on the project. They've developed a model to map the expected distribution of bat carcasses around wind turbines so investigators can more accurately and efficiently estimate the number of bats killed around a turbine.

THE AERODYNAMICS OF BATS

According to Markfort, the interdisciplinary collaboration that IIHR is known for is perfectly suited to this project. "It's a classic interdisciplinary type of problem. You have the animals, who exhibit specific behaviors around wind turbines, and occasionally they are impacted by the rotating blades. And then they're being thrown into a very chaotic turbulent flow field." The researchers' model began with a situation relatively well-known to environmental fluid mechanics—the turbulent flow field around a wind turbine—and then introduced a living creature whose aerodynamic properties are mostly unknown. To develop a successful model, the researchers needed to know more about bats. Toward that end, the biological survey contractor collecting the bat carcasses brought some to the researchers so they could determine their aerodynamic and other physical properties.

From there, the researchers developed a two-part simulation using computational fluid dynamics: first modeling the flow field and then putting the bat-like particles into the flow. Although much is still unknown about bat behavior, Martin explained that the simulation can provide a good start on understanding what happens when a bat collides with a turbine's rotor. In the simulations, he says, "There are thousands of particles. They are hitting the blades at different heights, at different speeds, with different mass, and all that will give us a map of carcass distribution on the ground." With this map, researchers, regulators, and energy providers will be able to better understand the interaction between bats and turbines.

Counting every single bat carcass around a wind turbine would be impossible — expensive in both time and money. But a good model like the one the IIHR team has developed could let energy providers and regulators count just a sample of the bats and project accurately to calculate the total. "For threatened or endangered species," Markfort says, "ideally you don't want to have any adverse impact." On the path to that ideal, understanding and estimating how wind energy affects bats and birds is an important step to protect these creatures.

A Tale of Soap Creek and Water

SOAP CREEK LEADS THE STATE IN FLOOD MITIGATION

They couldn't stop the flood, but they could slow it down. Tim Sandeen remembers the bad old days in the Soap Creek Watershed. When he was a teenager, he and his friends would drive down to Soap Creek after a big rain to look at the damage. "The water would be gushing across the road and big ol' fish would be flopping around," he says. Floods regularly took out roads and bridges, destroyed crops, and washed out topsoil.

Those days are gone. With help from their Natural Resources Conservation Service (NRCS) representative Fred Hainline, the farmers of Soap Creek banded together in the 1980s to develop a flood mitigation plan for their watershed.

Their idea was to capture and slow down water from major rainstorms in ponds, water and sediment control basins, and other conservation projects built throughout the watershed. In the process, they reduced damage to crops, roads, bridges, and more, while also improving water quality and creating new water recreation areas.

In 2010, the Iowa Flood Center (IFC) partnered with the Soap Creek group as part of the Iowa Watersheds Project (IWP), a statewide flood mitigation and water-quality improvement effort. The project ended in 2016, to be followed by the $96.9M Iowa Watershed Approach (IWA). Both projects received funding from the U.S. Department of Housing and Urban Development (HUD) to engage farmers and others in Iowa watersheds to build a more flood-resilient state.

But the Soap Creek landowners got there first, and they continue to lead Iowa in flood mitigation efforts.

Farmers Carl Miller, Ray More, and Mervin McDanel served on the first Soap Creek Watershed Board, and they carry on that work today. Miller, who

is now in his 80s, farms along South Soap Creek near Unionville. "The country's rough down here," he says, "and the soil erodes real easy." He and his neighbors saw significant damage to their land after every big rain. A four- or five-inch rain could destroy a crop, taking the topsoil with it.

"There's only so much dirt," says Sandeen, who is a farmer and a member of the Soap Creek Watershed Board. He also has a large pond on his property. "You have to take care of what you have," he adds.

Miller, too, has a farm pond on his land, one of 135 structures in the basin, which spreads across four counties (Appanoose, Davis, Monroe, and Wapello) in Southeast Iowa. Miller is a modest man who doesn't brag about his own foresight.

"We just started in and went to work on it, and continued right on," Miller says.

Sandeen, however, is proud of his neighbors and not afraid to say so. "They knew there was a need," he says. "It's unbelievable that you would even have the nerve or fortitude to even try to put something like that together."

He adds, "Those three guys — Miller, More, and McDanel — they're the ones who need a pat on the back."

The Soap Creek project is an amazing success story. At times over the years, the money dried up, and occasionally people got discouraged. But the leaders of the Soap Creek project became experts in scrounging for funding and persevering in pursuit of their vision. New members joined the board, but the vision stayed strong.

"We rarely have any disagreements, because we all have the same goals," says board member Jerry Parker. He believes in the long-term vision and funding viability of the project. "There's always going to be something coming along," Parker says. "Just don't give up on it."

Ray More says he's proud of what he and the others have achieved in the Soap Creek Watershed.

"It makes a guy feel good," he says.

CLOCKWISE FROM TOP LEFT: One of 135 farm ponds and other structures built for flood mitigation in the Soap Creek Watershed.

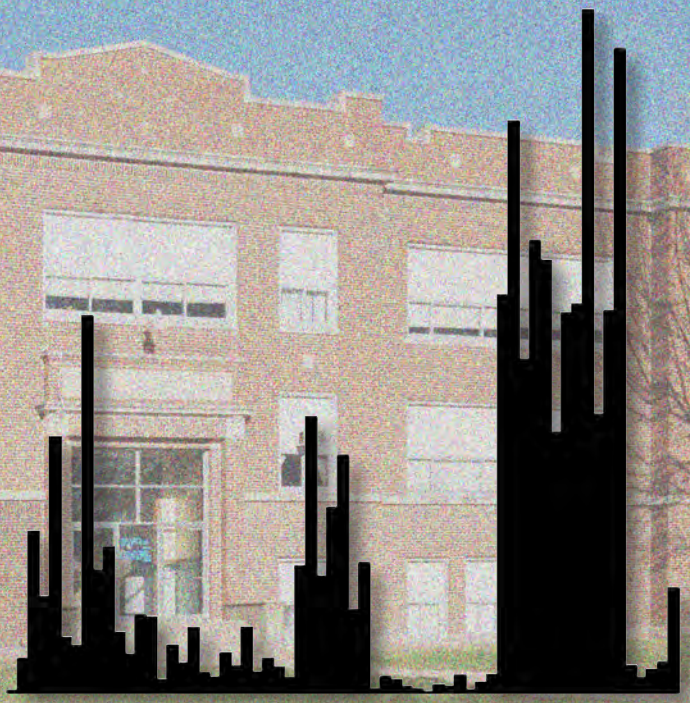
RIGHT: Carl Miller was one of the first to build a farm pond to help mitigate flooding and provide water for his livestock.

LEFT: Greg Brenneman of the Iowa DNR shows off a log weir at Lake Wapello State Park.

FAR LEFT: Iowa Flood Center Director Witold Krajewski (*left*) was one of about 75 participants in a tour of the Soap Creek Watershed on September 12, 2017. The tour, which was organized by the IFC and local partners, visited six farm ponds and several other conservation practices.

Learning Your PCBs

MEASURING CARCINOGEN EXPOSURE IN SCHOOLS



by Matthew McBride

Picture a typical kindergarten classroom. The walls are painted a light yellow and reflect the sunlight. The children are seated in molded plastic chairs that are a deep, rich blue. They hold red-handled scissors, cutting shapes from brightly colored construction paper. And all of these are potentially off gassing carcinogenic neurotoxins in amounts higher than ever observed.

"We don't expect school to be a place where the hazard is greater than in our homes," says Keri Hornbuckle, a research engineer at IIHR. Hornbuckle, who is also a professor of civil and environmental engineering at the University of Iowa (UI), conducted a study of the air in six junior and senior high schools in Indiana and Iowa. Her study found alarmingly high levels of polychlorinated biphenyls (PCBs). Hornbuckle's previous research measured PCB concentrations in homes and outside, including heavily contaminated sites. "Of all the work we've done, some of those schools had higher concentrations than everywhere else we have ever looked," Hornbuckle says. However, she adds, there is no need to panic. "I want schools to know that remediation is possible and not necessarily expensive."

WHAT ARE PCBS?

PCBs are chemical additives used in a range of products manufactured from the 1930s until 1979, when the Environmental Protection Agency (EPA) banned them. PCBs were popular in manufacturing as plasticizers and flame retardants. While many of the PCB signatures (the chemical makeup unique to each type of PCB) found at the schools matched legacy sources, such as old light ballasts or window caulking, Hornbuckle and her team also found non-legacy PCBs.

Despite the ban, there are loopholes. For instance, PCBs inadvertently produced during the manufacturing process are exempt. Brightly colored paints are a common source. However, the full extent of pigments that carry PCBs is unknown, and they are likely found in other brightly colored products as well. "We don't know all of them, but when we measure the air we can see the signature. They are clearly there," Hornbuckle says.

