Welcome to the first issue of the EES Newsletter. Having a medium to broadcast the progress and achievements of the EES Program, its faculty, students, alumni and staff has been a long-held dream, so it’s very exciting to see it finally take printed form. We hope you will look forward to reading the newsletter regularly and then pass it on to other interested colleagues. The plan is to publish twice a year, so please keep us informed about your activities and any personal or professional news you would like to share. Names and addresses to add to our mailing list would be greatly appreciated.

In this issue, Professor Alexandria Boehm describes her research on pollution of a southern California beach. Named a Clare Booth Luce Assistant Professor of Environmental Engineering, Ali arrived at Stanford at the beginning of this academic year from UC Irvine where she had held the position of Faculty Fellow from 2000-2002.

During the Summer Quarter there were big changes for Associate Professor Alfred Spormann’s group and the Stanford Biofilm Research Center; they moved to the new James H. Clark Center for Biomedical Engineering and Sciences. Professor Spormann is particularly excited about the way in which the move extends the breadth of the Civil & Environmental Engineering Department, bringing it closer to 30 different departments ranging from clinical medicine to the computational sciences. He believes the close proximity of this range of technologies will offer excellent opportunities for important breakthroughs in environmental research into the next generation. There are constant exchanges and his group is already collaborating with the biocomputational group and the imaging group through the Biofilm Research Center.

Civil & Environmental Engineering is fortunate to have Professor Richard Luthy serving now as Chair of the Department. As Chair, he is looking forward to supporting and applying the concept of engineering for sustainability, which was accepted as the unifying concept for the department at a departmental retreat in May 2003. Look for more information on this theme in our next issue. Professor Luthy is now Chair of the Water Science and Technology Board of the National Research Council. He has been on the Board since 1997.

Special thanks to Molly Y. Quan (yquan@stanford.edu) for her creativity, graphic skills and the design of this newsletter.

News Clips

- Associate Professor Lynn Hildemann began a sabbatical year on October 1, 2003. She is spending the year as a visiting fellow at Stanford’s Institute for International Studies, affiliated with their Center for Environmental Science & Policy studying the impacts that air pollutants have on ecosystems when they are transported long distances and then taken up by the soils and water bodies. Prof. Hildemann is also taking advantage of the extra flexibility in her schedule to spend more time with her 2-1/2 year old son.

- The EES Program hosted a visit by Professor Willy Verstraete, Head of the Department of Biochemical and Microbial Technology at the University of Ghent, February 9-10, 2004. His lecture, entitled "Environmental Biotechnology: The European Perspective" was organized to honor the research of Perry McCarty, Silas H. Palmer Professor Emeritus. Professor Verstraete described the approach of the European Union (EU-15) to environmental biotechnology, particularly in response to cultural attitudes in Europe, such as the prevailing "chemophobia" and opposition to genetically engineered organisms. Exciting innovations highlighted by Professor Verstraete included membrane bioreactors for water reuse and the development of new microbial consortia capable of cleaning up soils and sediments.

- Jennifer Field, a Professor in the Dept. of Environmental & Molecular Toxicology at Oregon State University, was recently the UPS Visiting Professor in the EES Program. She has been on the faculty at OSU since 1992 and during her 6 month stay at Stanford she collaborated with Professors Luthy and Criddle on a study aimed at determining the behavior of fluorinated chemicals during municipal wastewater treatment.

- Congratulations to Gary Hopkins, Brenda Sampson and Duc K.L. Wong who received their 25-year service pins and certificates at a ceremony January 21, 2004.
Huntington Beach is known as “Surf City” and the Beach Boys have sung of the wonderful waves, sun, and bikini-clad women of the beach. So you can imagine the public outcry when the beaches were shut down in the summer of 1999 because of elevated levels of fecal indicator bacteria (FIB) in the water. In recreational waters, high levels of these organisms correlate to the risk of gastrointestinal illness. During the closures, which lasted almost the entire summer, the City of Huntington Beach lost money, acquired a negative reputation, and tourist-based businesses in the area suffered. Local surfers began grass roots campaigns to force the city to fix the problem, but despite the collaborative efforts of the Regional Water Quality Control Board, the Orange County Sanitation District, the National Water Research Institute, the City of Huntington Beach, and the County of Orange to find a solution, the contamination source was not identified. Little did they know the challenges (both scientific and political) that lay ahead. As of summer, 2003, the source of the FIB has still not been pinpointed, and the beaches still suffer from chronic closures. Of course savvy environmental engineers know how to make the best of a pollution problem like this. I have spent the last three years studying it and I never cease to be amazed by what I learn.

