Program Description: Applications are invited from qualified and motivated undergraduate students (rising sophomores, juniors and seniors) from all U.S. colleges/universities to participate in a 10-week summer research in interdisciplinary water sciences and engineering at Virginia Tech. U.S. Citizens or Permanent Residents are eligible to apply. The research program is funded through the National Science Foundation – Research Experiences for Undergraduates (NSF REU) program. The 10-week internship will begin on May 24, 2015 (arrival day) at Virginia Tech and end on August 1, 2015 (departure day). We have already graduated 66 excellent undergraduate researchers representing 45+ institutions in the United States during 2007-09 and 2011-14. Successful applicants (hereafter referred to as REU fellows) will join one of the ongoing research projects in interdisciplinary water sciences and engineering and conduct research under the supervision of Virginia Tech faculty and graduate students. Research projects address interdisciplinary issues related to water science and engineering involving field work, laboratory simulations, literature review, and analysis of data. See Appendices 1 and 2 for list of faculty advisors and typical 2015 summer research projects, respectively. The summer research program is complemented by other professional activities. For example, REU fellows will attend weekly forums and participate in a few field trips. Speakers at these forums will include VT faculty members, graduate students and experts from water industry and government. These weekly forums provide an excellent opportunity to REU fellows to learn about commonalities between their various research projects, interact with each other and with other research mentors. REU fellows will make frequent presentations to their peers about their research progress and ultimately prepare a research report in collaboration with their research mentors suitable for conference presentation and/or publishing in a refereed journal or other appropriate publications.

Social interaction and networking is a major goal of the program. Several social activities are organized to encourage informal personal interaction between REU Fellows and the research team and the larger university community. See Appendix 3 for possible recreational activities.

Financial Support: The research internship includes a stipend of $450/week, housing (two persons per room), $400 for meal, and travel expenses (limited to a maximum of $500 per person).

Application: The deadline to receive all application materials is March 13, 2015 (5pm, EST). Applications should be submitted online via the website: http://www.lewas.centers.vt.edu/. The application should include:

1. A 300-word essay about your interest in water/environment research and professional goals, and indicate top two choices of summer research project including a brief justification (see
Appendix 2). The justification should be part of your essay. This should be uploaded as a PDF document in the online application form.

2. Unofficial College transcripts, to be uploaded as a PDF document in the online application form.

3. Two letters of reference to be sent by your referees (Referees are requested to upload a pdf document using a URL that will be emailed to them for our application system. Potential candidates are requested to remind their referees about this requirement. Letters should address candidate’s motivation to pursue research, enthusiasm, reliability, team-work skills and personality.

Applicants are requested to upload their applications along with other required documents by the deadline (March 13, 2015, 5:00 pm, EST). We have started reviewing the applications and will begin contacting the successful applicants beginning in the middle of March, 2015. For questions, please contact: Dr. Vinod K Lohani, NSF REU Program Director, e-mail: vlohani@vt.edu; Phone: (540) 231-9545; FAX: (540) 231-6903
# Appendix 1

## Program Management Team and Research Mentors

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Responsibility</th>
<th>Academic Discipline and Field of Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Carey</td>
<td>Virginia Tech</td>
<td>Research Mentor; Participant Selection</td>
<td>Biological Sciences; Freshwater Ecology</td>
</tr>
<tr>
<td>Dr. Hester</td>
<td>Virginia Tech</td>
<td>Research Mentor; Participant Selection</td>
<td>Civil &amp; Environ Eng.; Ecohydraulics</td>
</tr>
<tr>
<td>Dr. Edwards</td>
<td>Virginia Tech</td>
<td>Research Mentor; Participant Selection</td>
<td>Civil &amp; Environ Eng.; Water Infrastructure</td>
</tr>
<tr>
<td>Dr. Dietrich</td>
<td>Virginia Tech</td>
<td>Research Mentor; Participant Selection</td>
<td>Civil &amp; Environ Eng.; Analytical Chemistry</td>
</tr>
<tr>
<td>Dr. Xia</td>
<td>Virginia Tech</td>
<td>Research Mentor; Participant Selection</td>
<td>Crop &amp; Soil Environ Sciences – Soil Chemistry</td>
</tr>
<tr>
<td>Dr. Weiss</td>
<td>Virginia Tech</td>
<td>Research Mentor; Participant Selection</td>
<td>Geoscience; Coastal Engineering</td>
</tr>
<tr>
<td>Dr. Lohani*</td>
<td>Virginia Tech</td>
<td>Project Director (PI); Program Coordinator; Recruitment &amp; Selection; Assessment; Cohort Experiences/ Professional Development; Dissemination; Research Mentor</td>
<td>Civil and Agricultural Engineering; Watershed Instrumentation, Hydrology, and Engineering Education</td>
</tr>
<tr>
<td>Dr. Irish</td>
<td>Virginia Tech</td>
<td>Research Mentor; Participant Selection</td>
<td>Civil &amp; Environ Eng.; Coastal Engineering</td>
</tr>
<tr>
<td>Dr. Pruden</td>
<td>Virginia Tech</td>
<td>Research Mentor; Participant Selection</td>
<td>Civil &amp; Environ Eng.; Environmental Contaminants</td>
</tr>
<tr>
<td>Dr. Schreiber</td>
<td>Virginia Tech</td>
<td>Research Mentor; Participant Selection</td>
<td>Hydrogeosciences; Chemical Hydrogeology</td>
</tr>
<tr>
<td>Dr. Dymond</td>
<td>Virginia Tech</td>
<td>Research Mentor; Participant Selection</td>
<td>Civil &amp; Env. Engineering; Hydrology</td>
</tr>
<tr>
<td>Dr. He</td>
<td>Virginia Tech</td>
<td>Research Mentor; Participant Selection</td>
<td>Civil &amp; Env. Engineering; Environmental biotechnology</td>
</tr>
<tr>
<td>Dr. Muffo</td>
<td>Independent Assessment Consultant</td>
<td>Evaluation/Assessment</td>
<td>Academic Assessment</td>
</tr>
</tbody>
</table>