EPA rules appear to exempt pigments and dyes from the prohibition of PCB production. Pigments are everywhere — from plastic bags and packaging to newspapers, magazines, and more. Now we realize these pigments can bring PCBs with them. "We know that the magnitude of release is so large that PCB11 and perhaps the other PCBs that are in paint may equal the contribution from legacy PCBs," Hornbuckle says.

CAUSE FOR CONCERN

While Hornbuckle's finding of PCB concentrations up to 194 ng/m^3 in some schools is well below the EPA's action threshold of 500 ng/m^3 for students ages 12–15 years, she says it's important to note that the EPA limit is a best guess. Studies have not been conducted on PCB concentrations in the air and their possible negative outcomes. Prior to Hornbuckle's study, ingestion of PCBs through food was considered the primary method of exposure. Though the paths they take to get there are unclear, PCBs can be found in many foods.

ABOVE: This graph compares low levels of PCBs in outdoor air (*left*) to higher levels inside schools (*right*).

Fish, particularly from polluted waterways, show the highest concentrations, but even everyday foods such as hamburgers and fries contain PCBs.

Hornbuckle's findings are significant, as they challenge what was thought to be the primary method of exposure. "Our calculations show that children's exposure through breathing school air can be nearly as much as they get eating food in a normal diet, which is a lot, and a big concern," Hornbuckle warns.

THE MOST VULNERABLE ARE THE MOST EXPOSED

Hornbuckle's colleague, Assistant Research Scientist Rachel Marek, is the lead author on an article about the study that appeared in *Environmental Science & Technology*. Marek says that PCB exposure in school-age children is especially concerning because these compounds are known to impair memory and learning.

Because students are undergoing so many developmental changes, they're particularly sensitive to environmental contaminants. "PCBs, in addition to being carcinogens, directly affect many hormones in the body," Hornbuckle says. Further, PCBs interfere with the body's signaling. In adolescents and teenagers, this signaling affects things such as bone growth and synapse development. "There's unfortunately a lot of information that these chemicals are particularly dangerous for children," Hornbuckle continues.

WHAT'S THE NEXT STEP?

Now that Hornbuckle and her team have identified school buildings as a point of high exposure, they can begin finding cost-effective methods of abatement. "We're engineers and chemists," Hornbuckle says. "We made these kinds of measurements, but we also design methods for reducing these concentrations.

"Now we're beginning studies to better understand why PCBs are high in schools. Where are they coming from?" she says. "What can be done to remove the sources of PCBs to the air in the schools, and how can we do it in the least expensive way possible?"

This was a collaborative study with many authors, including Rachel Marek, Andrew Awad, Nicholas Herkert, and Keri Hornbuckle from IIHR; and Peter Thorne from the UI Department of Occupational and Environmental Health. Other contributors include the following: school staff who participated in the study; Craig Just (IIHR and UI College of Engineering) and David Osterberg (UI College of Public Health), who led the community engagement efforts; study coordinator Jeanne DeWall and field staff Barb Mendenhall and Nancy Morales (all UI College of Public Health), who organized and carried out the sampling; and IIHR's Hans-Joachim Lehmler (see story p.16) and Xueshu Li (both UI College of Public Health), who synthesized the diazomethane used to derive samples.

LEFT: IIHR's Rachel Marek (*left*) shows the PCB sensor used in schools to Keri Hornbuckle, who serves as associate director of the Iowa Superfund Research Program, a long-term multidisciplinary study of PCBs. The sensor is a small polyurethane foam disc that collects fine particles and gas phase PCBs from the air.

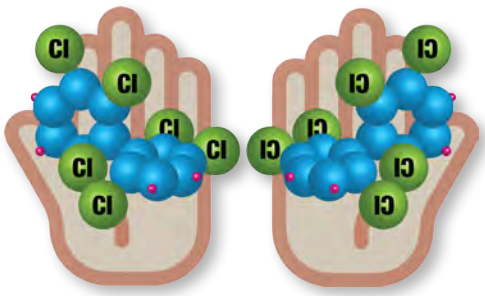
Going Chiral

Photo credit: Tom Langdon

SECRETS OF A SUCCESSFUL RESEARCH CHEMIST

Hans-Joachim Lehmler studies environmental contaminants, particularly polychlorinated biphenyls (PCBs) and their effects on humans. But what really gets him excited are the chiral molecules that make up PCBs and many other compounds.

What's a chiral molecule? Just look at your hands. Your right hand and left hand are mirror images of each other, but they're not the same. Chiral molecules are like our hands, Lehmler says. They're the mirror image of each other. His favorite example is the "purple pill," the popular heartburn medication first marketed as Prilosec. Lehmler, who is a University of Iowa (UI) professor of occupational and environmental health and an IIHR research scientist, explains that the active ingredient in Prilosec is chiral — the molecules are chemically the same, but when you look at them in three dimensions, the molecules are mirror images of each other. In a drug, the "left-hand" chiral molecules might be the active ingredient, while the right-hand molecules are inert — or vice versa.



ABOVE: This illustration of the chiral molecule PCB 136 shows chlorine atoms in green, carbon in blue, and hydrogen in red.

When the patent on Prilosec ran out, the pharmaceutical company created a new drug with only the active chiral molecules. The company was able to obtain another patent for this "new" drug, Nexium, and continues to market it, all thanks to chirality.

"On paper, if you don't look at it in three dimensions, it looks the same," Lehmler says. "But these chiral molecules have very different biological activities. One might react, the other not at all."

PCBs: BANNED, BUT STILL HERE

Many environmental contaminants are chiral, Lehmler says, including some pesticides and, of course, PCBs. These man-made organic chemicals were widely used in transformers and capacitors and in many other uses, until Congress banned them in 1979. The Environmental Protection Agency (EPA) lists PCBs as probable human carcinogens and developmental neurotoxins. Some studies have linked PCB exposure to autism and learning deficits.

Lehmler, a native of Germany, leads the Synthesis Core of the Iowa Superfund Research Program, which is a long-term, multidisciplinary study of PCBs and their sources, exposures, and toxicities. The Iowa Superfund program includes 17 scientists and engineers, including IIHR's Keri Hornbuckle (see story p.14), and others from five UI colleges and two other universities.

Lehmler's team produces, purifies, and characterizes individual PCBs for the Iowa Superfund. Although it's possible to buy the compounds, it's better to make the chemicals in the lab so they can be rigorously defined

and characterized, with no impurities.

PCBs are a large class of 209 different chemicals. Chemically, they all include biphenyl with varying numbers of attached chlorine atoms. Nineteen of the 209 PCBs are chiral under ambient conditions, e.g., at body temperature. When chiral compounds are released into the environment, purely physical processes do not distinguish between the two chiral "hands" or enantiomers. But as soon as the compound enters a biological system, such as the human body, chirality makes a big difference. Proteins are chiral, Lehmler explains, and so are amino acids, enzymes, lipids, carbohydrates, and more. These chiral entities interact differently with another chiral compound, such as PCBs.

"We are interested in how the body processes these compounds," Lehmler says. He's particularly focused on exposures before birth. Highly PCB-exposed children may have motor deficits and learning disabilities.

> "These chiral molecules have different biological activities. One might react, the other not at all."

Collaborators at University of California-Davis found that in exposed animals, only one PCB enantiomer remained at the end of their study. The others had been metabolized. What happened to the metabolized enantiomer? "It's turned into something else," Lehmler says. "It doesn't just go poof! And it's gone. It's a different chemical entity." This new metabolite might be harmless — or it might be as dangerous as the parent compound.

Lehmler just received a new two-year grant with the goal of understanding what happens in humans exposed to PCBs. He's looking forward to learning more about these complex processes. "Turns out there are a lot of surprises, things we kind of didn't expect based on what we knew from animal studies," Lehmler says. "And again, it ties in nicely with a lot of the work we're doing with the Superfund."

OUT OF THE SILO

For Lehmler, the best part of his work is collaborating with others, whether leading scientists at top universities or undergraduates in his own lab. "That's the most rewarding thing about research," Lehmler says.

The Iowa Superfund is a good example. "That's one of our strengths — working together," Lehmler says. He is also a member of the Water Sustainability Initiative (WSI), a faculty cluster spanning seven UI departments and three colleges, brought together to address complex water-related issues in a multidisciplinary fashion. All 10 WSI faculty members are affiliates of IIHR.

For Lehmler, the WSI formalizes his love of collaboration and keeps him in touch with other areas of study. "I think it's fun to be a part of it," he says. "I enjoy working with other people … I can get more stuff done and get answers more quickly."

Collaboration also keeps him motivated. "We're a fairly small but reasonably productive laboratory because we work with other people," Lehmler says. "That synergism makes science great and fun.

"That's the secret," he says. "Work with other people. Share what the lab can do, and also share the credit."

BELOW: Lehmler discusses a research poster and shares a laugh with graduate student Eric Uwimana.

Citizen Cwiertny

AN ENGINEER GOES TO WASHINGTON

> "I do think there are really good people working there. They are there because they love the country and they want to do their best to push it forward."

