Water HIGHLIGHTS

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WATER RESOURCES RESEARCH INSTITUTE
Community Outreach & Extension Services
University of the District of Columbia

FEATURE

3 Pharmaceuticals are in the Drinking Water: Reason for Concern

Recent water quality assessments conducted by the Associated Press indicated that a vast array of pharmaceuticals, antibiotics, anti-convulsants, mood stabilizers and sex hormones have been found in the drinking water supplies of the nation[1]. The number of chemicals found per analyzed sample varies from city to city. For example, in Philadelphia at least 56 pharmaceuticals or their byproducts have been found. In the District of Columbia and surrounding areas, only six pharmaceuticals have been reported. This number is expected to grow because no sewage treatment plant is currently designed to remove all pharmaceuticals. Despite the wide occurrence of these chemicals in the drinking water, including bottled water, many drinking water suppliers do not test for these chemicals nor inform their customers because they are not required to do so by law.

WHAT'S INSIDE

Director's**MESSAGE**

Building Capacity to Meet Future Water Resources Research and Training Challenges in the Nation's Capital

> "Advocating for clean-up efforts in the Anacostia Watershed is very relevant to pollution control in the Chesapeake Bay."

It's been an exciting five years serving as Director of the University of the District of Columbia's Water Resources Research Institute and participating in an incredible transformation of the Institute. Our role has evolved from simply providing seed grants to building capacity to train future scientists in water resource management. Though still a far cry from the glory days when Dr. Hame Watt was director, the Institute is taking on more challenges to serve the training and research capabilities for students and faculty members. Our Water Quality Testing Lab is now capable of testing and conducting comparative analyses with the DC Water and Sewer Authority (WASA) on most water quality parameters. Our Environmental Modeling and Simulation Lab will be capable of developing and testing new water quality models including Geographic Information System application in modeling processes. A fact sheet which interprets DC Water and Sewer Authority's monthly test results of tap water in DC resident homes is being completed. Our Water Quality Education Program in Cooperative Extension Service will conduct follow-up workshops to ensure residents understand their test results.

Advocating for clean-up efforts in the Anacostia Watershed is very relevant to pollution control in the Chesapeake Bay. Because storm and wastewater management in Washington, DC has out grown its handling capacity through the Combined Sewer Overflow system, it must be either reconstructed or supported with creative low-impact development projects. Unfortunately, the mounting challenges, especially in the area of emerging contaminants such as pharmaceuticals and organics, are not easily detected analytically and with increasing cost, very difficult to measure using standard methods. The Institute will continue to coordinate and facilitate water resources related research projects to assist in solving stakeholder-driven problems, but greater resources must be invested to build capacity to meet future research and training challenges.

The "Water Highlights Newsletter" shares our accomplishments and successes with stakeholders. Hence, we encourage you to enjoy reading it and please call on us when in need of advice or confronted with a problem related to your surface, ground or drinking water quality and quantity. ■

WILLIAM HARE
Director of the D.C. Water Resources Research Institute

Pharmaceuticals are in the Drinking Water: REASON FOR CONCERN

Recent water quality assessments conducted by the Associated Press indicated that a vast array of pharmaceuticals, antibiotics, anti-convulsants, mood stabilizers and sex hormones have been found in the drinking water supplies of the nation1. The number of chemicals found per analyzed sample varies from city to city. For example, in Philadelphia at least 56 pharmaceuticals or their byproducts have been found. In the District of Columbia and surrounding areas, only six pharmaceuticals have been reported. This number is expected to grow because no sewage treatment plant is currently designed to remove all pharmaceuticals. Despite the wide occurrence of these chemicals in the drinking water, including bottled water, many drinking water suppliers do not test for these chemicals nor inform their customers because they are not required to do so by law.

How do drugs enter drinking water supplies? When humans or animals get medications, part of these drugs is absorbed or transformed; the rest is excreted through bodily waste and enters the surface water via wastewater effluent discharges. In addition, unused medication may be flushed down the toilet, poured down the drain, or allowed to leach from landfills. Furthermore, surface runoff from land amended with animal manure may result in the contamination of surface or groundwater with veterinary medicines or growth hormones. When the drinking water source is contaminated with pharmaceutical products, be it ground water or surface water, part of these chemicals may ultimately reach the drinking water supplies because the existing water treatment plants are not designed to remove most of these pharmaceuticals.

