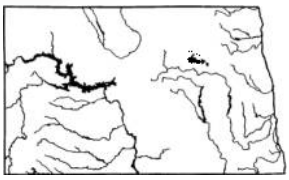
December 2015

North Dakota Water Resources Research Institute North Dakota State University Fargo, ND 58108-6050



Newsletter

The National Institutes for Water Resources

http://www.ndsu.edu/wrri

From the Director

Greetings!

Welcome to the 2015 issue of North Dakota Water Resources Research Institute (NDWRRI) newsletter. This is the first time you see "From the Director" section from me because I am the new Director of the Institute. After serving as the Institute Director for 12 years, Dr. G. Padmanabhan stepped down from the position. On behalf of the institute, I thank him for his leadership and efforts. In this 2015 issue, Dr. Padmanabhan provided us with reflections on his tenure as the Institute Director. This newsletter introduces the 2015 NDWRRI Fellows and highlights the 2014 Fellowship research projects. It features three selected Institute affiliated faculty in "Meet our Faculty" section. You will find a few stories on events participated by affiliated faculty and Fellows and the 4th Annual Distinguished Water Seminar hosted by the Institute. Included in this newsletter are recent water related publications from the United States Geological Survey (USGS) and the Institute.

In addition to the USGS annual base grant, the North Dakota State Water Commission has provided funding of 15% of the base grant to the Institute for the past several years. For 2015-2016, the Commission again graciously supported the Institute at the same level. The Institute used the entire funding from the Commission for the Graduate Fellowships. The Institute highly appreciates the Commission for continual support. The Institute would like to thank the State Advisory Committee for serving on a Fellowship review panel, providing valuable guidance on Institute's research priorities and Fellowship funding allocation, and helping in securing support from the State Water Commission.

During my tenure as the Director, the Institute will continue to serve as resources for stakeholders and to address water issues in North Dakota through research. Please let me know if you have any suggestions for the Institute.

Very truly,

Eakalak Khan
Director

Inside this issue:

Reflections from the Immediate Past Director

The North Dakota Water Resources Research Institute (NDWRRI) was founded in 1965 by authority of Congress as one of the 54 Institutes in each state and several territories that make up the National Institutes of Water Resources administered through the United States Geological Survey (USGS). Each Institute receives an annual Federal matching grant as authorized by Section 104 of the Water Resources Research Act of 1984 with subsequent amendments. Each Institute is located at a land-grant university. NDWRRI is on the campus of North Dakota State University (NDSU). The two research universities of the state, NDSU and the University of North Dakota (UND) come under the purview of NDWRRI.

I was appointed the Director of NDWRRI on October 1, 2001 as Dr. Gregory McCarthy, the previous Director, moved to a new position, Associate Vice President for Interdisciplinary Research, after more than ten years of distinguished service to the Institute. This was an additional charge for me. I was already serving as the Chair of the NDSU Department of Civil Engineering and Construction. I am convinced my several years of teaching and research experience in the area of hydrology and water resources along with my appreciation and respect for its interdisciplinary nature helped me direct the Institute program successfully. After thirteen years, I stepped down from the Director position on February 28, 2014. Dr. Eakalak Khan has been appointed the Director since then. Soon after I assumed charges as the Director in 2002, the Institute office was moved to the administrative building of the Dean of NDSU College of Engineering and Architecture from its previous location in the NDSU Department of Chemistry. A State Advisory Committee consisting of three members representing the three principal agencies dealing with water issues – North Dakota State Water Commission, North Dakota State Health Department, and the USGS – has already been in place. The committee advises the Director on the long term research agenda, state's priority water research areas, and program administration. Although NDWRRI has no state line-item support, the North Dakota State University and University of North Dakota administrations have been supportive of its efforts. A NDSU part-time employee works for the Institute to assist the director with Institute finances, communications and information transfer.

NDWRRI has been traditionally directing its annual base grant to two or three faculty-led research projects. However, the annual base grant dropped to a very low level of $20,000 per year during FY 1995-98. The Institute wisely chose to use the base grant for graduate student summer fellowships. Based on the recommendations by a USGS 5-year evaluation panel review on the performance of the Institute during the period 1992-97, the Institute was placed under "probation status" and was about to lose funding in 2000. So, my first priority after taking office was to develop a solid program consistent with the mission of Section 104 of the Water Resources Act using the annual base grant and to secure additional funding to support the program. It was decided to expand the Graduate Summer Research Fellowship program that was chosen as a stop-gap measure during the lean funding period into a full fledged program with research spanning the entire academic year rather than only summer. Also, efforts were focused to secure additional funding from state agencies.

Section 104 of the Water Resources Research Act requires all National Water Resources Institutes to apply their Federal allotment funds to plan, conduct or otherwise arrange for competent research that fosters: (A) the entry of new research scientists into the water resources field, (B) training and education of future water resources scientists, engineers, and technicians; (C) the preliminary exploration of new ideas that address water problems or expand understanding of water and water-related phenomena; and (D) the dissemination of research results to water managers and public.

The upgraded Graduate Research Fellow (GRF) program meets the requirements of Section 104 of the Water Resources Act effectively in the following respects:

1. Often it is junior faculty as well as graduate students who perform competent research that fosters the entry of new research scientists into the water resources field;

Reflections from the Immediate Past Director

2. The modest annual federal allotment is focused on training and education of future water resources scientists, engineers, and technicians;
3. Graduate students thesis and dissertation topics foster the preliminary exploration of new ideas that address water problems or expand understanding of water and water-related phenomena;
4. Through the newsletter, website, plus student and faculty presentations and peer-reviewed publications, the dissemination of research results to water managers and the public is accomplished;
5. The NDWRRI cooperates closely with other colleges and universities in the state that have demonstrated the capability of research, information dissemination and graduate training by offering competitive fellowships at both research universities in North Dakota; and
6. The NDWRRI cooperates closely with other institutes and other organizations in the region to increase the effectiveness of the institute and for the purpose of promoting regional cooperation by encouraging faculty to seek in -kind and cash matching support from those institutes and organizations, and its external seminar program.

Most of the Federal allotment funds was directed towards competitive graduate student research fellowships, each of which is also a research project that could result in a MS thesis or doctoral dissertation. The faculty advisors could find matching or co-funding for the research through the university, or grants from local, county, state or federal agencies, foundations, or industry. The funds they already have may be leveraged by coupling them with a fellowship to a graduate student supported by the Institute.