DAVID CWIERTNY WATCHED THE LIVE C-Span broadcast intently from his office on Capitol Hill. The House of Representatives was nearly ready for the final vote on a bill reviewing the Natural Gas Pipelines Act. As the lawmakers got down to work, Cwiertny waited to hear what Democrats would say in opposition to the bill that was up for vote.

New Jersey Representative Bonnie Watson Coleman rose and began to speak, and Cwiertny realized he was hearing his own words. "For that moment, the things I had written and worked on had the attention of the 400 members of the House of Representatives," Cwiertny says. "You can't talk about it without feeling kind of geeky or bragging, but I really felt like I was part of the process."

In the end, their efforts fell short. "We were making an argument against it," Cwiertny says. "It still passed, but we did our darnedest."

Cwiertny spent almost a year on Capitol Hill as a Congressional Fellow with the American Association for the Advancement of Science (AAAS), providing technical support on environmental issues to the Democrats on the Committee on Energy and Commerce.

"I thought it might be a unique way to spend a sabbatical," Cwiertny says. "I sort of wanted something different."

NO-BRAINER? NOT SO MUCH

And "something different" is exactly what he got. Leaving behind his busy academic and research life at IIHR and the University of Iowa (UI), Cwiertny and his wife Kelly packed up their two children and moved to Arlington, Va., for a year. Instead of an easy commute to his office on campus, Cwiertny took a bus every morning to the train station, where he boarded the Metro for a 30-minute ride to Capitol Hill. His wife, an attorney, worked remotely, and they enrolled their children, ages 7 and 5, in nearby schools.

It was an interesting time to be in D.C. "It's partisan, and there is no way around it," Cwiertny says. His first experience with legislation made that perfectly

clear. The committee was considering a bill to provide emergency funds to the citizens of Flint, Mich., who are still struggling with unsafe drinking water.

It should have been a no-brainer, Cwiertny says. But even a clear-cut issue like Flint can still be politicized. The ranking Democrat on the committee ended up voting against the bill because of unrelated language inserted into the bill, including deregulation of the way we handle coal ash and removal of protections for endangered species in California.

The bill went on to pass and become law, despite the objections of some Democrats on the committee. "It was a good lesson to start out on," Cwiertny says. He learned he could be OK with the end result, which sent much-needed funds to the people of Flint, even though there were parts of the bill he did not like.

LOVE FOR COUNTRY

Cwiertny was part of a team of eight congressional staffers working for the committee. Members of Congress rarely say anything that's not scripted, so staffers spend a lot of time researching and writing statements, questions, blurbs, and more. Although Cwiertny was the newbie on the team, he was able to contribute, especially in his areas of expertise, such as drinking water and wastewater treatment. That's the point of the AAAS Congressional Fellows program — to allow PHD-level scientists to contribute to public policy.

Cwiertny's year in D.C. left him feeling more hopeful about government and the workings of American democracy. He got a perspective that few of us will experience — with the staff working behind the scenes, away from the spotlight. "I do think there are really good people working there," Cwiertny says. "I say that with all sincerity for both parties. They are there because they love the country and they want to do their best to push it forward."

He also believes the American system of government is strong and well-crafted enough to withstand whatever we might throw at it. The democratic process, murky as it is, is playing out as the founding fathers intended. "There's hope in that," Cwiertny says. "The people have power."

MAKING HIS MARK

Another bonus was Cwiertny's congressional ID — a passport to the behind-the-scenes Washington, D.C., that tourists rarely get to see. He was able to take his kids on tours of the Capitol, including the floor of the house and the Speaker's Balcony, which has one of the best views in D.C. The family participated in several of the marches that happened on an almost weekly basis.

And every weekend, they explored a new museum, monument, or park, including Gettysburg, Pa., and Jamestown, Va. "It was such a privilege," Cwiertny says.

But nothing could match the opportunity to contribute to policy-making. Cwiertny says he wanted to learn about the disconnect between what researchers do in fundamental science and the people who make policy decisions. "I had a lot to learn, but I also felt like I could help," he says.

Cwiertny's year in D.C. left him with a new desire to be engaged and involved in government however he can, even now that he's back at work in Iowa City. "I'm not only hopeful, I'm also more appreciative and more eager to be involved where I can," Cwiertny says. "There are levels at which we can be involved as citizens — I'm finding ways to make my own mark."

THIS PAGE, TOP: Cwiertny and his family on the famous Speaker's Balcony, enjoying a stunning view of the National Mall.

BOTTOM: The Cwiertny family at the Lincoln Memorial.

FACING PAGE: Cwiertny and his daughter in the U.S. Capitol's Statuary Hall.

IIHR Solves Real-World

"THIS IS WHAT WE ARE TRYING TO BUILD. HELP US OUT."

by Matthew McBride

The University of Iowa Rec Center is one of the most popular places on campus; however, few of the students running on the treadmills, swimming in the Olympic-sized pool, or climbing the three-story rock wall likely realize that across the alley, IIHR's shop is modeling what will be one of the largest stormwater conveyance systems in the world.

WHAT IS STORMWATER CONVEYANCE?

In older sewer systems, heavy precipitation can quickly exceed the storm sewer's capacity and overflow into the sanitary sewer. This is called "combined sewage overflow," or CSO. Cities often have emergency outlets to prevent sewage from backing up into the streets. Unfortunately, many were initially designed to drain into local creeks or rivers. Today, Environmental Protection Agency (EPA) regulations ban this, so municipalities must collect and store the water until it can be treated.

If the cities had the space, they would likely build detention basins at the surface level, says Troy Lyons, director of engineering services at IIHR. Such basins would need to be as large as a city block, and few cities have that kind of space. "The alternative is to go underground," Lyons says.

RIGHT: Clients watch the St. Louis dropshaft model in action.

HOW THE PROJECT CAME TO BE

The city of St. Louis retained Jacobs Engineering as part of Project Clear, a $1B-plus CSO initiative. Jacobs then hired IIHR to model an approach channel, dropshaft, and deaeration chamber that will ultimately handle overflow from Hidden Creek in Forest Park, which is home to the city's zoo, art museum, history museum, and science center. IIHR was the natural choice for a number of reasons.

First, IIHR researchers have modeled similar systems for domestic and international communities, including London and Washington, D.C. IIHR has partnered with engineering companies worldwide facing complex real-world problems. Lyons says clients often approach IIHR with requests that boil down to, 'OK, this is what we need to build — help us out.' The dropshaft for the St. Louis project is a "vortex" style that was patented by IIHR researchers in the early '80s. For decades, IIHR has been and remains one of the global experts is this type of stormwater conveyance system.

WHY MODELS?

"The strength of physical models is you can stand there and look at them and very quickly say, 'OK, this is

Problems

working. This is not,'" Lyons says. In developing the model for St. Louis, it became apparent early on that the approach chamber (which will guide the overflow from the creek to the system) would need to be modified, something computer models didn't indicate.

Despite the impressive capabilities of computer modeling, they still cannot replicate the full complexity of these flows. One problem is air caught or entrained in the water. If not properly ventilated, this entrained air can become pressurized, pushing back through the system and turning manholes into geysers. It's not yet possible to numerically model complex flows with entrained air, Lyons says. To numerically model each bubble in such flows would require a finer grid and more computational capacity than researchers currently have available.

AN OPPORTUNITY FOR STUDENTS

Projects such as this provide great opportunities for students, both undergraduate and graduate. Students work on construction and data collection, and some projects can even serve as a master's thesis if the study warrants.

"That's how I got involved," Lyons says. He transferred to the University of Iowa to study civil and environmental engineering and was hired by IIHR's Larry Weber to support research work for outside clients. Lyons continued this work throughout his master's degree studies and following graduation was hired to work at IIHR as a professional engineer. Lyons says he didn't know a lot about hydraulics when he started, but he found the work interesting. "It was me getting out in the lab and working on some real projects that got me excited about hydraulics and basically began my career," Lyons says.

TOP: IIHR built a 1:24 scale physical model of a portion of the Ohio River near the Cardinal Power Plant.

INSET PHOTOS: Services for clients include design, welding and fabrication, and expert construction.

ABOVE, TOP: IIHR's Engineering Services Director Troy Lyons (*right*) and Jacob Odgaard (*left*) confer with a client from St. Louis on the storm sewer dropshaft.

ABOVE, BOTTOM: IIHR staff make an adjustment to the St. Louis dropshaft model.

Standing Strong for Iowa

Larry Weber recently stepped down as director of IIHR to become executive associate dean of the University of Iowa College of Engineering. We took this opportunity to talk with him about his triumphs, disappointments, and legacy as he moves on to a new challenge.

A few at a time, people filed in and sat down. Slowly the Seamans Center lecture hall filled up with IIHR staff and students. Fatigue showed on their faces — they had been through a lot.

Less than a week earlier, IIHR had evacuated the Stanley Hydraulics Lab as the flood of 2008 swallowed up buildings along the river one after the other. IIHR's director at the time, Larry Weber, had called this meeting to talk about what was next. Weber had just heard from his faculty colleague Witold Krajewski, who said he would be a few minutes late. Wait for me, Krajewski told Weber.