The concentration is low, so why should we worry? Concentration of these pharmaceuticals in the drinking water is very low, generally in parts per billion or parts per trillion, which is far below the levels of medical doses. Hence, both the pharmaceutical industries as well as the regulators are reluctant to take action. Indeed, based on what we now know, there is little or no risk to human health from pharmaceuticals in the drinking water. Nevertheless, there are reasons for concern about their presence in the drinking water:

- Small amounts of medications have had adverse effects on human blood cells, human embryonic kidney cells and human breast cancer cells, as well as wildlife. Male fish are also being feminized and creating egg yolk proteins; this adverse ecological effect has an impact on fishermen. Pharmaceuticals are actually designed to have very specific effects at very low concentrations; the adverse effects of such small concentrations on people with weak immune systems is not yet known.
- So many drugs in the water supply are being ingested in various combinations that were never intended for humans. In addition to pharmaceuticals, humans are exposed to several other industrial chemicals—including pesticides—via food they eat as well as the air they inhale. The Environmental Working Group found 287 industrial chemicals in blood from an umbilical cord. This demonstrates that even if someone thinks he/

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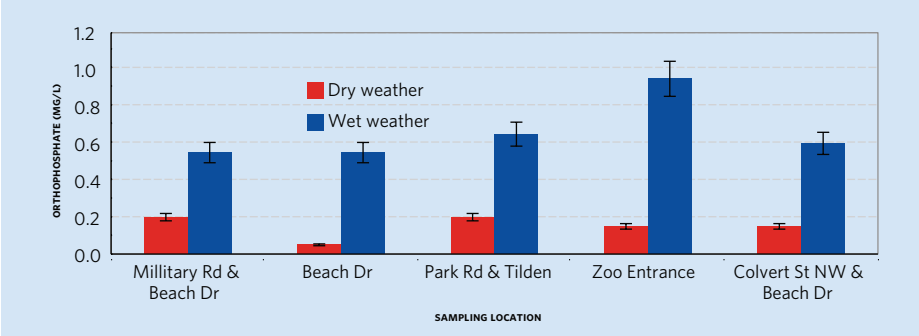
Water Quality Monitoring in Rock Creek Park

Rock Creek is one of the major tributaries of the Potomac River. In the District of Columbia, the downstream part of the Creek is highly influenced by Combined Sewer Overflows (CSOs). In order to identify the main sources of fecal contaminantion and nutrient loading into the Creek, the DC Water Resources Research Institute has conducted water quality monitoring during the wet and dry weather flows. In November 2007 (during wet season), water samples were collected twice (before and after a storm event) at seven outfalls located along the Creek, and then analyzed for fecal coliform, phosphate, nitrate and Biological Oxygen Demand (BOD).

The results showed that during storm events, the concentration of nitrate and BOD decreases, whereas the concentration of phosphate and fecal coliform increases. For example, 4.36 inches of rain resulted in about ten times more fecal contaminantion as compared to 0.41 inches of rain. This indicates that the bulk of the contamination was due to CSOs, where raw sewage mixes with runoff from the street and is discharged into the Creek when the flow exceeds the capacity of the existing sewer system.

During the dry weather flow, samples were collected twice, in July and August 2008, at five sampling locations along the Creek between Military Road and Connecticut Avenue in the District. The samples were then analyzed for nitrate and phosphate concentrations. The results showed that during the dry weather flow, the concentration of phosphate and nitrate decreased as the river flow got lower. This indicated that there was no significant external nutrient loading into the Creek during the dry weather flow. This again confirmed that the main contamination in the Creek is occuring during storm events, which is mainly due to CSOs. In the Rock Creek watershed, previous studies have also estimated that for every half inch of rain there would be a CSO discharge at some some of the outfalls located in Rock Creek Park. ■

TOLESSA DEKSISSA, Ph.D.
Research Associate, Water Resources Research Institute
University of the District of Columbia



FEATURED UDC RESEARCHER

Dr. Byunggu Yu is the Chairperson of the Department of Computer Science and Information Technology at the University of the District of Columbia. He has many years of academic education and research experience and actively works with colleagues at other institutions. He is an internationally renowned computer scientist who has expertise in spatiotemporal informatics and databases (http://csit.udc.edu).

Recent developments and innovations in spatiotemporal informatics (storage, update, and retrieval of continuously changing data) and relevant sensor technologies can provide exciting opportunities and innovations in urban water resource management and decision making applications. For example, such emerging technology can significantly improve the monitoring and decision making processes in the Long Term Control Plan (LTCP) that addresses the Combined Sewer Overflow and storm water discharge problems in the District of Columbia. The benefits include the following: (1) highly cost-efficient and continuous monitoring of the runoff quantity and quality; (2) data and tools for real-time analysis and sharing of raw runoff data for better emergency and maintenance decisions; (3) lab and field training, education, and research.

From the informatics perspective, the technical barrier is the fact that any sensor data is associated with some missing (undetected) stimuli values. This is due to the fact that, although the input runoffs and pollutions can continuously change over time (they are a natural phenomena), no sensor-computer can have infinite sensor resolution, update frequency, and computation power. Especially considering remote sensor platforms, significant additional data loss can occur because of various reasons including maintenance time, system upgrade, temporary power outage, and communication loss.