The GRF has blossomed into a healthy program supporting about 12-15 graduate students engaged in water research at NDSU and/or UND every year. Approximately, 200 graduate students benefitted from the program during my period as the Director. Fellowship awards varied from $3000-$18,000. Approximately 12-15 faculty per year participated in the program, a considerable increase from 2-3 per year before. More faculty started encouraging their graduate students to apply for the Fellowship. Faculty while seeking co-funding for the Fellowship projects have been interacting with industry and state agencies more frequently and purposefully. Several larger proposals to national funding agencies have resulted out of the Fellowship projects. Many of the Fellowship recipients have taken up responsible positions in the water resources profession.

The success of the program led to the removal of the “probation status” in 2004. Currently, the NDWRRI GRF program is viewed by other Institutes as a successful model and worth emulating. Recognizing the contributions of the Institute in addressing state’s water problems and in training water professionals, North Dakota State Water Commission has been contributing 15% match to the federal annual base grant in support of NDWRRI Graduate Research Fellow (GRF) program beginning 2005.

It has been my pleasure to have worked with many accomplished water professionals, faculty, and graduate students in my 13 years as the Director of NDWRRI. I enjoyed every moment of the interactions and discussions with faculty, students and the advisory committee. I wish NDWRRI GRF program a successful future with increased funding support from NDSU, UND, USGS, and State water agencies. Over the years, the program has engaged in cutting-edge research in surface and groundwater water quantity, quality, treatment, remediation, to name only a few. To have an idea of the graduate research fellowship project topics, all one needs to do is to visit the NDWRRI website: https://www.ndsu.edu/wrri/ . The program has great potential for enabling water research by graduate students and faculty to find solutions for state and regional water problems.

Sincerely,

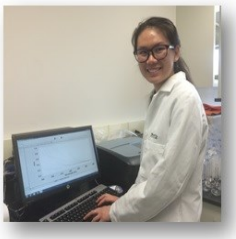
G. Padmanabhan
Past Director

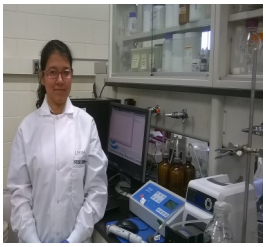
The Institute Awarded Sixteen Graduate Fellowships for the Year 2015-2016

Fellow: Boonsiri Dandumrongsin

Title: Contribution of Soluble Microbial Products on Dissolved Organic Nitrogen and its Biodegradability in Wastewater Effluent

Advisor: Halis Simsek, Agricultural and Biosystems Engineering, NDSU





Fellow: Umma Salma Rashid

Title: Injectable Nanoparticle-based Permeable Reactive Barriers for Groundwater Contaminant Remediation

Advisor: Achintya Bezbaruah, Civil and Environmental Engineering, NDSU

Fellow: Ryan David

Title: Use of Mixers in Water Towers to Prevent Ice Formation and Improve Water Quality

Advisor: Wei Lin, Civil and Environmental Engineering, NDSU

Fellow: Debjit Roy

Title: Snowmelt Water Infiltration into Frozen Soil in the Red River of the North Basin

Advisor: Xinhua Jia, Agricultural and Biosystems Engineering, NDSU

Fellow: Bryce DeGuise

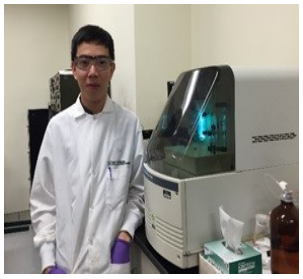
Title: Evaluation of Onsite Wastewater Treatment Systems – Sand Filters and Biological Treatment

Advisor: Wei Lin, Civil and Environmental Engineering, NDSU

Fellow: Rebecca Doyle

Title: Quantifying Soluble Salt Removal from Subsurface Tile-Drain Agricultural Fields

Advisors: Abbey Wick and Francis Casey, Soil Science, NDSU



Fellow: Soklida Hong

Title: Glutaraldehyde Removal from Flowback and Produced Water Using Photolysis

Advisors: Eakalak Khan, Civil and Environmental Engineering and Jayaraman Sivaguru, Chemistry and Biochemistry NDSU

Fellow: Swati Sharma

Title: UV Light Effect on Bioavailability of Dissolved Organic Nitrogen in a Trickling Filter Process

Advisor: Halis Simsek, Agricultural and Biosystems Engineering, NDSU

Fellow: Mohammad Hossain

Title: Biopolymers for Phosphate Removal from Eutrophic Lakes

Advisor: Achintya Bezbaruah, Civil and Environmental Engineering, NDSU

Fellow: Bahareh Shoghli

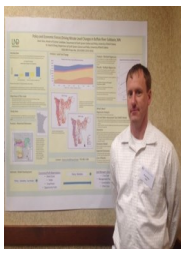
Title: Design Parameters of Embankment Dams in the Upper Midwest in Potential Climate Change Conditions

Advisor: Howe Lim, Civil Engineering, UND

Fellow: Navaratnam Leelaruban

Title: A Study of the Spatial and Temporal Characteristics of Drought and its Impact in North Dakota

Advisor: G. Padmanabhan, Civil and Environmental Engineering, NDSU

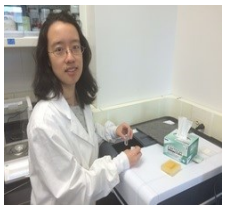


Fellow: Brent Silvis

Title: Analysis of the Impact of Policy and Economic Drivers of Land-Use Change on Nitrogen Levels of Surface Waters within the Snake, Buffalo and Eastern Wild Rice Subbasins

Advisor: Haochi Zheng, Earth Systems and Policy, UND

The Institute Awarded Sixteen Graduate Fellowships for the Year 2015-2016



Fellow: Jingyi Sun

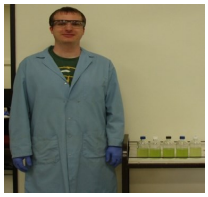
Title: Evaluation of Bioavailable Dissolved Organic Nitrogen Using Various Algal Species

Advisor: Halis Simsek, Agricultural and Biosystems Engineering, NDSU

Fellow: Luisa Torres

Title: Risks of Water Contamination Associated with the Wastewater from Oil Production in the Bakken

Advisor: Eakalak Khan, Civil and Environmental Engineering and Om Yadav, Industrial and Manufacturing, NDSU



Fellow: Mitchell Swanson

Title: The Role of Algal Species on Phosphorus Bioavailability

Advisor: Eakalak Khan, Civil and Environmental Engineering, NDSU

Fellow: Anthony Wamono

Title: Effects of Calcium Based Surface Amendments on the Hydraulic Conductivity and Selected Physical Properties of Subsurface Drained Sodic-Saline Soils

Advisor: Dean Steele, Agricultural and Biosystems Engineering, NDSU

Upcoming Events

Water Environment Federation/International Water Association Nutrient Removal and Recovery Conference, Denver, CO, USA, July 10 - 13, 2016