Once Krajewski had arrived, Weber started the meeting. "Well, here we are," he said. At that point, Krajewski stood up and stopped the meeting. "He said he wanted to thank me for my leadership in this difficult time," Weber says. "He asked everybody to give me a round of applause."

Weber was so moved, he had to turn his back to the crowd. To hear such heartfelt public support from a faculty colleague meant the world to Weber. "It was huge," he says. "It was just huge."

A ROCKY START

Looking back now, at the end of Weber's successful 13-year tenure as director of IIHR, it is hard to imagine how difficult his first few years on the job were.

Weber earned BS, MS, and PHD degrees in civil and environmental engineering at the University of Iowa (UI). After graduation, he accepted a position with IIHR's Jacob Odgaard working on fish passage projects for hydropower utilities in the Pacific Northwest. It was work Weber loved and at which he excelled.
Later, he became a member of the faculty and enjoyed success in the classroom as well. When then-IIHR Director V.C. Patel announced in 2003 that he would step down and an internal search for the next director of IIHR was opened, Weber thought, well, why not me?

"I was very naïve," Weber says. "With great ambitions, I said, yes, sure, I'll put my name out there."

He was up against full professors with longer tenure and impressive research and publication records. Despite that, Dean of Engineering P. Barry Butler saw something in Weber — leadership ability, perhaps, and vision — and selected him for the job. Weber accepted.

And so began a challenging period. Bad feelings lingered on after he assumed the role of director. Butler stuck by his decision and by Weber. But at IIHR, Weber was alone. "It was a very lonely period in my life."

Still, Weber held on. Whether through perseverance or sheer stubbornness, he was determined to do the job he was hired to do and to do it well. "[My wife] Miechelle and I have always been committed to the University of Iowa," he says. "I come from a simple background. You just want to do a good job."

IT RAINED AND RAINED

In June 2008, heavy rains brought destructive flooding to Eastern Iowa and the UI, which suffered almost $1 billion in damages.

Weber watched as the river levels rose and university officials began to talk about evacuating Stanley Hydraulics Lab. "Every day it seemed like things just got a little worse," Weber remembers. On Thursday of that week, an additional six to eight inches of rain fell. "It just kept raining and raining and raining," he says.

Weber was working at the lab that Thursday night when he noticed an ominous silence. The sump pumps

OPPOSITE: Weber stands on the bridge with the bulwark of Stanley Hydraulics Lab behind him.

BELOW: Floodwaters rising in June 2008.

ABOVE:
IIHR students and staff sandbagging in 2008.

OPPOSITE PAGE:
Weber *(right)* and Krajewski together created the Iowa Flood Center, which Krajewski leads.

in the basement had stopped. He called in a contractor, and they went to the basement to try to restart the pumps. "You could hear all this debris — logs and rocks — bouncing up against the side of the building." About midnight, they heard a loud crack as something big hit the block windows. At that point, they gave up the fight (for the moment) and left with only one pump working.

The next morning, Weber notified the staff to start evacuating. University officials wanted everyone out by 5 PM. The staff moved out computers and data servers and movable research equipment — everything essential. Employees brought their own pickups and cars up on the sidewalk, loaded them up, and moved them out. Shortly before noon, university officials padlocked and chained the doors and turned off the power.

Theoretically, no one was allowed back in until the university gave the okay. Engineers, however, are known for a certain what-the-hell, just-get-it-done attitude. Weber wasn't about to allow valuable equipment in the basement to be damaged or destroyed by floodwaters if he could help it. Earlier in the week, he had rented two gas-powered sump pumps, "just in case." By removing an exhaust fan, IIHR shop staff could drop in a suction hose from the pumps to keep the water levels below the towing tank. Weber and other staff watched over the pumps 24/7 until the water receded. Weber took the first overnight shift himself.

To stay awake, he walked halfway across the Burlington Street Bridge and stopped to look back at the hydraulics lab. The power was off along the river. Except for the full moon, darkness reigned. No one was around, and the darkened hulk of the hydraulics lab loomed over the churning river below. "It's an image I'll never forget," Weber says.

In a chaotic week, it was a moment of calm reflection. Weber was four years into his tenure as director of IIHR. It hadn't gotten off to a great start, but he had just started to think things were moving in the right direction. He had recently been reappointed, not with universal support, but with support.

Now the flood had knocked everything into emergency mode. "It was a little overwhelming," Weber says. "If something terrible had happened to this building and there was loss of life, I just couldn't accept ownership of that."

A FLOOD CENTER IS BORN

When the floodwaters retreated, leaving behind mud and devastation, Weber took on a leadership role in the recovery process on campus and statewide. The challenge of repairing and rebuilding required innovation, research, and new ideas. One of the best of these was inspired by a meeting with legislators a few months after the flood: the Iowa Flood Center (IFC), a new academic center focused on flooding.

> "Somebody had to stand strong — stand up for our water and our natural resources. I felt that I had that responsibility."

The IFC illustrates IIHR's adaptability to the needs of the times. The center brought a new research focus on direct service to Iowans. Thanks to the IFC, Iowans can access information about rainfall and flooding online through the Iowa Flood Information System (IFIS). IFIS puts data directly into the hands of emergency managers, public safety personnel, and the public. With this information, Iowans can better protect their property, their families, and their livelihoods. It can also save time and—most important—lives.

In the process of founding and advocating for the IFC, Weber and Krajewski (who went on to become the center's director) have become a very effective team and the best of friends — a sort of dynamic duo. "We work well together," Weber says. "There's probably nobody I am closer to on the faculty."

The IFC was only the first of several innovations under Weber's leadership that have positioned IIHR

to better serve the state of Iowa. The UI Water Sustainability Initiative and the Iowa Geological Survey are now affiliated with the institute; researchers here developed the Iowa Water-Quality Information System; and Weber co-founded the Iowa Nutrient Research Center based at Iowa State University. The institute also led the effort to secure a $96.9M grant to the state of Iowa from the U.S. Department of Housing and Urban Development for the Iowa Watershed Approach, a watershed-based flood mitigation and water-quality project (see story p. 14). Weber played a major role in all of these game-changing efforts for water resource issues in the state of Iowa.

But why? Why so profoundly rock the boat of a well-established and respected organization like IIHR?

"I think it's a deep-rooted passion and commitment to the state of Iowa," Weber says. "It's a sense of justice, if you will, a sense of what I believe is right." His vision for the institute and the state recognizes that there is a very public impact of certain policies that maximize private corporate wealth. "I felt like I had a responsibility to the people of Iowa, knowing what I knew and seeing what I saw, that somebody had to stand strong — stand up for our water and our natural resources. I felt that I had that responsibility."

MOVING ON

Today, Weber has turned his attention to new challenges at the UI College of Engineering, where he serves as the executive associate dean. "There's a lot I'd like to do there," he says. "I think I can have a lasting positive impact on the college. And I'm excited about that."

Even so, Weber knows many will question his decision to leave IIHR. It was a difficult choice, but Weber says once he had made up his mind, he felt liberated. "I came to the realization that I'm not going to be director forever," he says. "It's just a matter of when, not if. What better way to go out than on top?"

Weber says he leaves the institute healthy and well-positioned for the future. And he's happy to see his successor, Interim Director Gabriele Villarini, in the job. "Gabriele wants to lead and direct, and he's got the personality, the vision, the energy. Why not give him the opportunity to serve as interim director?"

As a researcher, Weber is still a vital part of IIHR. And advocating for the IFC is written into Weber's new job description — a clear indicator of how strongly he feels about the IFC and IIHR.

"Such an investment was made by so many people, me included," Weber says. "That investment is worth fighting for."

FROM THE ARCHIVES:

V.C. Patel's Amazing Journey

FORMER IIHR DIRECTOR V.C. PATEL took a long and circuitous route to IIHR and the University of Iowa. Any other man might have turned back several times along the way, but not Patel. A 20-year-old V.C. Patel arrived in London in late December of 1958 with only one suitcase. He had traveled alone from his home in Kenya, hoping to attend college in Britain. He took a taxi to Trafalgar Square to check in with the advisor to Kenyan students, a Mr. Billington. What Patel heard was not encouraging.

"What are you doing here? How could you come here without authorization?" Billington demanded. "There's nothing I can do for you!"

A KENYAN IN LONDON

Slightly deflated, Patel returned to the sidewalk. London in December was cold, and he didn't have

ABOVE:
V.C. Patel was instrumental in reinvigorating and remodeling the C. Maxwell Stanley Hydraulics Lab.

LEFT:
V.C. Patel (*left*) with a friend at the Nairobi airport in 1958, about to begin his amazing journey.

the proper clothes. He had only one other hope — in his pocket, he had the address of a man from Nairobi. But he lived in Plymouth, 250 miles from London. Patel, whose family was of Indian descent, inquired and learned that he would need to take a train. It was raining, and the train was packed. He could not find a seat and was standing near the door when the train stopped at Exeter, the journey half over.