Dr. Yu has investigated the relevant spatiotemporal informatics and developed necessary processing techniques that are required to break the above technical barrier above. His research will help us develop innovations in water resource decision support systems and long-term multidisciplinary research projects.

FEATURED UDC RESEARCHER

Dr. Deepak Kumar is an Assistant Professor and the Assistant Chair of the Department of Biological and Environmental Sciences at UDC. Dr. Kumar finished his Ph.D in Molecular Biology/Zoology from Central Drug Research Institute, India. His pre-doctoral research focused on the development of a DNA probe for detection of Mycobacterium tuberculosis in biological fluids. Dr. Kumar has a US and a European patent on this DNA probe from his Ph.D. work (US Patent # 6,114,514; European Patent # EP 0945462A1). The DNA probe is licensed to Biotron India Private Limited, a subsidiary of Biodot Inc. (Irvine, CA) and is released as a PCR based kit for detection of *M. Tuberculosis* in clinical samples. During his Ph.D., he also developed a novel transposon trap strategy and identified a novel transposon from *M. Fortuitum*. In 1997, Dr. Kumar joined the Lombardi Comprehensive Cancer Center (LCCC) at Georgetown University. At LCCC, he gained experience in cancer gene discovery and functional genetics, and identified and characterized two cancer associated genes; (1) the antiapoptotic oncogene SCC-S2 and (2) SCC-112 that is downregulated in breast and renal cancers. Besides SCC-S2 and SCC-112, he also was instrumental in the characterization of several other differentially expressed genes in breast cancers. He has one US patent issued (United States patent # 7,253,272.) and coauthored 4 more pending patent applications on the uses of these differentially expressed genes involved in cancer development.

Dr. Kumar joined UDC in 2003 as part of the National Cancer Institute (NCI) funded P20 UDC-LCCC partnership planning grant. Prior to 2003, UDC had very limited biomedical research programs and no cancer research activities at all. As part of UDC-LCCC partnership, and with partial funds from our first P20 grant, Dr. Kumar initiated cancer research at UDC and applied for an MBRS-SCORE grant from NIGMS in 2003. He was awarded the MBRS-SCORE grant in 2004 (S06GM008005, $470,000 direct cost, 2004-2008) and with the help of those funds, and support from U56 UDC-LCCC partnership grant, established the first cancer research laboratory at UDC. In his MBRS SCORE grant, Dr. Kumar has identified and characterized a novel gene CCDC130

in pancreatic cancer. Currently, he is pursuing the characterization of CCDC130 in cancer cell signaling.

Dr. Kumar also holds an adjunct assistant professor appointment in the Department of Oncology at the LCCC. He is also the member of the Molecular Targets and Developmental Therapeutics (MTDT) program at LCCC where he regularly interacts with other members of the program.

Consistent with his interest in identification and characterization of molecular targets, Dr. Kumar is also collaborating with Dr. Robert Clarke at LCCC on the characterization of molecular targets of tocotrieno is induced apoptosis in breast cancer cells using nutrigenomics approaches. This project has received further funding (2006-2008) from the Agricultural Experiment Station at UDC funded by the USDA.

Dr. Kumar is also working on the characterization of signaling pathways induced by arsenic exposure in mammalian cells. This project is funded by UDC Water Resources Research Institute and the USGS.

Dr. Kumar's interest of molecular targets in cancer cell signaling has led to his most recent interaction with Dr. Stephen Byers at LCCC where he is collaborating with Dr. Byers at LCCC on the characterization of Tazarotene Induced Gene 1 (TIG1) in vitamin D signaling in prostate cancer.

Dr. Kumar is actively involved in enhancing research at UDC. Recently, he was awarded the MERCK/AAAS grant for enhancing undergraduate research at UDC where he will involve UDC students in an interdisciplinary cancer research on synthesizing new anti-cancer molecules and testing them on cancer cell lines. He has also received a collaborative grant from Department of Defense's Prostate Cancer Research Program to train undergraduate students in Prostate Cancer research at the Center for Prostate Disease Research (CPDR) at Rockville, MD.