Water Environment Federation Technical Exhibition and Conference (WEFTEC), New Orleans, LA, USA, September 24 - 28, 2016

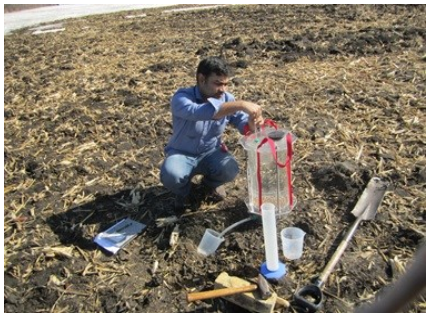
International Water Association World Water Congress & Exhibition, Brisbane, Queensland, Australia, October 9 - 14, 2016

Minnesota Water Resources Conference, St. Paul, MN, USA, October 18 - 19, 2016

American Water Resources Association Annual Water Resources Conference, Orlando, FL, USA, November 13 - 17, 2016

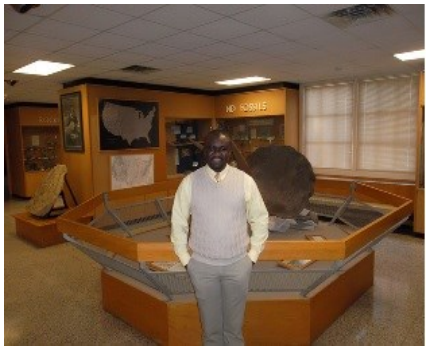
2014 — 2015 NDWRRI Fellowship Research Highlights

Debjit Roy: Snowmelt water infiltration into frozen soil in Red River of the North Basin



In the northern hemisphere, nearly 60 percent of land surfaces are seasonally frozen and North Dakota is a part of that area. There is no simple and clear answer on how water infiltrates into frozen soil. The lack of understanding of the infiltration process into frozen soil is the major limiting factor affecting spring flood forecasting. In recent years, during the spring flood events in the Red River of the North Basin, flood forecasting cannot be estimated accurately due to lack of data on infiltration into frozen soil. Any error in flood prediction can cause significant financial losses and threaten 200,000 people lives in the Fargo-Moorhead metro area as well as people and animals in the entire basin. The proposed research project focuses on snowmelt infiltration characteristics into frozen soils. The specific objectives of the research study are to measure infiltration amount/rate into frozen soil at field and laboratory conditions, to develop a snowmelt water infiltration model based on historic, laboratory and field data, and to evaluate model outputs with other available infiltration models. A Cornell sprinkler infiltrometer is now being calibrated and tested in field for infiltration measurement. Infiltration tests were done in different research fields in North Moorhead, Clay County, MN and Fairmount, ND during early spring and late Fall of 2014 and 2015. At least 60 minutes infiltration tests were conducted in each test run by using Cornell Sprinkler infiltrometer. Few Min disk infiltrometer tests were also done in Fairmount site during Fall 2015. Soil moisture and temperature data were collected from sensor data logger after each field experiment. A frozen soil column experiment has been on-going from this spring 2015. Two wooden boxes (approximate dimension: 50 x 50 x 30 cm) were made to fill with soil collected from one of the experimental sites. Soil moisture and temperature sensors (5TE, Decagon devices) were setup at 10, 15 and 30 cm depth. Every time wooden boxes with soil were frozen in a freezer until the temperature reached below 0°C. Long duration infiltration experiments were conducted with Cornell Sprinkler infiltrometer and soil moisture and temperature data were collected in a datalogger. A relationship between infiltration amount and rate, soil moisture content, soil hydraulic conductivity and soil moistures will be established from those laboratory experiment results.

Prosper Gbolo: Quantifying Phosphorus Cycling and Fate within an Abandoned Feedlot



Nutrients, including nitrogen and phosphorus are important in various ecosystems, but when mismanaged can cause adverse health and ecological problems. It is hypothesized that nitrogen can cause a short-term contamination of soils and groundwater beneath feedlots, but phosphorus can cause both short- and long-term contamination in well-drained iron and calcium rich soils. To test this hypothesis, a feedlot abandoned more than a decade ago was used as a model for this research because of the existence of different soil types, apparent variable plant vigor, and the hydrological conditions prevailing. This research aims at determining the sources and sinks of nutrients, characterizing nutrients distribution, and quantifying phosphorus budget. Soil, groundwater, surface water, and plant tissue samples were collected and analyzed for nutrients. It was observed that nitrogen concentration was less at the source (feedlot pens) due to processes including denitrification, volatilization, leaching, and transportation in the wetlands characterized by high plant vigor. In contrast, phosphorus was sequestered in soils at the source area that had high organic matter, iron, and calcium content, making it unavailable for plant consumption. This research provides insight into the viability of feedlots abandoned more than a decade as a source of phosphorus to supplement the primary sources of phosphorus used in fertilizer. Phosphorus concentrations in some areas exceed 50 mg kg^{-1}, which implies no soil phosphorus fertilization is required for plant growth. Agronomists and stakeholders in agriculture and food security should take a holistic approach and conduct feasibility studies on using sequestered phosphorus in abandoned feedlot soils as alternative source of phosphorus fertilizer.

2014 — 2015 NDWRRI Fellowship Research Highlights

Mohammad Enayet Hossain: Biopolymers for Phosphate Removal from Eutrophic Lakes

Novel iron cross-linked alginate beads (FCA) were successfully used for aqueous phosphate removal using three different concentrations of phosphate (5, 50 and 100 mg PO_4^{3-}-P/L). About 97% phosphate was removed in 360 min from the aqueous solution by wet beads having an initial phosphate concentration of 5 mg PO_4^{3-}-P/L. With 50 and 100 mg PO_4^{3-}-P/L, the beads were found to remove ~76% and 24%, respectively in 360 min. Environmentally important concentration (100 µg PO_4^{3-}-P /L) was also tested with FCA beads and very fast removal was achieved. Around 80% of phosphate was removed within 20 min. No change in phosphate removal was observed in the presence of Cl^-, HCO_3^-, SO_4^{2-}, NO_3^- and natural organic matter.

Navaratnam Leelaruban : A Study of the Spatial and Temporal Characteristics of Drought and its Impact in North Dakota

This study investigated groundwater level response to droughts. Groundwater levels data from the U.S. Geological Survey Ground-Water Climate Response Wells Network, and National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) drought indices and climatic variables are used in this study. Specifically, the impact of drought severity and duration on groundwater levels is studied for selected wells from the great plain regions. The correlation matrix of the drought indices and depth to groundwater levels (monthly median values) is calculated and used to identify the reliable drought indices to monitor the groundwater responses to the drought. The drought indices reflect the groundwater responses better than the climatic parameters such as precipitation and temperature. The Palmer Hydrological Drought Index and 24 month-Standardized Precipitation Index have better correlation with groundwater levels than other drought indices and climatic variables. In addition, the duration of drought events were found to have significant influence on groundwater level response to drought. It is considered moderate or more severe drought If SPI-24 month $\leq$ -0.8.