The Problem in Detail

Figure 1 shows a map of Huntington Beach. The area of beach severely impacted by pollution is between stations 6N and 9N. It is located within Huntington State Beach, shoreward of a thermal outfall and wastewater outfall and 1800 m north of two watershed outlets. Historical water quality data on FIB has been collected here since 1958 at almost all the stations (numbered 39S to 39N on the map) at least once a week, and often every day. These data provided my colleagues and me with a wonderful opportunity to address some fundamental issues about the microbial pollution problem. We asked: Is the pollution problem near 6N and 9N new, or has it been present for some time? Is water quality worse now than it has been in the past?

Using the historical data, we were able to answer these questions, and tell an amazing story. Fecal pollution is worse during rainy winters, especially during El Nino events, than during the dry summers (see the gray lines in the top panel of Figure 2). The worst water quality ever seen at Huntington Beach was in the winter of 1969, when there were major problems with the sewage infrastructure resulting in sewage spills during the heavy El Nino rains. The construction of a longer outfall in the early 1970s (indirectly a result of the Clean Water Act) had an immediate, positive impact on shoreline water quality, as evidenced by the decrease in average total coliform after its construction (see bottom panel of Figure 2). On average water quality was no worse in 1999 than it was in the 1980s. Overall, along the entire shoreline of Huntington Beach and Newport Beach, summer water quality appears to be improving with time, probably as a result of improved management of runoff, storm drains, and sewage infrastructure.

So what about the pollution problem that is causing beach closures currently at stations 6N and 9N? An historical examination of temporal variations in water quality at individual stations along the shoreline shows that the current water quality problem is unprecedented. Although the
historical data revealed pollution problems at other stations in the past (from leaking sewer lines and storm drains at the beach), no problem had ever existed before at 6N and 9N. Furthermore, we found that the pollution problem at 6N and 9N began in 1997. The reason public attention was brought to the problem in 1999 was that beach closures were forced by new state water quality standards (passed in Assembly Bill 411) that essentially required cleaner beaches.

We uncovered additional amazing results. I examined the periodicity of the beach closures at 6N and 9N from 1997 to 2001. When the data from these stations are binned according to the day since the full moon samples were collected, I found that there was a striking “lunar pattern” (Figure 3). Bacteria levels are typically much higher during the full and new moons than at other times. In fact, it is easy to predict when the beaches will be closed, and when fecal pollution indicators will be elevated. The exact mechanism whereby the moon modulates the pollution in phase with the fortnightly tide remains a bit of a mystery.

I would need more space than is available here to discuss this mechanism, but it is related to either the flux of groundwater or internal tidal bores and has driven the direction of some of my work at Huntington Beach.

Another amazing pattern we uncovered is the diurnal relationship between sunlight and FIB. Figure 4 shows the mean level of total coliform (TC), fecal coliform (FC), and enterococci (ENT), all FIB, each hour of the day as observed during a 14 day, 24 hour-a-day study at the beach. You can clearly see that the bacteria levels decrease with increasing levels of sunlight. But this cannot be interpreted to mean that the beaches are safer for swimming at noon. These organisms are not pathogens themselves, but rather indicators of pathogens. We do not know for certain if actual human pathogens typically associated with sewage, like Hepatitis A virus, adenovirus, or Salmonella spp. also become inactivated when the sun is overhead. A cautious interpretation of this pattern is as follows. In order to get a conservative estimate of risk, fecal indicator bacteria should be measured early in the morning before sunlight renders them useless. Luckily, at Huntington Beach, water is tested at 7:00 am, so conservative estimates of risk are used to decide whether a beach should remain open or closed. However, at some beaches where there is a shortage of funds to cover testing, water sampling is conducted at all hours of the day. For example, in Santa Cruz, it is not unlikely that samples are collected at high noon. Our results concerning sunlight suggest that the California government should modify its guidelines for beach monitoring and insist that sampling is completed in the dark, or early in the morning. If this cannot be done, then sampling should at least be conducted at the same time everyday so that the diurnal variability will not confound day-to-day pollution comparisons.
Gypsy Achong, PhD, 2003
After completing her PhD, Gypsy spent “a wonderful summer of visiting friends and family” and is now working as a consultant with Geomatrix Consultants, Inc. in Oakland. She can be reached at gachong@geomatrix.com or achong@stanfordalumni.org.