Dr. Kumar has developed several collaborations within UDC, LCCC and with other institutions and initiated several cross disciplinary biomedical research projects. He has teamed up with Dr. Lily Liang, a computer scientist from the Computer Sciences Department at UDC, to develop new algorithms and bioinformatics software tools to analyze expression data generated by high throughput microarray applications. He has published vigorously in the area of biomedical research and has represented UDC for the first time at the cancer related national conferences such as the AACR annual meeting. As indicated above, he is also involved in training undergraduate and graduate students in cancer research. Very recently (Sept., 2008), he, along with Dr. Carolyn Cousin at UDC, was awarded a $1.5 million educational grant from NCI to establish the Cancer Academy at UDC to train minority students in cancer research. ■

DEEPAK KUMAR, Ph.D.
Assistant Professor, Department of Biological and Environmental Sciences, University of the District of Columbia

Molecular Signaling by Environmental Arsenicals in Mammalian Cells

Annual Progress Report for FY2007

ARSENIC IS A MAJOR CONTAMINANT in drinking water that is associated with various cancers, skin lesions, peripheral vascular disease and hypertension. Additionally, humans are exposed to organic arsenicals when used as pesticides and herbicides (e.g., monomethylarsonic acid, dimethylarsinic acid [DMAV], also known as cacodylic acid). The main sources of arsenic contamination in our drinking water include erosion of natural deposits, runoff from orchards, and glass and electronics production wastes.

On January 22, 2001, EPA adopted a new standard for arsenic in drinking water at 10 parts per billion (ppb) to replace the old standard of 50 ppb. The new rule became effective on February 22, 2002 and compliance was compulsory by January 23, 2006. EPA estimated that about 3,000 (5.5%) of the nation's 54,000 Community Water Systems (CWSs), and 1,100 (5.5%) of the 20,000 Non-Community Water Systems (NTNCWSs), needed to lower arsenic levels in their drinking water. Although arsenic is a known human carcinogen in vitro, carcinogenicity of arsenic in vivo has not been established. Unlike many other carcinogens, arsenical compounds do not directly induce gene mutations. However, they do potentiate the genotoxic effects of other mutagens and are associated with chromosomal abnormalities. These properties indicate that arsenic has a mode of action different from other well-characterized environmental carcinogens whose actions are mediated by DNA damage and warrants investigation into the molecular signaling modulated by environmental arsenicals.

At UDC, we examined the cytotoxic effects of arsenic on MCF-7 human breast cancer cell lines. The cells were treated with various concentrations of sodium arsenite ranging from 0.5µg/ml to 6 µg/ml for 24h. Sodium Arsenite inhibited the growth of MCF-7 cells (Figure 1).

We further studied if the arsenic induced growth inhibition is due to induction of apoptosis in these cells (Figure 2) and whether arsenic induces the DNA damage response pathway genes P53 and P21.We found that there was a marked increase in P53 and its target P21 protein expression after treatment with sodium arsenite. This indicates that sodium arsenite treatment induces the expression of DNA damage response genes in MCF-7 breast cancer cells. ■

FIGURE 1. Sodium Arsenite inhibits the proliferation of MCF-7 breast cancer cells.

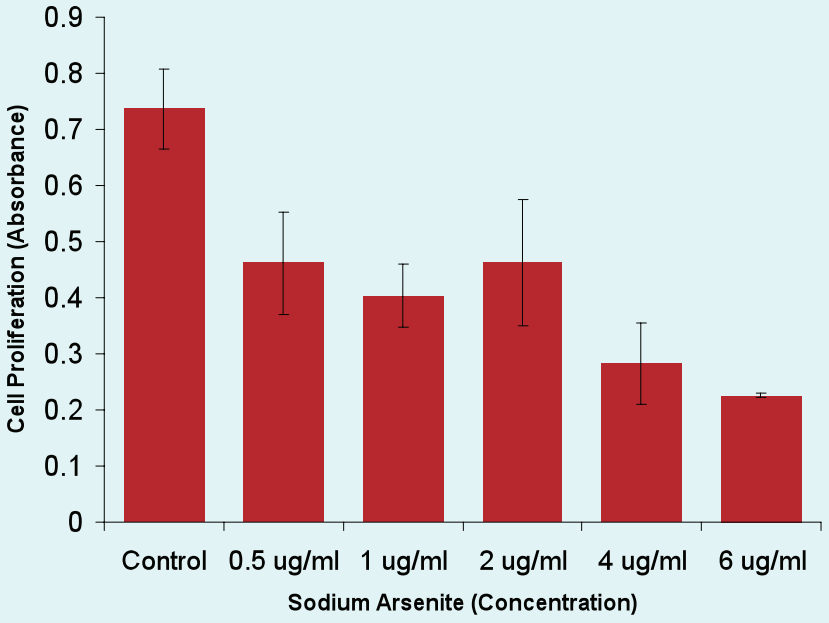
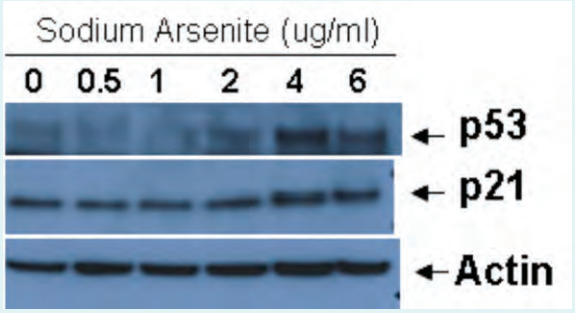


FIGURE 2. Sodium Arsenite induces the expression of P53 and its target gene P21.