Dasuni Ranapathi Arachchige: Flash Flood Potential Mapping Using GIS and Flash Flood Potential Index (FFPI) in Turtle River and Forest River Watersheds, North Dakota

Flash flooding is a rapid onset natural hazard and can cause extensive property and crop damages as well as deaths. The National Oceanic and Atmospheric Administration storm database reports 464 flash flood events from 1996 to 2013 in North Dakota causing two deaths, more than $145 million in property damage and $14 million in crop damage. The main purpose of this study is to identify the critical areas of flash flooding within two selected watersheds in eastern North Dakota. The research method relies on the use of a GIS-based model, the Flash Flood Potential Index, that incorporates physiographic characteristics from the watershed. This Flash Flood Potential Index has been used for predictions at various geographic locations from Colorado to Iowa. The index has not been used, to our knowledge, in a flat-lying region such as the Red River Valley of North Dakota and Minnesota. In this study, digital elevation models at 30 m and 3 m resolutions were used to evaluate the sensitivity of the index. Three different scenarios were used with changes for the original FFPI equation. The preliminary results include maps showing areas susceptible for flash flooding in the watersheds. Notably, the highest values of the index for this study correspond to urbanized areas and impervious surfaces such as roads and built spaces, and high slopes reflecting an increased vulnerability to floods and inundation of the watersheds. The correlation between historical events and index results was also tested. Some modifications of the index for flat-lying landscapes might have to be considered in future studies.

2014 — 2015 NDWRRI Fellowship Research Highlights

Anthony Wamono: Effects of Calcium Based Surface Amendments on the Hydraulic Conductivity and Selected Physical Properties of Subsurface Drained Sodic-Saline Soils

In this study, the cone index (CI), a measure of penetration resistance, was determined for plots at Wyndmere and Grand Forks sites in North Dakota using a hand held penetrometer. Soil water content measurements were taken augment the CI data. Statistical analyses of CI relationships with depth, moisture content, drainage state, and surface treatments were determined. A Cornell sprinkler infiltrometer was used to measure the changes in hydraulic conductivity of the plots. The effectiveness of calcium based surface amendments and cover crops under drainage and non-drainage options on improving the hydraulic and mechanical properties soil was evaluated. The experiments showed that gypsum application increased the penetration resistance of the soil during wet conditions, reduced the drawbar power requirements and improved the movement of the water through the soil matrix in comparison to spent lime. The improvement in infiltration was limited to the soil matrix with water at 2 cm tension, the final infiltration including both matrix flow and flow the larger macro-pores was not affected by the surface treatments.

Derrick Deering: Three Dimensional Analyses of Flow Dynamics & Chlorination of Ground Water Supply Reservoir in a Cold Region

This research focuses on determining if a ground water storage tank that is currently in operation in East Grand Forks, Minnesota is fully mixed, and if the chlorine concentration fluctuates throughout the tank. Since the city has experienced stratification during the summer, different designs of the interior geometry are analyzed for fully mixed conditions to evenly maintain chlorine concentration throughout the tank. Additionally, since in cold climate regions, such as Minnesota and North Dakota, water distribution systems tend to have issues related to cold weather, winter conditions will also be considered to reduce freezing. With drastic fluctuations in seasons, the Upper Midwest experiences difficulties maintaining water quality in both summer and winter. Collaboration with the City of East Grand Forks, Minnesota allows for data collection of a current water reservoir that has experienced both ice formation and stratification in the past. The storage tank in East Grand Forks utilized for this project also supplies water to a limited population with projections of future development. Computation fluid dynamics (CFD) software is utilized to analyze the flow conditions and chlorine concentration throughout the tank. The data collected from the City of East Grand Forks, Minnesota will be utilized to determine accurate boundary conditions within the storage tank for CFD simulation. The results from the CFD models will be evaluated to determine which geometry is most applicable for Upper Midwest water storage reservoirs in water distribution systems. The results of this research will benefit the water distribution industry tremendously, expanding the understanding of flow conditions within a storage tank as well as CFD applications for water quality and hydraulics. Lastly, this research will allow the operators of the East Grand Forks, Minnesota water distribution plant to have more control and understanding of what is happening throughout their distribution system, specifically the ground water storage tank, as well as some potential method(s) that may be more efficient to maintain the storage tank water quality.

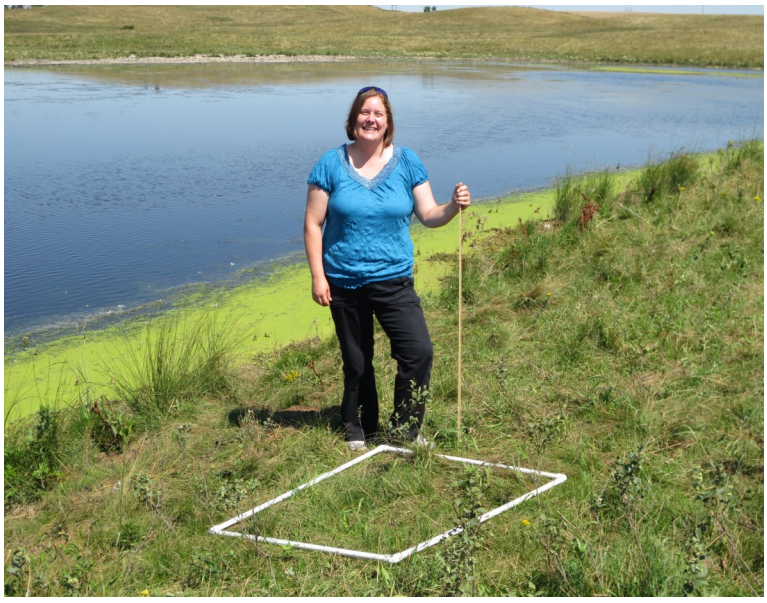
Meet Our Faculty

Dr. David Delene is an Associate Research Professor in the Department of Atmospheric Sciences at the University of North Dakota (UND). Dr. Delene received a B.S. in Applied Physics from Michigan Technological University in May 1993, a M.S. in Geophysics from Michigan Technological University in August 1995, and a Ph.D. from the Department of Atmospheric Sciences at the University of Wyoming in December 1998. Dr. Delene spent two years as a Research Associate at the Cooperative Institute for Research in Environmental Sciences in Boulder Colorado, working on evaluating uncertainties in satellite retrievals of aerosol optical depth before coming to UND in 2001. Since coming to UND, Dr. Delene has focused on conducting airborne measurements to understand aerosol-cloud interaction and precipitation formation. Measurements from the UND's Citation Research Aircraft, along with radar, surface and satellite observations, provides new information for understanding cloud and precipitation processes. Research projects have taken Dr. Delene to such interesting places as Alaska, Hawaii, New Zealand, India, UAE, Saudi Arabia, West Africa, and Chile.