A tall Kenyan man boarded the train and said, "V.C., what are you doing here?"

It was George, a friend from Patel's school days in Kenya. George was studying at the University of Exeter and was on his way to see friends in Plymouth.

Patel poured out his story to George, who said, "Patel, you are in bad shape." In Plymouth, George took Patel to the YMCA for a place to stay. There, Patel met students from all over the British Commonwealth — India, Malaysia, Singapore, and more. From these students, Patel learned that he needed to take exams — A levels — before any college or university would talk to him.

Patel went to see Mr. Huxley, a faculty member at the local Plymouth and Davenport Technical College. Huxley looked at Patel and said, "How can you be here? You don't have any papers. We can't let you take A levels." But after a little more persuasion, Huxley agreed to let Patel take his physics class.

PATEL 1, BRITISH OFFICIALDOM, NIL

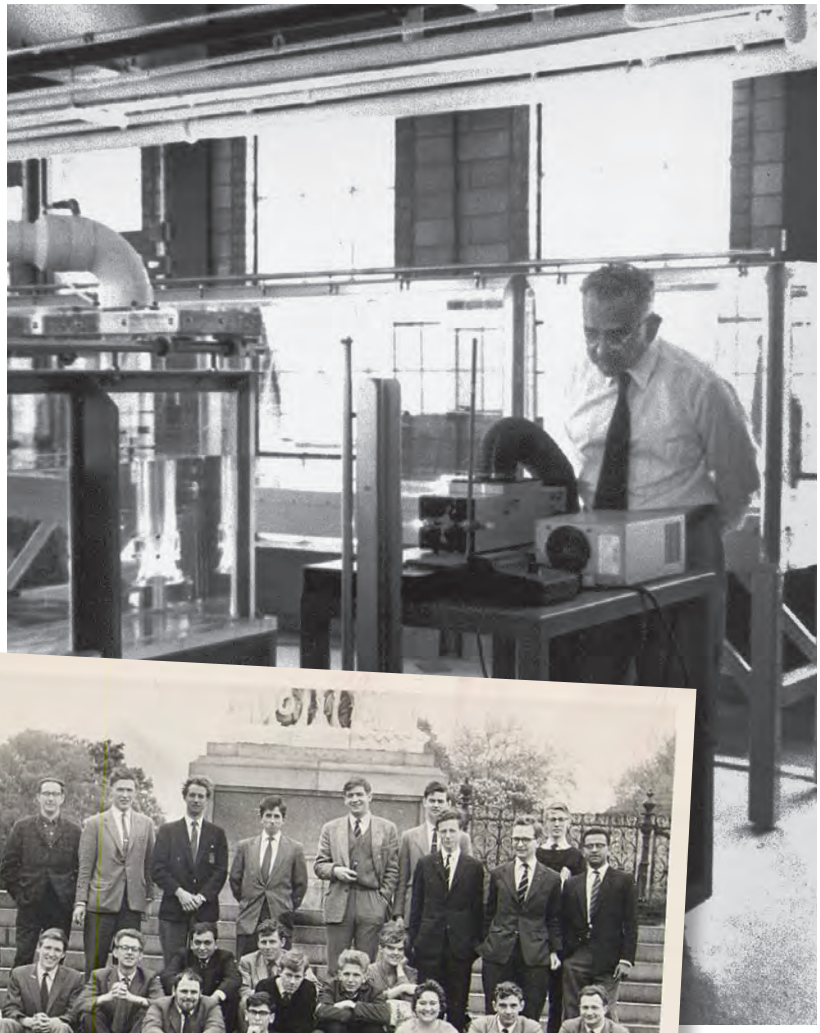
"I didn't pay too much attention in class," Patel admits. But he got his hands on 10 years' worth of A level exams in the subjects he hoped to study. He solved all the problems on his own and went to see Huxley again, showing him the work he had done. This time, it had the desired effect. Huxley relented and said he would allow Patel to take the A level exams in four months' time.

It should have turned up the pressure, but Patel had an amazing level of confidence in himself. "I don't remember worrying about these things somehow," he says. And his confidence was well-founded. In June, he took the exams.

"To say the least, I aced them," he says. With these scores, he could go wherever he wanted. He dreamed of studying aeronautics, and the top university for aeronautics was Imperial College in London.

After that, a long summer stretched out in front of Patel with no classes and no exams. "I spent most of the summer playing cricket and enjoying myself with a lot of company," he says.

In late summer of 1959, he received a letter from Imperial College, offering him not only admission,



TOP: Patel examines experimental equipment at IIHR.

CENTER: The aeronautics class at Imperial College, London, 1962. Patel is standing at far right.

BOTTOM: With Cambridge classmates on an outing to Wales in 1963. Patel is seated at left.

but also a scholarship. He sailed through the Imperial College aeronautical engineering program and earned a BS in 1962, followed by a PHD in fluid mechanics at Cambridge in 1965, both in record time.

Patel was clearly a fine student and a gifted researcher. Despite his inauspicious arrival in London, he had never doubted himself or his abilities.

IOWA BECKONS

Toward the end of his stint at Cambridge, Patel met IIHR's Lou Landweber, who was impressed with the young man. After graduation, Patel taught fluid mechanics to undergraduates at Cambridge, spent a year at the aeronautics department at the Indian Institute of Technology (where he met his soon-to-be wife Manjula and married her in 1966), and then returned to Cambridge. And a few years later in 1970, when Patel was looking for a position in the United States (his wife had fallen in love with the states during Patel's stint at Lockheed Martin in Georgia), he wrote to Landweber and expressed his interest in IIHR. At the same time, he wrote to two other universities. Landweber was the first to reply, inviting Patel to present a seminar.

"I gave a seminar on unsteady turbulent boundary layers and computation," Patel says. "And for the life of me, I don't know why, but they appreciated it."

A job offer from IIHR Director Jack Kennedy followed by telegram in a matter of weeks.

"The fact that I was hired at IIHR even though my background was in aeronautical engineering says much about the breadth of vision of Kennedy and Landweber," Patel says.

A FACULTY MEMBER IS BORN

Patel, just 33 at the time, came to Iowa with his wife and 1-year-old son in January 1971. He expected to do research, but shortly after his arrival, Landweber asked him if he would teach a class — Advanced Mechanics of Fluids. Patel agreed.

Within a week, he was appointed as an assistant professor of mechanics and hydraulics. But Patel was not happy — only assistant professor? He stormed in to talk to Kennedy. "I have taught. I have written books," Patel protested. "Published in top journals!" Kennedy agreed and suggested that Patel talk to Kwan Rim, who was chair of the department. Rim concurred, and appointed Patel as an associate professor.

"Rouse was mad as hell," Patel remembers with a chuckle. Dean of Engineering Hunter Rouse (former IIHR director) couldn't believe a faculty member had been appointed and promoted without his knowledge.

But before long, even Rouse was impressed with his

TOP: A newly-minted PHD at Cambridge, 1965.

CENTER: Patel with his bride Manjula, 1966.

BOTTOM: The newlyweds return to Cambridge, 1966.

new faculty member. Patel, now 36, was appointed head of the Division of Energy Engineering, and a year later in 1975, he became a full professor.

Patel pursued an active research life at IIHR that spanned more than 35 years. In 1990, he was appointed a University of Iowa Foundation Distinguished Professor, and in 2000, he was named the Edwin B. Green Chair in Hydraulics. He developed a special focus program in ship hydrodynamics, funded by the Office of Naval Research. His expertise in boundary layer theory, viscous flow, and turbulence brought major fundamental contributions to fluid mechanics.

MAKING A DIFFERENCE

Patel also contributed to IIHR's studies of cooling towers, biological flows, river flows, and turbines. He applied computational fluid dynamics (CFD) models to ship hydrodynamics, work with worldwide impact.

"We were doing CFD well before the term became commonplace," Patel says with pride.

Patel also accepted administrative work "because I felt I could make a difference," he says. He assumed the directorship of IIHR in 1994 and established high-speed computing and CFD as major research tools. He also undertook a total remodel of the Hydraulics Lab (and the fundraising to pay for it), turning it into a comfortable and functional space. Patel also created the International Perspectives in Water Resources Planning study-abroad class, modernized IIHR's financial system, and led the fundraising and planning for the Lucille A. Carver Mississippi Riverside Environmental Research Station (LACMRERS). In addition, Patel traveled the world to maintain relationships with IIHR's distinguished alumni, as Rouse and Kennedy had before him.

He stayed in this role at IIHR for a decade, and then very deliberately stepped aside. But Patel's work was not done. A year earlier, he had accepted a position as director at the Center for Computer-Aided Design (CCAD). He steadied the ship, restored morale, and left a healthy center for his successor. He retired in 2007.