DEEPAK KUMAR, Ph.D.
Assistant Professor, Department of Biological and Environmental Sciences, University of the District of Columbia

Anacostia Watershed Toxics Biomonitoring: 2008 Activities

The Anacostia River in DC and MD has been termed one of the three most polluted regions of the Chesapeake Bay. Research sponsored by the DC Water Resources Research Institute has used clams in active biomonitoring to find the source areas of EPA Priority Pollutants in the Anacostia watershed. In 2008 this research program received support from the Friends of Lower Beaverdam Creek (FLBC) and the Environment Club of Eleanor Roosevelt High School (ERHS). Five seniors in the EHRS Honors Program had active biomonitoring projects in the Anacostia. An article in the Washington Post and a Science News video brought publicity to this research.

Lower Beaverdam Creek is considered the most contaminated Anacostia subtributary. On July 25, 2008, David Fahrenthold of the Washington Post and Dan Smith of Friends of Lower Beaverdam Creek assisted in active biomonitoring for sources of polychlorinated biphenyls (PCBs) and Aroclors (PCB mixtures)

in the upper portion of Lower Beaverdam Creek. The results suggested a small length of the creek included a major PCB source. This work was featured in a August 4, 2008 Washington Post article "Aquatic Bloodhounds Unleashed in Anacostia Pollution Research". These findings will be followed up in 2009.

In October 2008, five EHRS honor students carried out three active biomonitoring projects at Anacostia watershed sites. One study examined sources of polycyclic aromatic hydrocarbons (PAHs) in upper Lower Beaverdam Creek. Another looked for a suspected source of chlordane to Still Creek, and a third made a complete EPA Priority Pollutant analysis at two sites in Sligo Creek, which had never been previously examined. The students presented their results at a Science Fair and are writing papers on the projects. Preliminary results showed Lower Beaverdam Creek had high PAHs originating from outside the Beltway, and Sligo Creek had little contamination apart from significantly elevated chlordane. A short science video was produced by Ivanhoe News and can be found at http://www.sciencedaily.com/videos/2009/0110-clam_cleanup.htm. More students are now interested in Anacostia Watershed Toxics Active Biomonitoring projects for 2009. ■

HARRIETTE L. PHELPS, Ph.D.
Professor Emeritus, Department of Biological and Environmental Sciences, University of the District of Columbia.

Key EPA Internet Tools for Watershed Management: Hands-on Training Workshop

In collaboration with EPA's Watershed Academy, the UDC School of Engineering and Applied Sciences (SEAS) and the DC Water Resources Research Institute (WRRI) organized a hands-on technical training workshop on December 12, 2007. In this workshop titled, "Key EPA Internet Tools for Watershed Management," a wide array of 25 participants included representatives from the District Department of the Environment's Watershed Protection Division, Water Quality Division, and Planning and Enforcement Division; the University of Maryland; John Hopkins University; Anacostia Watershed Society; Friends of Sligo Creek; as well as UDC faculty members and students from SEAS, the College of Arts and Sciences, the Agriculture Experiment Station and WRRI.

Ms. Anne Weinberg from EPA and Ms. Jenifer McDonnell from Tetra Tech Inc. gave this two-part training session in which participants learned how to build partnerships, characterize watersheds, and subsequently set goals and identify solutions for management. Using the EPA Internet Tool, they also learned how to design

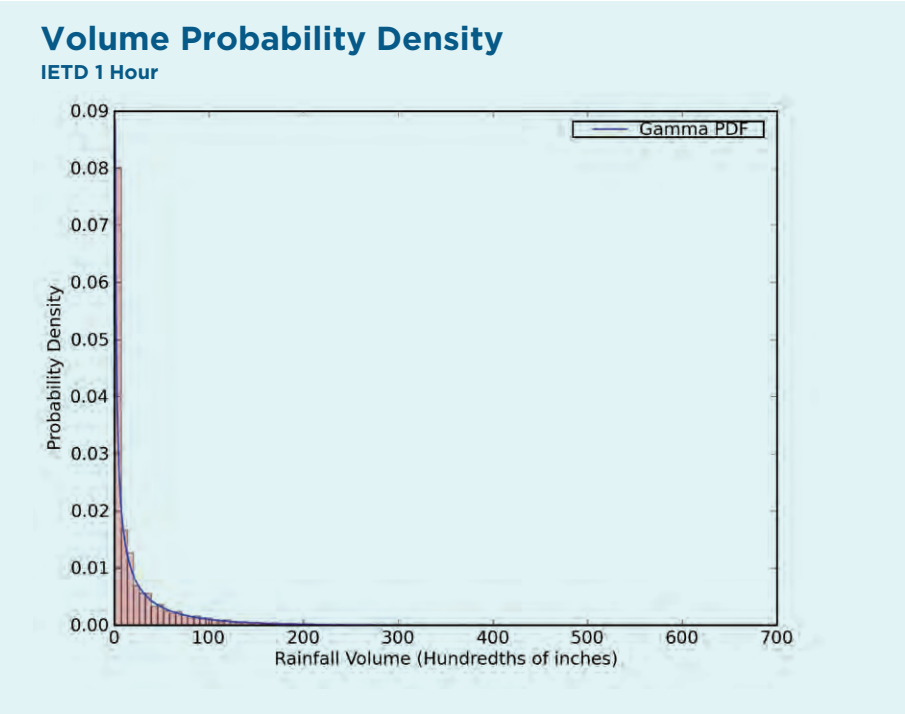
and implement water quality programs and measure progress to make necessary adjustments to improve the plan. All participants who completed the day-long workshop received an official certificate of completion awarded from EPA's Watershed Academy. ■