Dr. Delene research interests include atmospheric aerosols, cloud physics, weather modification, satellite remote sensing of aerosols and clouds, air pollution, and climate change. Central to his research interests are the suspended particles in the atmosphere known as aerosols. Atmospheric aerosols are an important area of research since they affect the earth's climate by scattering and absorbing radiation and by influencing the characteristics of clouds. Understanding the influence of aerosols on the earth's climate is necessary for reliable predictions of anthropogenic induced climate change. The direct effect of aerosols to scatter and absorb radiation in the atmosphere influences the amount of radiation reaching the earth's surface and the amount radiated back to space. Absorption of radiation by aerosols can heat the atmosphere sufficiently to affect the formation of clouds, and the cloud droplet number concentration is determined to a large extent by a subset of atmospheric aerosols, called cloud condensation nuclei (CCN). CCN influence the lifetime of clouds by reducing the number of large cloud droplets and hence inhibit the precipitation formation process. Satellite data extend in space and time in-situ measurements to give a global prospective that is costly to obtain with in-situ measurements. In -situ and satellite measurements need to be synthesized and incorporated into climate models so predictions can be made and tested about cloud microphysics, radiation balance, and precipitation. Models that fully incorporate aerosols may be used in examining how aerosols, radiation balances and precipitation systems are coupled and investigate possible feed backs. Collaboration among researchers is critical and Dr. Delene collaborates with other researches to obtain and analyze measurements to understand the earth's climate and weather systems.

Dr. Delene's ongoing research projects include; 1.) the 2015 CAPE project where the University of North Dakota's Citation Research Aircraft is used to conduct measuring in Florida thunderstorm concurrent with one of the most advanced radars systems in the world, the Navy's Mid-Course Doppler Radar (MCR), 2.) UTC Aerospace System Flight Testing to test new instrumentation for commercial aircraft by conducting comparison with advance microphysical instruments on board the Citation Research Aircraft, 3.) development of a small, light-weight cloud condensation nuclei counter for unmanned aircraft systems using piezo film sensors and 3-D printed components, and 4.) the Polarimetric Cloud Analysis and Seeding Test project to conduct an assessment of hygroscopic seeding of convective clouds in North Dakota for increasing precipitation.

Meet Our Faculty



Dr. Christina Hargiss is an Assistant Professor at North Dakota State University (NDSU) in the School of Natural Resource Sciences (SNRS). She earned her B.S. in Comprehensive Science Education and M.S. and Ph.D. in Natural Resources Management at NDSU. Prior to joining the faculty she worked as a research specialist in Range Science at NDSU and as adjunct faculty at Concordia College.

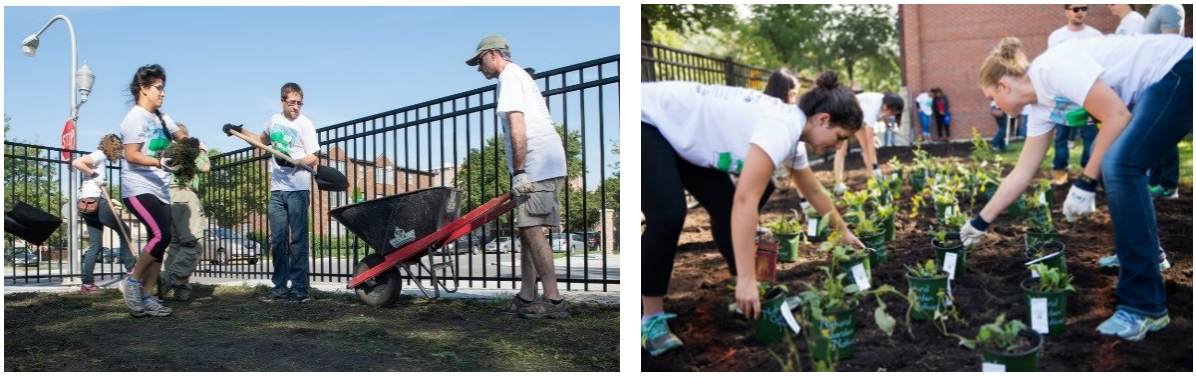
Dr. Hargiss' research interests include wetland ecology, urban ecosystems, urban water use, environmental education, and the impacts of road dust from energy development on natural resources. Her M.S. student, Alexis Steinman, is a current NDWRRI fellowship recipient. Alexis' research focuses on examining the changes that occur in wetland ecosystems, specifically water quality and plant communities, across a gradient from rural - peri-urban - urban. Dr. Hargiss teaches a variety of classes at NDSU including Natural Resources and Agroecosystems, the National Environmental Policy Act (NEPA), the SNRS senior capstone experience course, and Environmental Education and Outreach. She also is a facilitator for Project WET and Project Learning Tree, and serves on the Board of Directors for River Keepers.

Dr. Jayaraman Sivaguru (Siva) is the James A. Meier Jr. Professor at the Department of Chemistry and Biochemistry, North Dakota State University (NDSU), Fargo, ND, USA. He completed his Bachelors (1996) and Masters (1998) degrees from St. Joseph's college, Trichy, Tamil Nadu, India and Indian Institute of Technology, Madras, Tamil Nadu, India respectively. He came to the US in 1998 to pursue his doctoral degree and worked with Prof. V. Ramamurthy at Tulane University, New Orleans, LA, USA. After receiving his PhD in 2003, he did his post-doctoral studies with Prof. Nicholas J. Turro at Columbia University, NY, USA from 2003-2006. Siva began his independent career as an assistant professor at NDSU in 2006, was promoted as an associate professor in 2011 and as a full professor in 2014. He is a recipient of 2008 NSF CAREER award, 2010 Grammaticakis-Neumann Prize from the Swiss Chemical Society for outstanding independent research by a young faculty under the age of 40 in the fields of photochemistry or photophysics or molecular photobiology, 2011 Young-investigator award from the Inter-American Photochemical Society (I-APS) and 2012-young investigator award from Sigma-Xi. At NDSU, Siva has been honored with the 2010 Excellence in Research award and 2011 Excellence in Teaching award both from the College of Science and Mathematics and 2012 Peltier Award for Innovation in Teaching. He was a 2011 Global Centre for Excellence visiting young professor at Osaka University, Suita Campus, Osaka, Japan. In 2013, he was named the American editor for the Journal of Photochemistry and Photobiology – A: Chemistry, published by Elsevier. In 2014, he has been named as the James A. Meier Jr. Professor at NDSU. From 2015, he is an associate editor for Royal Chemical Society – Advances. His research interests on light induced processes span the areas of supramolecular photochemistry, asymmetric photochemistry, organo-photocatalysis, supramolecular photocatalysis, photochemical degradation and molecular recognition in chemical and biological systems. Currently his research program is investigating a) light induced axial to central chiral transfer in atropisomeric systems, b) atropisomeric templates for asymmetric organo-photocatalysis, c) supramolecular photocatalysis with water-soluble nano-containers; d) light responsive materials derived from biomass; and e) use of photochemical methods for water remediation from unconventional oil production.