Patel's parents were Indian and devout Hindus. In his own life, Patel says, he spent decades chasing material things, until a guru came into his life and changed his view of the world. Patel says that his guru inspired him to conduct himself in a way that would benefit the staff and students at IIHR without regard for personal rewards. Today, he considers himself deeply spiritual and travels the world presenting on these topics.

When Patel speaks of IIHR, it is with a special warmth. "It's a family in many ways," he says. The renovation of the building helped create a place that brings together diverse people working on widely varying projects.

"What brings us together as a family is that we come from diverse areas," Patel says. "It's that diversity that keeps us together."

ABOVE: Patel shares a laugh with Marian Muste as he admires Muste's newly published hydraulics textbook.

STUDENT VOICES :

What do you love to do in your free time?

Ellen Black / Cedar Rapids, Iowa
RESEARCH AREA: *Microbial ecology*

"I love being outside and seeing new landscapes … Backpacking is a way to disconnect from technology and be reminded of why I aspire to improve water quality through a career in environmental engineering."

Timur Dogan / Iowa City, Iowa
RESEARCH AREA: *Ship hydrodynamics and CFD*

"*Kum Do,* or the Way of the Sword, is the Korean art of sword fencing … Through Kum Do I've developed concentration, strength, and self-control. Plus the sparing armor (*Hogu*) looks awesome!"

Amina Grant / Piscataway, New Jersey
RESEARCH AREA: *Lead, copper, and arsenic in drinking water systems*

"I love to write stories and bake. In my community, I love to volunteer with children. I joined the Iowa chapter of Graduate Women in Science in which I can engage children in different science contexts."

Lauren Grimley / Houston, Texas
RESEARCH AREA: *Urban hydrology*

"I enjoy biking and hiking on local trails, attending concerts and festivals downtown, and going to Iowa sporting events. I also try to travel around the Midwest to visit new cities and explore state parks."

Gabriel Perez Mesa / Medellin, Colombia
RESEARCH AREA: *Scaling theory of floods*

"Running, biking, and soccer! Those are my passions … I always find the feeling of pushing the limits of my body pleasant after a long day of hard work."

Matt Meulemans / Kimberly, Wisconsin
RESEARCH AREA: *Water-quality sampling*

"I love fishing, hunting, hiking, and just exploring the natural areas that Iowa and the surrounding states have to offer. I'm always excited to find a new area that is seemingly untouched by people."

Nick Pflug / Ames, Iowa
RESEARCH AREA: *Transformation of endocrine-active steroids*

"I love to be in nature when not at work, hiking big mountains, rock climbing, hunting, fishing, backpacking, camping, etc. It helps to replenish the soul."

Danielle Thomas / Placentia, California
RESEARCH AREA: *Flood frequency estimation*

"I've been in the kitchen since I was in elementary school, helping produce holiday feasts and baking treats … As I've gotten older, cooking and baking is what I do to relieve stress and share products of love."

A Song of Wind and Water

by Mikael Mulugeta

ON APRIL 9, 2015, THE TORNADO of Rochelle-Fairdale touched down in Lee County, Ill., and rumbled along for 30 miles before retreating, leaving devastation in its wake. The most powerful tornado in the United States that year was also the first tornado Alex Morrison ever chased. At the time, she was studying meteorology as an undergraduate at Valparaiso University. With some classmates and several meteorologists, she followed the tornado from a safe distance. The EF4 tornado, the second most destructive designation on the Enhanced Fujita scale, reached speeds up to 200 mph and caused $19 million in damages.

When Morrison and her peers stopped in the city of Rochelle, they saw buildings caved in, semi-trucks overturned, and streets littered with debris. Morrison calls the experience sobering and remembers realizing at that moment why meteorologists study and work so hard to understand extreme weather events.

Today, Morrison has given up storm chasing and is instead pursuing a PHD in civil and environmental engineering at the University of Iowa (UI). She is also part of the Sustainable Water Development (SWD) graduate program, which aims to educate engineering students in a broad range of topics, including public policy, economics, and the human impacts of research. Morrison picked the UI and SWD because of her interest in hydrology, the opportunity to work with IIHR Interim Director Gabriele Villarini, and her own ties to the Midwest.

Morrison grew up in Plainfield, Ill., where her fascination with weather was born. In 1990, Plainfield endured the only EF5 tornado ever recorded in August, which is late in the tornado season. Morrison grew up learning about Plainfield's record tornado and adoring the movie *Twister*. This set her on the path to study meteorology at Valparaiso, but an encounter during her freshman year sparked an interest in hydrology.

That year, Morrison met a National Weather Service (NWS) hydrologist who told Morrison about her work — monitoring river levels, issuing flood alerts, and acting as a conduit of information between river forecast centers and the NWS. Morrison could envision herself in such a role.

Morrison's research compares historical and current rainfall models to understand how precipitation has changed over time and to predict future rainfall. The SWD program also offers opportunities outside of the lab, and Morrison says she is happiest when doing hands-on work in communities, collaborating with other engineers, and dealing with the effects of climate change.

"After completing the program, we'll be able to go out into society and explain to someone who isn't well-versed in hydrology or engineering what our research means and why it's important to care about these issues," says Morrison. "Hopefully, because we understand the policy side as well, we can work to make a more sustainable environment for our country."

Morrison is more than just a well-rounded engineer. She also earned a minor in music and currently plays clarinet in the UI band. She paints regularly and is an avid gamer, a fact she says surprises people who don't know her well.

BELOW: Alex Morrison learned the importance of accurate weather forecasting when she saw the effects of an EF4 tornado in person.

Taking on a Challenge

WHEN HYUNSE YOON ARRIVED at the University of Iowa in 2004 for his PHD studies, he was excited to begin his doctoral studies in ship hydrodynamics.

Yoon had come to Iowa, halfway around the globe, from his home in South Korea to work with a well-known man in ship hydrodynamics — Fred Stern. Not that they had yet been introduced. "I had never seen him before!" Yoon remembers. "But I knew he was a very famous person in the ship hydrodynamics field."

Yoon completed a PHD in mechanical engineering at the University of Iowa (UI) in 2009 and went on to serve as a postdoc and later as an associate research scientist at IIHR.

The best part of his professional work at IIHR was the challenge, Yoon says. Stern always posed challenging research topics for his team, Yoon says, problems that others might not take on.

A recent example of which Yoon is proud is a project for the U.S. Navy applying tomographic PIV (particle image velocimetry) in the IIHR towing tank. "That technique is state-of-the-art," Yoon says. "We were the first to conduct a successful tomographic PIV study in the towing tank. The outcomes were used for worldwide CFD validation."

Yoon's duties included supervising student employees who work on towing tank research. He made it a point to treat his employees with respect, always making sure they understood exactly what to do and why they were doing it.

Jerry Spector, an undergraduate in chemical engineering, says that Yoon always laid out clear expectations for the student employees. "I can't say enough about Hyunse," Spector says. "He's a great boss."

Mechanical engineering student Michelle Guetzko agrees. "He makes sure we actually know how it works and why it's set up that way."

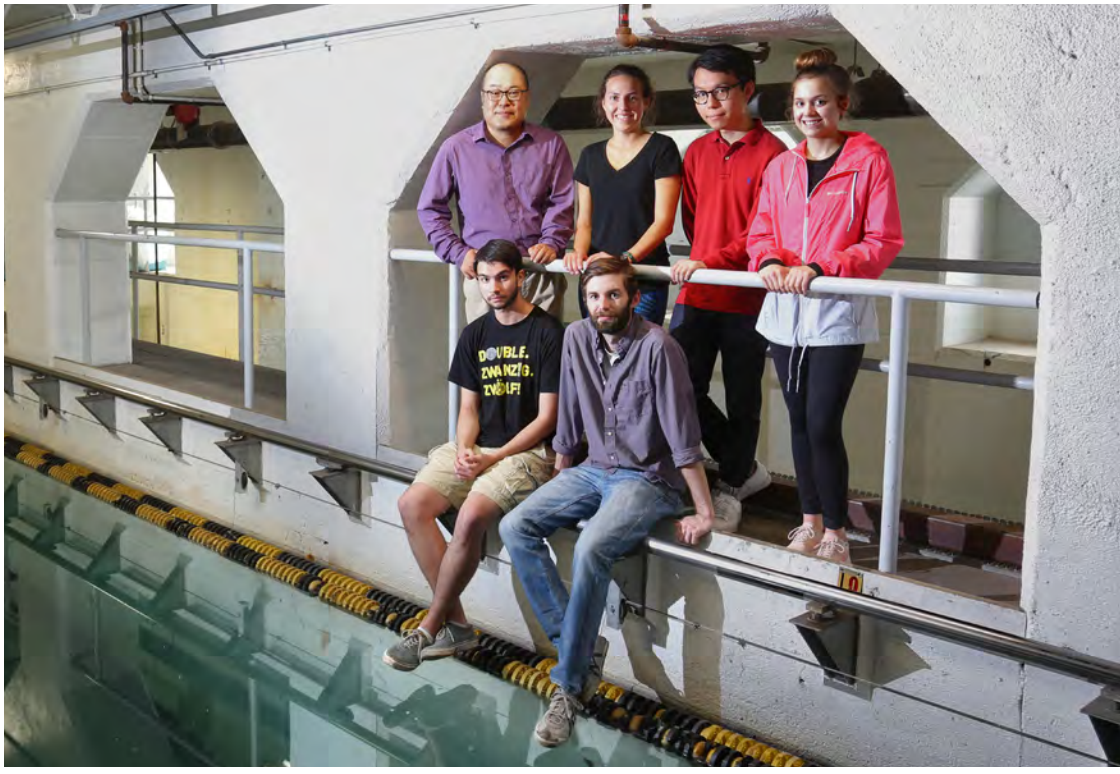
Yoon says this was a deliberate decision to assure good outcomes. "I try to explain the best I can," he says. "I always want my students to know what they are doing."