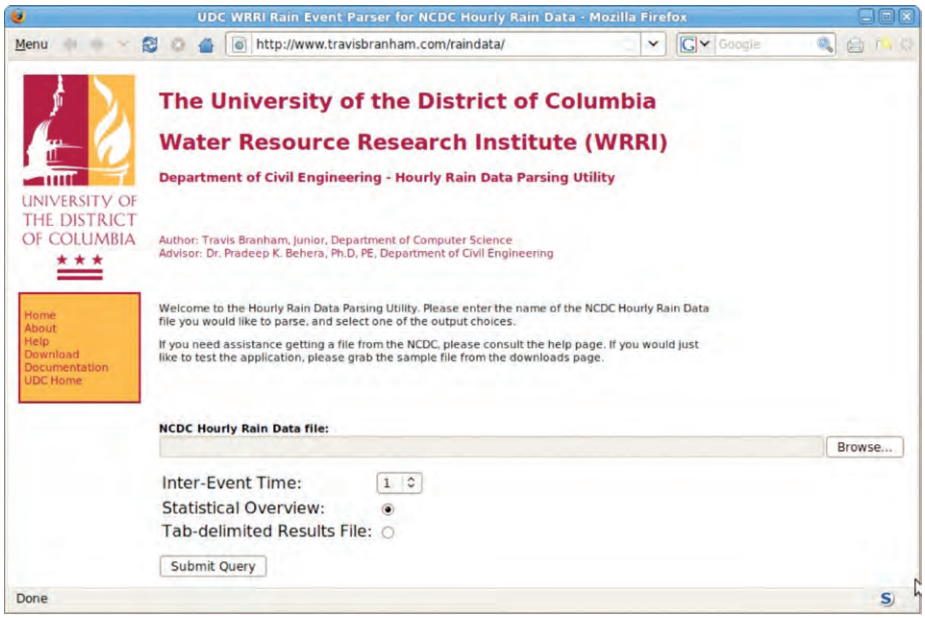
TOLESSA DEKSISSA, Ph.D.
PRADEEP BEHERA, Ph.D., PE
HARRIETTE L. PHELPS, Ph.D.

Development of a web-based Rainfall Statistical Analysis Tool

THE ANALYSIS OF URBAN STORMWATER pollution is a primary step in developing cost-effective solutions for wet-weather flow problems. Often the solutions are proposed based on limited monitoring and modeling efforts due to their exorbitant cost. Continuous simulation models have been used to analyze the existing watershed and stormwater pollution condition and to develop alternative solutions. Examples of continuous simulation models include EPA SWMM. As these models are resource intensive, often development of watershed–wide simulation models is avoided during planning-level analysis. On the other hand analytical probabilistic models are computationally efficient compared to continuous simulation models and can be easily used to develop a watershed-wide model.

In the case of the District of Columbia sewer system, analytical models can be easily applied to analyze the existing water pollution problems and to develop alternate solutions. The primary input to the analytical stormwater model is statistical parameters of the long-term rainfall records. Federal agencies, such as NOAA and NCDC, provide the meteorological data which are typically used by the continuous simulation models. The rainfall records are generally pre-processed for use in stormwater models. However, analytical models use the same long-term rainfall records in a different manner. At UDC, we developed a web based statistical tool. The long-term rainfall records are statistically analyzed and fitted with several probability distribution functions. The parameters of best fitted probability distribution functions for the rainfall characteristics, such as storm event volume, event duration, event intensity and inter-event time, are used in the analytical models in lieu of continuous records.