NDSU Student Volunteers at WEFTEC

On September 26, 2015, 114 Water Environment Federation Technology and Exposition Conference (WEFTEC) attendee volunteers and approximately 20 community volunteers helped modify 264 m^2 (2845 ft^2) at the Pershing Magnet School (Chicago). NDSU students who volunteered for the community service project included Ruchi Joshi, Chaipon Juntawang, Kellen Grubb, Anna Cunningham and Aundie Softing. The project included construction of a rain garden, creation of a 216 m (707 ft) outdoor classroom incorporating permeable pavers and underground stormwater storage, planting native prairie grasses and flowers, and installing educational materials to teach students about green infrastructure. Volunteers installed a teaching tool to demonstrate the rate at which stormwater infiltrates various materials used in the construction and found on the school grounds. The finished garden and outdoor classroom will help capture and store stormwater, improve aesthetics, and demonstrate basic elements of biology and environmental sciences to students. Classes already have used the space for reading, lunch-time, and education about trees and leaves. The WEFTEC 2015 service project was conducted in partnership with the Metropolitan Water Reclamation District of Greater Chicago, City of Chicago Department of Water Management, and Chicago Public Schools.

Rain garden construction progress at Pershing Magnet School Chicago, IL.
Photo courtesy of the Metropolitan Water Reclamation District of Greater Chicago.



NDSU students volunteer for the community service project in Chicago, IL during WEFTEC 2015 on a Saturday morning.

NDSU WEFTEC Design Team

NDSU Wins Environmental Design Competition at WEFTEC 2015

The North Dakota State University team placed first in the student design competition's environmental design category. A) From left, WEF Board of Trustee member Erin Mosley with team members Kellen Grubb, Luisa Torres (ND WRRI Fellow), Anna Cunningham, Dain Synhorst, and faculty advisor, Wei Lin (ND WRRI Faculty). Photo courtesy of Oscar & Associates. B) A glimpse of the proposed plan for the project titled 'Water Reclamation for Irrigation of a Softball Complex'.

North Dakota State University (NDSU) competed in the Environmental Design Competition at the 88th Annual Water Environment Federation Technical Exhibition and Conference (WEFTEC) in Chicago, IL. The 14th annual competition was held on September 27, 2015 and is open to all universities nationwide. WEFTEC hosts two competitions: Wastewater Design (e.g. hydraulics, capacity design, and upgrades to existing systems) and Environmental Design (e.g. contemporary engineering topics such as sustainability and water reuse). The NDSU student chapter team, who represented the North Dakota Water Environment Association, competed in environmental design category and won the best design team award (first place). The team included CEE seniors and graduate students. Zach Cormican, Anna Cunningham, Dane Ekdom, Kellen Grubb, Kevin Kruger, Jacob Mitzel, Ursinio Puga (ND WRRI Fellow), Dain Synhorst, Zach Thelen, Luisa Torres, Shane Traulich, and Nick Wyers were members of the design team. The team that presented the final project during the WEFTEC included seniors Kellen Grubb, Anna Cunningham, Dain Synhorst, and graduate student Luisa Torres (ND WRRI Fellow). The project, Water Reclamation for Irrigation of a Softball Complex, presented by the NDSU team was developed as a part of the Environmental Engineering Design (CE 499/696) class taught by Dr. Wei Lin (ND WRRI Faculty) in Spring 2015. The project focused on determining the best design alternative to reclaim water from the Fargo wastewater treatment plant to irrigate a 21-diamond softball complex in order to conserve conventional piped water and reduce nutrients discharges into the Red River. The project was well received by a panel of judges comprising of professional engineers and consultants. NDSU student team was awarded first place in the competition along with certificates, and a monetary award of $2,500. The conference also allowed for professional networking through career fairs, a great learning experience through an open exhibition hall, technical sessions and much more.

Environmental and Water Resources Sustainability Mini Symposium

NDSU College of Engineering hosted a Mini Symposium on Environmental and Water Resources Sustainability

On November 13, 2015 NDSU College of Engineering hosted a Mini Symposium on Environmental and Water Resources Sustainability. This Mini Symposium is part of a series of symposia hosted by NDSU College of Engineering in collaborations with Jerome J. Lohr College of Engineering of South Dakota State University (SDSU) and College of Engineering & Mines of University of North Dakota (UND). These three partner colleges have limited faculty members in many research focus areas to have critical mass needed to conduct sizable research projects. Collaboration is considered as an essential strategy to improve the competitiveness on larger proposals. The purpose for the mini symposium is to create a venue for faculty in environmental engineering and science and water resources related areas to make contact and develop relationships leading to development of collaborative competitive research projects and particularly submit larger proposals requiring broader participation and expertise. Invited speakers included esteemed national and international researchers and ND WRRI faculty:

Dr. Hassan Abbas, OCL (Pvt) Ltd., Former UNESCO Chair in Knowledge Systems for Integrated Water Resources Management
"A New Efficient Capillary-Irrigation System at Farm-scale - Prospects, Potentials and Implications"
Dr. Djuna Gulliver, National Energy Technology Laboratory, Department of Energy
"Microbial Ecology of Marcellus and Bakken Shale Produced Waters"
Dr.. Sudhir Murthy, DC Water
"Maximizing Process Intensification and Resource Recovery- from Theory to Practice"
Dr. Achintya Bezbaruah, NDSU
"A Decade of Environmental Nanotechnology Research at NDSU: Milestones and Challenges"
Dr. Xiao (Frank) Feng, UND
"Emerging Contaminants In the Upper Mississippi River Basin: Occurrence, Fate and Transport"

A) Dr. Eakalak Khan, ND WRRI Director, introducing invited speaker, Dr. Sudhir Murthy, DC Water and B) Invited speakers with NDSU and SUDU faculty (front row, from left, Drs. Laurent Ahiablame, Guanghui Hua, Sudhir Murthy, Eakalak Khan, Hassan Abbas, and Djuna Gulliver) and former and current ND WRRI fellows (back row)

Recent Publications and Presentations by Institute Fellows and PIs

Journal Papers

Torres, L., O. Yadav, E. Khan (2016) A review on risk assessment techniques for hydraulic fracturing water and produced water management implemented in onshore unconventional oil and gas production. Science of the Total Environment, 539, 478-493.