John Chung, MS, 1997
John is living in South Pasadena and working as a Civil Engineer for the LA County Sanitation Districts “designing various facilities and systems related to sanitary landfill engineering”. His e-mail address is jchung@lacsd.org

Jeff Cunningham, PhD, 1999
Jeff and family left Stanford for Texas in July, ’02. Jeff is an Assistant Professor in the Environmental & Water Resources Division of the Civil Engineering Dept. at Texas A&M, and his wife, Amy Stuart, also a CEE grad, is on the research staff in the Dept. of Atmospheric Sciences there. You can contact Jeff at jcunningham@civilmail.tamu.edu

Alison M. Cupples, PhD, 2003
Alison has moved to the Midwest to take a position with the USDA-ARS at the University of Illinois Urbana-Champaign researching anaerobic herbicide degradation. You can contact her at acuppies@uiuc.edu

Jon Dahl, MS, 2001
Jon has been living in the Los Angeles area since his graduation from Stanford, working first as a Water Quality Engineer for the LA County Sanitation Districts then transferring within that organization to the Calabasas landfill to work as an Operations Engineer. At the same time he is a National Guardsman in an Engineering and Installations squadron. He can be reached at jdahl@lacsd.org

Edward M. Driggers, 1998-2000, Postdoc with Prof. Spormann
Ed is now located in Cambridge, MA, working as a Senior Scientist for a start-up company. He writes: “In a small biotech start-up such as Microbia, responsibilities are broadly defined, and everyone takes on multiple roles. Ed can be reached at edriggers@microbia.com

Andrea R. Ferro, PhD, 2002
Andrea is an Assistant Professor at Clarkson University, Potsdam, New York, “where the chilly winds blow most of the year” and she is “...barely breathing these days with this assistant prof job!” She and her husband are living in a new house there and can be contacted at aferro@clarkson.edu

Landon Gates, MS, 1991
Landon writes: “I gave up on environmental consulting about 4 years ago. After a year or two of playing at a couple dot-coms, I got my General Contractor’s license and started renovating houses in San Francisco. Someday I’ll put together a website to show off some of our work...” He lives in San Francisco and can be reached at landon_gates@yahoo.com

Upal Ghosh, Engineering Research Associate, 2000-2002
Upal and his family moved to Baltimore at the end of 2002 after he accepted an Assistant Professor position in the Dept. of Civil & Environmental Engineering at the University of Maryland, Baltimore County. He wrote: “...Civil & Environmental Engineering is a new program in UMBC, so I am starting from scratch with two other new faculty...” Upal can be reached at ughosh@umbc.edu

Roger W. Kohne, MS, 1991
Roger has been working with Black & Veatch on water treatment plant design since 1991 and is currently a Senior Project Engineer. Beginning April, 2004, he will be based in Concord, CA and can be reached at kohnerw@bv.com

Jochen Mueller, Post Doctoral Fellow, 2001-2003
Jochen, a Postdoc with Alfred Spormann, 2000-2003, is now a Postdoc at the Center of Marine Biotechnology (COMB) in Baltimore, working with Shil DasSarma on the genomics of extremely halophilic archaea. He can be reached at Mueller@umbi.umd.edu

Dale Pelletier, Post Doctoral Fellow
At the end of 2002 Dale and his family moved to Oak Ridge, TN where he is doing research at Oak Ridge National Laboratory. He writes: “Thanks again to everybody for making my time at Stanford a very pleasurable experience. I miss you all...” His e-mail address is pelletierda@ornl.gov

Mandy Ward, Life Science Research Associate, 2000-2003
In the middle of winter, 2002-2003, Mandy left Stanford for Johns Hopkins University in Baltimore where she had accepted an Assistant Professor position in the Dept. of Geography and Environmental Engineering. Her research lab there is working with “...the available sequence data [of microbial genomes] to study microbial gene expression in the environment.” For more detailed information, go to her Web page at http://www.jhu.edu/~dogee/people/faculty/ward.html or e-mail her at mjward@jhu.edu