Yoon's job at IIHR was a demanding one. He remembers a time when he worked 80 hours a week for many weeks. "I realized that in the end, it is not good for me. I'm trying to slow down."

But he believed in the work, and he believed in working hard. "Good outcomes never happen without effort," he says.

When he has time, Yoon loves spending time with his young family. He and his wife, Woon Koh, have two children: a son, Taejune, aged 14; and a daughter, Seoyoung, aged 10.

Iowa City was a welcoming haven for Hyunse Yoon and his family. "It is a peaceful, clean, and safe place to live with family," he says. He struggles to find anything negative to say about Iowa, but then adds, "I always wish the winter could be shorter."



BELOW: Hyunse Yoon (*back row, left*) resigned from IIHR late last year for a new opportunity at the University of Michigan Marine Hydrodynamics Lab. Here he poses with his student employees next to the IIHR towing tank. *Back row, left to right*: Gabrielle Armetta, Jieqiu Shao, and Michelle Guetzko. *Front row from left:* Roman Doyle and Jerry Spector.

ADVENTURES AT IIHR AND BEYOND

The Three Musketeers

THE TELEPHONE RANG, shattering the middle-of-the-night stillness in the small apartment. Federico Maisch groaned and rolled over to look at the clock. 1:30 am! His wife pulled the pillow over her head as Maisch picked up the phone.

It was a familiar voice, pleading for help. "Federico, we flooded the ice room!" Maisch's friend and fellow IIHR grad student Marcelo Merino was on the other end of the line. "You need to come and help right now!"

"So I went, and we cleaned it up," Maisch remembers with a laugh. "I don't know if faculty realized in the morning that the ice room had been flooded."

A LIFETIME OF FRIENDSHIP

Maisch, Merino, and Marco Román, the third member of this trio of friends, can laugh about their ice room escapades now. They laugh about a lot of things. These three University of Iowa (UI) alumni visited IIHR and Iowa City recently with their wives for a sort of personal reunion, revitalizing their friendship and remembering the people and events that made their student days at IIHR unforgettable.

All three came to IIHR from Latin America: Maisch from Peru, and Merino and Román from Ecuador. And all three earned advanced degrees at the UI in the early 1970s after studying and conducting research at IIHR. Following graduation, they all enjoyed long and varied careers.

"We shared a lot at the university," Merino says. "We learned a lot from each other." The coursework and research were intense. Socially, the atmosphere was much more relaxed. The three friends often ate lunch and studied together, laughing, joking, and sometimes even singing, building a friendship strong enough to last a lifetime.

Singing, you ask? Yes, singing. Again, Maisch tells the story. The three friends were studying together late at night. "I don't know why," Maisch says, "but I started singing. Marco, as the gentleman that he is, came and put his hand on my shoulder and said, 'Federico, is that absolutely necessary?'"

> "I learned the joy of working and providing service. They forged us as engineers, but also as people with strong ethical values."
>
> — FEDERICO MAISCH —

The three friends laugh uproariously at this story from days gone by, reveling in the opportunity to reconnect.

KENNEDY TALES

Although the work at IIHR was challenging, there was support there, too. "I was fortunate to work with Jack Kennedy," Merino says. "I learned from him not only engineering, but also professional ethics and a way of looking at the world that was humane and also respectful."

Then-IIHR Director Jack Kennedy demanded hard work from his students. "But if you did the work, he was kind to you," Merino says. He remembers when his first child was born. Merino asked Kennedy if he could take a few days to be with his wife and baby. Long before parental leave for fathers was even thought of, Kennedy told him to take as many days as he needed. "Your family is the most important thing," Kennedy told the new father. "For me," Merino says, "that was awesome."

Kennedy also taught his students to relax and to maintain a sense of humor, whatever challenges they might be facing. Merino says he used to hurry to the lab early in the morning to meet with Kennedy to discuss his thesis. At one such meeting, Merino mentioned the old saying that the early bird gets the worm. Ah, but there is another version, Kennedy countered. "The early worm gets eaten by the bird!"

Maisch also remembers many other teachers and professors who taught their students more than engineering. "I also learned the joy of working and providing service," Maisch says. "They forged us as

engineers, but also as people with strong ethical values."

When the trio left IIHR, they took these values with them, as well as the ability to address new problems with confidence and ingenuity. "The faculty took away our fear of tackling any problem," says Maisch, who went on to 41-year career at the engineering firm Greeley and Hansen, where he rose to the position of executive vice president. "All through my professional life, I've drawn from the lessons that I learned here."

Román agrees. At IIHR, he learned how to address unexpected challenges, as well as how to conduct his professional life, which included government work in water resources, shrimp farming, and his current position as a sanitary engineer. His friend Merino, now retired, worked in academia, government, industry, and consulting.

EXPERIENCING AMERICA

Beyond IIHR, the state of Iowa also offered a welcoming home for the young men and their families. "The people we met in Iowa made us feel welcome," Merino says. He remembers a family in Osage who invited international students to share their Thanksgiving. A busload of students traveled to Osage for food, family, and a taste of midwestern culture. "That made an impression on people from other parts of the world about the generosity of the people of Iowa," Merino says.

Román says the international diversity of the students and faculty at IIHR also added to his experience here. "We had the opportunity to meet so many wonderful people from the United States and the world," Román says. "That was quite important in my life."

Iowa was a wonderful place to experience America, Maisch says. He now lives near Chicago at Northbrook, Ill. "To us, this is home," he says.

ABOVE: The three musketeers return to IIHR (*left to right*): Marco Román, Federico Maisch, and Marcelo Merino. All three earned MS degrees at the UI in 1974.

The Fiscal Year in Review

The year just past was a period of transition for IIHR. The institute had a remarkable 13-year record of research and institutional success under the directorship of Larry Weber. This year, Weber stepped down to assume a new position as executive associate dean in the University of Iowa (UI) College of Engineering. Interim Director Gabriele Villarini assumed his new role at IIHR in August 2017.

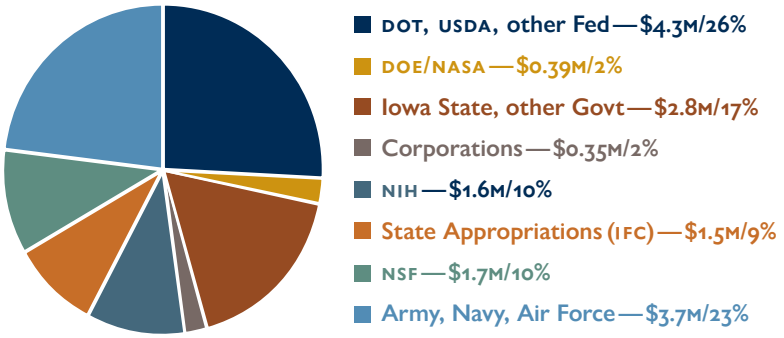
In early 2017, the Iowa Legislature considered defunding the Iowa Flood Center (IFC). Thanks to the extraordinary support from IFC partners and supporters statewide, the center was funded at a reduced rate rather than completely eliminated ($1.2 million compared to $1.5 million the previous year). We're grateful for the legislature's continued support, and for the help of everyone who rallied for the IFC. Still, this reduction in funding has presented challenges for the IFC and IIHR.

Nevertheless, we have a lot to celebrate. The high level of scholarly productivity and funding among IIHR researchers demonstrates the institute's ability to nurture and support a wide range of fluids-related research activities under many different sponsors. IIHR has created an environment in which researchers pursue basic or applied research according to their interests and funding opportunities. This flexibility also helps to ensure that IIHR maintains a diverse portfolio of projects and funding streams that fluctuates depending on current economics and trends. This model has allowed IIHR to remain academically relevant and fiscally strong through its nearly 100-year history.