Gbolo, P., P. Gerla (2015) Spatiotemporal distribution of soil nutrients within an abandoned cattle feedlot. Journal of Soils and Sediments, 15, 71-80.

Fisher, J., D. Mushet, C. Stockwell (2014) Potential for parasite-induced biases in aquatic invertbrate population studies. Hydrobiologia, 722, 199-204.

Odabas. M., N. Leelaruban, H. Simsek, G. Padmanabhan (2014) Quantifying impact of droughts on barley yield in North Dakota, USA using multiple linear regression and artificial neural network. Neural Network World, 24(4), 343-356.

Conference Proceedings

Leelaruban, N., G. Padmanabhan (2015) Droughts-groundwater relationship in northern great plains shallow aquifers, in Proceedings of the World Environmental and Water Resources Congress, American Society of Civil Engineers, Reston, VA, 510-519.

Swanson, M., M. Kasi, E. Khan (2015) Sensitivity of phosphorus bioavailability tests to algal species, in Proceeding 88th Annual Water Environment Federation Technical Exposition and Conference, Water Environment Federation, Alexandria, VA.

Conference/Seminar Presentations

Dandumrongsin, B., H. Simsek, C. Rongsayamanont (2015). Characterization of soluble microbial products and its contribution on dissolved organic matters in municipal wastewater effluent. International Prairie Student Conference, August 13-14, 2015, Brookings, SD.

Dandumrongsin, B., H. Simsek (2015). A method to determine biodegradability of organic nitrogen using laboratory scale column system. North Dakota Experimental Program to Stimulate Competitive Research (ND EPSCoR) State Conference, April 22, 2015, Fargo, ND. (Poster presentation)

Hossain, M.E., C.W. Lee, A. Bezbaruah (2015). Iron uptake from bare and phosphate-laden nano-iron by Lactuca sativa grown in hydroponics, Sustainable Nanotechnology Organization Conference, November, 2015, Portland, OR. (Poster presentation)

Hossain, M.E., C. Ritt, A. Bezbaruah (2015). Development of biopolymer-based slow-release phosphate and iron fertilizers, World Environmental & Water Resources Congress, May, 2015, Austin, TX.

Hossain, M.E., C. Ritt, A. Bezbaruah (2015). Iron Cross-linked biopolymer beads for aqueous phosphate removal, North Dakota Experimental Program to Stimulate Competitive Research (ND EPSCoR) State Conference, April 22, 2015, Fargo, ND. (Poster presentation)

Leelaruban, N., G. Padmanabhan (2015). Droughts-groundwater relationship in northern Great Plains shallow aquifers. World Environmental and Water Resources Congress, May 17-21, 2015, Austin, TX.

Recent Publications and Presentations by Institute Fellows and PIs

Rashid, U.S., S. Simsek, A.N. Bezbaruah (2015). Injectable nanoparticle-based permeable reactive barriers for groundwater contaminant remediation, North Dakota Experimental Program to Stimulate Competitive Research (ND EPSCoR) State Conference, April 22, 2015, Fargo, ND. (Poster presentation)

Roy, D., X. Jia, D. Steele, X. Chu (2015). Measurement and simulation of infiltration rates into undrained and subsurface drained soils. 2015 ASABE Annual International Meeting, July 26-29, 2015, New Orleans, LA. (Roy, D. is a fellow supported by NDSWC matching fund)

Roy, D., X. Jia, D. Steele (2015). HYDRUS model simulation of infiltration rates into undrained and tile drained soils. North Central ASABE Conference, April 10-11, 2015, Fargo, ND. (Roy, D. is a fellow supported by NDSWC matching fund)

Schewe, R., F.X.M. Casey, A.F. Wick (2015). Quantifying salt removal from tile drainage in the Red River Valley. Annual ASA-CSSA-SSSA Meetings, November 18, 2015, Minneapolis, MN.

Schewe, R., F.X.M. Casey, A.F. Wick (2015). Water flow characteristics of a shrink-swell soil from a wetting and drying cycle. Annual ASA-CSSA-SSSA Meetings, November 17, 2015, Minneapolis, MN. (Poster Presentation)

Sharma, S., M.H. Ademola, H. Simsek (2015). Impact of solids retention time on wastewater derived bioavailable dissolved organic nitrogen. ASABE Annual International Meeting, July 26-29, 2015, New Orleans, LA. (Sharma, S. is a fellow supported by NDSWC matching fund)

Sharma, S., M.H. Ademola, H. Simsek (2015). Wastewater treatment using microalgae Chlamydomonas Reinhardtii and bacteria in a continuous flow stirred-tank reactor (CSTR). North Dakota Experimental Program to Stimulate Competitive Research (ND EPSCoR) State Conference, April 22, 2015, Fargo, ND. (Sharma, S. is a fellow supported by NDSWC matching fund) (Poster presentation)

Shoghli, B., Y.H. Lim (2015), Predictive scheme for failures of embankment dams with high overtopping potential: Case studies using remote sensing data. World Environmental & Water Resources Congress, May, 2015, Austin, TX. (Shoghli, B. is a fellow supported by NDSWC matching fund)

Shoghli, B., Y.H. Lim (2015). Comparative study for evaluating the soil moisture in improving flood forecasting. North Dakota Experimental Program to Stimulate Competitive Research (ND EPSCoR) State Conference, April 22, 2015, Fargo, ND. (Shoghli, B. is a fellow supported by NDSWC matching fund) (Poster presentation)

Silvis, B. (2015). The Impact of policy and economic drivers of corn production on nitrogen levels of the Buffalo River subbasin, Minnesota, 2006-2014." Geological Society of America North-Central Section Meeting, May, 2015, Madison, WI. (Silvis, B. is a fellow supported by NDSWC matching fund)

Silvis, B., H. Zheng (2015). Policy and economic forces driving nitrate level changes in Buffalo River Subbasin, MN. North Dakota Experimental Program to Stimulate Competitive Research (ND EPSCoR) State Conference, April 22, 2015, Fargo, ND. (Silvis, B. is a fellow supported by NDSWC matching fund) (Poster presentation)

Sun, J., J. Ohm, M. Blonigen, H. Simsek (2015). Evaluation of bioavailable dissolved organic nitrogen in municipal wastewater using algae Chlamydomonas reinhardtii and Chlorella vulgaris. 88th Annual Water Environment Federation Technical Exposition and Conference (WEFTEC), September 26-30, 2015, Chicago, IL.