The proposed web-based statistical tool will provide the user with many functions: (i) extraction of rainfall records from the NOAA and NCDC sites; (ii) preprocessing of data for statistical analysis; (iii) fitting of probability distribution functions and estimation of their parameters. ■

TRAVIS BRANHAM, RESEARCH ASSISTANT;
PRADEEP K. BEHERA, Ph.D., PE
Deptartment of Computer Science & Technology,
University of the District of Columbia

Decision Support System to Deal with Water Emergencies for Metropolitan DC

The Washington Aqueduct, initially built by the Army Corps of Engineers during 1853 to 1863, is the District of Columbia's first public water system. Since its inception, it has undergone several improvements and expansions including modern filtration and fluoridization processes. Currently, water is drawn from the Potomac River at Great Falls and Little Falls by the Washington Aqueduct, which is run by U.S. Army Corps of Engineers, and is treated at two water treatment plants: Dalecarlia and McMillan. The District of Columbia Water and Sewer Authority (DC WASA) purchases the treated water and distributes it to more than half a million residential, commercial, and governmental customers in the District of Columbia. The Authority delivers water to over 130,000 locations in Washington, D.C. and provides nearly 135 million gallons of drinking water a day for individuals and businesses. The distribution system is comprised of approximately 1,300 miles of pipes, five pumping stations, five reservoirs, four elevated water storage tanks, 36,000 valves, and 8,700 hydrants.

IMAGE COURTESY OF DISTRICT OF COLUMBIA WATER AND SEWER AUTHORITY.

For water utilities, enhancing physical security is one of many priorities. Because of the competition for limited resources, including financial and personnel, current compliance requires a very balanced approach across each of the following five dimensions: (i) financial (ii) personnel (iii) management tools, (iv) operational approaches, and (v) physical security design features. This is a complex decision problem which requires a holistic response—especially in an emergency.

Similar to many metropolitan areas in the nation, the Metropolitan DC water system is a large and complex system. Since the District of Columbia is the nation's capital, external threats—particularly to an essential commodity like water—are always more heightened. There is, therefore, a need to develop an efficient decision support system (DSS) for the water utility system, which would not only assist in preparing for but also help during emergencies.

One of the primary questions that this research tries to answer is, "Which aspect of disaster management lends itself most meaningfully to a decision support system?" Limited information and decision load constraint (i.e., a manager or a decision maker can make only a limited number of meaningful decisions in a given time frame) are two challenges in emergencies—including water emergencies.

This research analyzes different utilities of DSS implementation in four phases associated with disaster management. They are:

- Mitigation efforts attempt to prevent hazards from developing into disasters altogether, or to reduce the effects of disasters when they occur. The mitigation phase differs from the other phases because it focuses on long-term measures for reducing or eliminating risk. This could take the form of intelligent environmental scans to support policy making and resource allocation. This phase may benefit the most from DSS. We believe that the development of microworlds, where policy designers and affiliated parties can simulate disaster scenarios and push the system to extremes, could not only save money in the long run but could also provide the basis for higher quality disaster management. This is especially true of water emergencies that are rare but can be simulated faithfully to evaluate low-probability, high-impact events.
- In the preparedness phase, emergency managers develop plans of action for when disaster strikes: (a) communication plans with easily understandable terminology and chain of command, (b) development and practice of multi-agency coordination and incident command, (c) proper mainte-

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Effect Of Pelletized Poultry Manure On Crop Production And Vadose Zone Water Quality

Poultry manure has long been recognized as the most desirable organic fertilizer. It improves soil fertility by adding major and essential plant nutrients as well as soil organic matter, which improves moisture and nutrient retention. However, continuous application of poultry manure in areas where there are concentrated poultry farms raises great concern about water quality.

Basically, applying only what plants can utilize may reduce nutrient leaching into receiving waters, but manure born pathogens remain the main concern. Subsequently, Perdue AgriRecycle Inc. has initiated producing processed and pelletized poultry manure for easy handling and movement. In spite of the fact that its nutrient composition is known, its effectiveness on crop production and water quality is not well documented. The objective of this study was to investigate the effect of pelletized poultry manure on crop production and vadose zone water quality. The concentration of orthophosphate, nitrate, fecal coliform and total coliform in soil, as well as soil water at the vadose zone, was analyzed for two consecutive years.

Using sweet corn as the main crop and wheat as the cover crop the following season, results show that application of pelletized poultry manure positively affected the crop growth and biomass production of the cover crop. Soil water quality was also impacted, where higher rates of manure application together with mineral fertilizer resulted in higher nitrate and orthophosphate leaching. ■

TOLESSA DEKSISSA[1,2,*], WILLIAM W. HARE[1,3] AND JAMES R. ALLEN[2]
University of the District of Columbia, [1]Water Resources Research Institute, [2]Agricultural Experiment Station, [3]Cooperative Extension Service, *tdeksissa@udc.edu

WRRI FY 2008 Seed Grant Awards

Listed below are the five grants awarded to researchers for FY 2008 104B grant:

TITLE OF AWARD:
Development of Web-based Rainfall Statistical Analysis Tool for Urban Storm Water Management Analysis

PRINCIPAL INVESTIGATOR:
Pradeep Behera, Ph.D., P.E.
Associate Professor, Engineering, Architecture & Aerospace Technology, University of the District of Columbia

GRANT AWARD:
$8,200

TITLE OF AWARD:
Addressing the Distribution of Synthetic Organics and the Degradation of Polyaromatic Hydrocarbons in the Anacostia River through Microbial and Stable Isotopes

PRINCIPAL INVESTIGATOR:
Karen L. Bushaw-Newton, Ph.D.
Assistant Professor, Department of Biology
American University

GRANT AWARD:
$15,000

TITLE OF AWARD:
Gradual Variation Analysis for Groundwater Flow in the District of Columbia (Phase II)

PRINCIPAL INVESTIGATOR:
Li Chen, Ph.D
Associate Professor, University of the District of Columbia

GRANT AWARD:
$15,000

TITLE OF AWARD:
Modeling of Integrated Urban Wastewater System in the District of Columbia (Phase II)

PRINCIPAL INVESTIGATOR:
Tolessa Deksissa, Ph.D
Research Associate, University of the District of Columbia

GRANT AWARD:
$25,682

TITLE OF AWARD:
Application of Spatiotemporal Informatics to Water Quality

PRINCIPAL INVESTIGATOR:
Byunggu Yu, Ph.D.
Department of Computer Science and Information Technology, University of the District of Columbia

GRANT AWARD:
$ 15,000

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nance training of an emergency services, (d) development and exercise of emergency population warning methods combined with emergency shelters and evacuation plans, (e) emergency alternative water supply to the community, and (f) stockpiling, inventory, and maintenance of supplies and equipment. The DSS could help in simulating preparedness arrangements in addition to addressing issues of resource allocation and budgetary decision making.

■ The response phase includes the mobilization of the necessary emergency services and first responders in the disaster area. This is likely to include a first wave of core emergency services, such as firefighters, police and ambulance crews. They may be supported by a number of secondary emergency services, such as specialist rescue teams. The DSS may not be directly useful in this phase.

■ The aim of the recovery phase is to restore the affected area to its previous state. It differs from the response phase in its focus; recovery efforts are concerned with issues and decisions that must be made after immediate needs are addressed. This phase requires post facto analyses of decisions and responses so as to create a knowledge base for the future and to provide input to ongoing disaster preparedness activities.

Clearly, information and decision systems are important to each of these phases. It is also clear that as we progress with the chronological phases of disaster management, the nature, frequency and quality of information required for supporting operations or decision making changes significantly. ■

SHIVRAJ KANUNGO, Ph.D.
Associate Professor, Department of Decision Sciences,
George Washington University

PRADEEP K. BEHERA, Ph.D., P.E.
Associate Professor, Engineering, Architecture & Aerospace Technology
University of the District of Columbia

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she has never been exposured to industrial chemicals, industrial pollution may start right in the womb. Infants can be exposed to industrial chemicals in the womb if the mother is exposed to these chemicals of concern before or during pregnancy. In addition, we live in a world of chemical mixtures whose long term effects on human health are not well understood. Data has shown, however, an increase in birth defects over the last 30 years, which could be related to early life exposure to industrial compounds and emerging contaminants[3].

> "Infants can be exposed to industrial chemicals in the womb if the mother is exposed to these chemical of concern before or during pregnancy."

■ Long term exposure to very low concentrations of medication may also lead to different adverse effects on human health. Traditional toxicity tests for drugs are based on short-term studies, not a lifetime study, and cannot truly represent the possible human exposure over a lifetime. There are risks associated with chronic exposure to these chemicals that create some degree of uncertainty in the sustainability of future medical treatments. For example, chemotherapy can act as a powerful poison, hormones can hamper reproduction or development, medicine used for depression and epilepsy can damage the brain or change behavior, and antibiotics can allow germs to mutate into more dangerous forms. There is even evidence of outbreaks of microbial strains resistant to antibiotics in the environment[4].

Potential action steps

In order to address the problem of pharmaceutical products in drinking water, three potential action steps are suggested. The first step is protection at the source of pollution and includes returning unused drugs to the pharmacy. We may develop technologies to remove pharmaceuticals and their products in the wastewater treatment plants. Advanced wastewater treatment plants that remove both nutrient and emerging contaminants can reduce point source pollution. Diffused source pollution related to manure borne pharmaceutical products may be addressed partly by best management practices. The second step is developing alternative, environmentally friendly products. The third step is changing consumer behavior through environmental education and outreach programs in order to reduce exposure to multiple sources of industrial products and excessive use of pharmaceutical products. Consumers need to limit the number of chemicals they are using, including types of personal care products, fragrances, insecticides, etc. ■

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