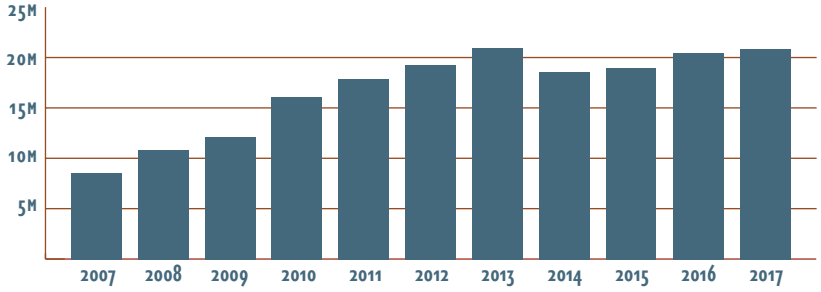
INTERNAL INVESTMENTS

	2016	2017
Graduate Students	$167,431	$160,426
Postdoctoral Associates	$59,973	$58,822
Research Engineers	$303,519	$230,933
Facilities & Equipment	$585,316	$959,721
Total IIHR Internal Investments	**$1,116,239**	**$1,409,902**

EXTERNAL FUNDING BY SPONSOR FY17



FISCAL YEAR 2007–17 FUNDING



IIHR ADVISORY BOARD

Randy Beavers (2013–17)
Urban and Rural Water Systems (retired)

Scott C. Hagen (2014–18)
Professor, Louisiana State University

Catherine Kling (2016–20)
Professor, Iowa State University

Robert Libra (2013–17)
Iowa State Geologist (retired)

L.D. McMullen (2013–17)
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BP America Inc.

Paul Shang (2017–21)
NSWC Carderock Division

Brennan Smith (2015–19)
Oak Ridge National Laboratory

*Richard H. Stanley (2013–17)
Chair, The Stanley Foundation

Jinn-Chuang Yang (2014–18)
National Chiao Tung University

*It is with great sorrow that we report the death of Richard Stanley on Nov. 17, 2017. IIHR has lost a great friend and colleague.

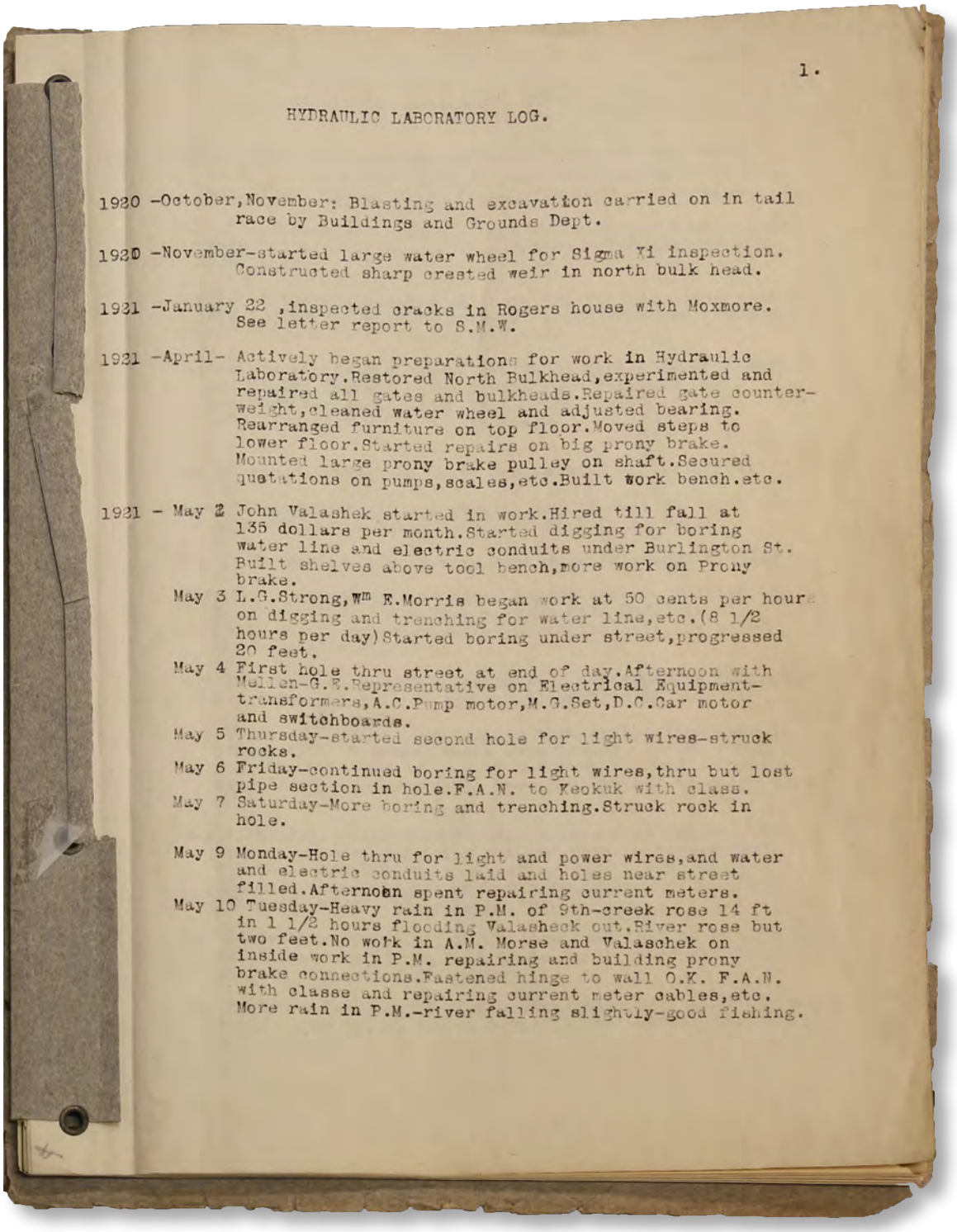
Ex Officio Members

Alec Scranton
Dean, UI College of Engineering

Gabriele Villarini
Interim Director, IIHR

Carmen Langel
Director of Development and Communications, IIHR

DIRECTOR'S LOG, OCTOBER 1920



1.

HYDRAULIC LABORATORY LOG.

1920 -October,November: Blasting and excavation carried on in tail race by Buildings and Grounds Dept.

1920 -November-started large water wheel for Sigma Xi inspection. Constructed sharp crested weir in north bulk head.

1931 -January 22 ,inspected cracks in Rogers house with Moxmore. See letter report to S.M.W.

1931 -April- Actively began preparations for work in Hydraulic Laboratory.Restored North Bulkhead,experimented and repaired all gates and bulkheads.Repaired gate counter-weight,cleaned water wheel and adjusted bearing. Rearranged furniture on top floor.Moved steps to lower floor.Started repairs on big prony brake. Mounted large prony brake pulley on shaft.Secured quetations on pumps,scales,etc.Built work bench.etc.

1931 - May 2 John Valashek started in work.Hired till fall at 135 dollars per month.Started digging for boring water line and electric conduits under Burlington St. Built shelves above tool bench,more work on Prony brake.

May 3 L.G.Strong,Wm E.Morris began work at 50 cents per hour on digging and trenching for water line,etc.(8 1/2 hours per day)Started boring under street,progressed 20 feet.

May 4 First hole thru street at end of day.Afternoon with Mellen-G.E.Representative on Electrical Equipment-transformers,A.C.Pump motor,M.G.Set,D.C.Car motor and switchboards.

May 5 Thursday-started second hole for light wires-struck rocks.

May 6 Friday-continued boring for light wires,thru but lost pipe section in hole.F.A.N. to Keokuk with class.

May 7 Saturday-More boring and trenching.Struck rock in hole.

May 9 Monday-Hole thru for light and power wires,and water and electric conduits laid and holes near street filled.Afternoon spent repairing current meters.

May 10 Tuesday-Heavy rain in P.M. of 9th-creek rose 14 ft in 1 1/2 hours flooding Valasheck out.River rose but two feet.No work in A.M. Morse and Valaschek on inside work in P.M. repairing and building prony brake connections.Fastened hinge to wall O.K. F.A.N. with classe and repairing current meter cables,etc. More rain in P.M.-river falling slightly-good fishing.

Dennis Hill of Cedar Rapids rescued a set of journals by IIHR founding Director Floyd Nagler at a recent area auction. Hill's amazing discovery includes Nagler's day-by-day account of the construction of the Hydraulics Lab, alongside notes on visitors, contractors, and the weather (as well as good fishing days and the occasional bit of wry humor), stretching from 1920–33. Hill donated his find to the University of Iowa Archives. Hill, who reports that he goes to a lot of auctions, says that it's not a question of the monetary value — it's the cultural and intellectual value of auction finds such as this one that keep him motivated.

IIHR ALUMNI: You can be part of the story, too! For our centennial in 2020, we're collecting the stories, photos, and artifacts of IIHR's history. If you'd like to contribute, contact us at iihr@uiowa.edu. Thanks!

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319-335-5237
www.iihr.uiowa.edu

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To be a leader in fluids-related fundamental and applied research; to provide interdisciplinary education for future leaders in science and engineering; and to advance knowledge in support of sustainable natural and engineered systems.

OUR VISION

To be an international leader among academic institutions in hydroscience and engineering research recognized for integrating laboratory, field, and simulation-based experimentation, and participatory interdisciplinary education.