Recent Publications and Presentations by Institute Fellows and PIs

Torres, L., O.P. Yadav, E. Khan (2015). Risks associated with water and wastewater management in unconventional oil and gas production. Poster presented at the 2015 Water Quality and Technology Conference & Exposition, November, 2015, Salt Lake City, UT. (Torres, L. is a fellow supported by NDSWC matching fund) (Poster presentation)

Wamono, A., D. Steele, Z. Lin, T. DeSutter, X. Jia, D. Clay (2015). Effects of gypsum and sugarbeet spent-lime application on the hydraulic properties of subsurface drained saline-sodic soils. ASABE Annual International Meeting, July, 26-

Institute Publications

Technical Report No: ND14-01
Sodic Soil Swelling and Dispersion and Their Implications for Water Movement and Management
Yangbo He and Thomas DeSutter

Institute publications can be accessed via the Institute website: http://www.ndsu.edu/wrri

Theses and Dissertations

Arachchige, Dasuni Ranapathi (2015) Mapping flash flood potential using GIS and the flash flood potential index (FFPI) in the Turtle River and Forest River watersheds in North Dakota. M.S. Thesis, Department of Geography, College of Arts and Sciences, University of North Dakota, Grand Forks, ND.

Bo, Yanghe (2014) Sodic soil swelling and dispersion and their implications for water movement and management. Ph.D. Dissertation, Department of Soil Science, College of Agriculture, Food Systems, and Natural Resources, North Dakota State University, Fargo, ND.

Deering, Derrick (2015) Thermo effects to ground water reservoirs in water distribution systems experiencing cold climate and efficient preventative measures. M.S. Thesis, Department of Civil Engineering, College of Engineering and Mines, University of North Dakota, Grand Forks, ND.

Fisher, Justin (2015) Northern leoaprd frogs in North Dakota: assessing the conservation status of a widespread amphbian species. Ph.D. Dissertation, Environmental and Conservation Sciences Program, College of Graduate and Interdisciplinary Studies, North Dakota State University, Fargo, ND.

Gbolo, Prosper (2014) Quantifying phosphorus cycling and fate within an abandoned feedlot and adjacent wetlands. Ph.D. Dissertation, School of Geology & Geological Engineering, College of Engineering and Mines, University of North Dakota, Grand Forks, ND.

Sun, Jingyi (2015) Bioavailability and biodegradability of dissolved organic nitrogen originated from municipal and animal wastewater. M.S. Thesis, Department of Agricultural and Biosystems Engineering, College of Agriculture, Food Systems, and Natural Resources, North Dakota State University, Fargo, ND.

Recent USGS Reports

Regional regression equations to estimate peak-flow frequency at sites in North Dakota using data through 2009
Tara Williams-Sether
2015, Scientific Investigations Report 2015-5096

https://pubs.er.usgs.gov/publication/sir20155096

Water-quality characteristics in runoff for three discovery farms in North Dakota, 2008-12
Rochelle A. Nustad, Kathleen M. Rowland, Ronald Wiederholt
2015, Scientific Investigations Report 2014-5212

https://pubs.er.usgs.gov/publication/sir20145212

Strategic Plan 2015-2017
ND North Dakota State Water Commission and Office of the State Engineer
2015

http://www.swc.nd.gov/info_edu/reports_and_publications/strategic_plans/pdfs/2015.pdf

Modeling of the Page Aquifer: An Assessment of Groundwater Availability
Rex P. Honeyman
Water Resource Investigation No. 55, 2014

http://www.swc.nd.gov/info_edu/reports_and_publications/pdfs/wr_investigations/wr55_report.pdf

Wastin' Away in Central North Dakota: Glacial Ice Stagnation and the Central Dakota Aquifer System
Gordon M. Sturgeon
Water Resource Investigation No. 57, 2014

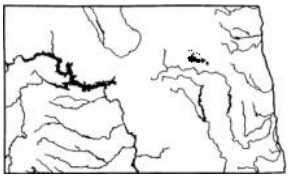
http://www.swc.nd.gov/info_edu/reports_and_publications/pdfs/wr_investigations/wr57_report.pdf

4th NDWRRI Annual Distinguished Water Seminar

The annual 4th Distinguished Water Seminar sponsored by the Institute was held on February 19, 2015. The featured speaker was Dr. Gregory V. Lowry, Water J. Blenko Sr. professor of civil and environmental engineering at Carnegie Mellon University in Pittsburgh. Dr. Lowry, is also the deputy director of the Center for Environmental Implications of Nanotechnology of CMU. The topic title was "Nanotechnology in Water Science and Engineering: Sustainably Harnessing the Power of Nanotechnology." Dr. Lowry presented an overview of the history of the Environmental Nanotechnology field, and recent advances in applications and implications of engineered nanomaterials in water science. The talk was co-sponsored by the Departments of Civil and Environmental Engineering, Agricultural and Biosystems Engineering, Geosciences, the Environmental and Conservation Sciences Program, and the School of Natural Resources Sciences, all of North Dakota State University. The seminar is the fourth of the annual Distinguished Water Seminar series by eminent water professionals on emerging issues, challenges and new research directions in water resources.

Abstract: Nanotechnologies have tremendous potential for helping to achieve the Millennium Goals for sustainable development. However, the introduction of new technologies and materials must be done sustainably to achieve those benefits. The Environmental Nanotechnology field has evolved over the past decade, moving from unrealistic expectations of the benefits of nanotechnology and overblown fears about negative impacts, to realizing some of those benefits and gaining a better understanding of the potential for negative impacts of nanomaterials along their lifecycle. Dr. Lowry will present an overview of the history of the Environmental Nanotechnology field, and recent advances in applications and implications of engineered nanomaterials.

Following the seminar, students and faculty had opportunity to interact with Dr. Lowry.



North Dakota Water Resources Research Institute
North Dakota State University
P.O. Box 6050 Dept. 2890

Phone: 701-231-7717
Fax: 701-231-6185
E-mail: eakalak.khan@ndsu.edu
Website: www.ndsu.edu/wrri

North Dakota Water Resources Research Institute (NDWRRI)

The Institute was founded in 1965 by authority of Congress as one of the 54 Institutes throughout the nation and is administered through the United States Geological Survey. The NDWRRI receives funding through section 104 of the Water Resources Research Act of 1984 and it applies its Federal allotment funds to research that fosters: A) the entry of new research scientists into the water resources field, B) training and education of future water resources scientists, engineers, and technicians; C) the preliminary exploration of new ideas that address water problems or expand understanding of water and water-related phenomena; and D) the dis-