* Project Management
Appendix 2

Virginia Tech NSF/REU Site: Interdisciplinary Water Sciences and Engineering
NSF REU Summer 2015 Research Projects
REU Site Duration: May 24 – August 1, 2015

Project ID# 1: Evaluating the factors driving the vertical distribution of cyanobacteria in drinking water reservoirs; Mentors: Drs. Carey and Schreiber
Cyanobacterial (blue-green algal) blooms are increasing in many freshwater lakes and reservoirs worldwide, and pose substantial risks to drinking water quality because of their scums, odors, and toxins. Because most drinking water reservoirs are able to control the depth of their source water withdrawal, determining the vertical distribution of cyanobacteria and other phytoplankton populations in the water column is critically important for protecting drinking water quality. The REU participant will be involved in a project in collaboration with the Western Virginia Water Authority (WVWA) to study the vertical distribution of different phytoplankton taxa in drinking water reservoirs, using both high-frequency sensors and manual sampling methods. The REU student will work with a graduate student mentor to conduct intensive field sampling to monitor water chemistry and the vertical distribution of phytoplankton in several different reservoirs, and analyze the factors (e.g., nutrients, light, reservoir management) that influence phytoplankton community structure. We seek an REU student that has experience and interest in field sampling and data analysis, and can work independently while participating in a fun, collaborative team in the field.

Project ID#2. Drinking Water Quality; Mentor: Dr. Dietrich
Worldwide, the increasing population/agriculture/industry causes increased natural and anthropogenic contamination of water supplies that has led to the need to use lower quality water sources for drinking water. Research projects will focus on the effects of source water quality on the resulting drinking water and human health. These projects include: 1) modeling human exposure at the air-water interface to contaminants that are volatilized from drinking water and inhaled by humans; 2) evaluating consumer perception of drinking water through analysis of utility consumer complaints pertaining to the quality of the drinking water; 3) assessing reactivity of zero-valent iron in aqueous solutions; 4) investigating communication strategies for informing the public about water quality.

Project ID#3: Hydrology and Hydraulics Impacts on Ecological Health and Water Quality of Streams and Rivers; Mentor: Dr. Hester
This research aims to understand the mechanisms connecting human activities in stream corridors and watersheds with degradation of stream and river ecosystems and water quality, to allow better informed ecological stream and river restoration design, pollutant attenuation by natural processes, and watershed planning. Current projects entail field work and associated data analysis to evaluate the effect of human activities such as stream restoration on surface water-groundwater exchange, floodplain hydraulics, and water quality in streams and rivers. The REU participant’s role will vary but typically entail installing piezometers or stream gauges; installing, monitoring, or downloading hydraulic and water quality sensors; assisting with tracer tests in streams; surveying streambed and floodplain topography; collecting water quality samples; analyzing sensor or survey data; and presenting results in a written report or oral presentation.
Project ID#4: Quantification of distinguishing features of tsunami versus hurricane sediment overwash events; Mentors: Drs. Irish and Weiss
Coastal hazards like tsunamis and hurricanes can move large volumes of sediment at the coast, drastically changing the coastal landscape. Since these coastal hazards are relatively rare, it is difficult to accurately quantify the risk posed by these hazards strictly from contemporary history of such events. Thus, there is a need to better understand these processes in a way that enables meaningful interpretation of information in the geological record. In this study, distinguishing characteristics between tsunami and hurricane sediment overwash events will be investigated. The purpose of this investigation is to identify (a) which hurricane surge and wave conditions lead to sediment overwash volumes of specified magnitudes and (b) which tsunami runup heights lead to sediment overwash volumes of specified magnitudes. The REU student will be responsible for carrying out a series of idealized computational simulations with the open-source code XBeeach and evaluating model results to identify patterns between the input forcing (waves and water levels) and overwash characteristics. The student will be expected to write a document and present results of the XBeeach model setup, its application, and results.

Project ID#5: Recovery of Nutrients and Water from Wastewater Using an Integrated Osmotic Bio-electrochemical System; Mentor: Dr. He
Sustainable wastewater treatment should significantly clean polluted water while minimize energy consumption of the treatment process and decrease the carbon footprint. Wastewater contains more energy contents than what is required for treatment process, and extracting such contents from contaminants will help accomplish sustainable wastewater treatment. In addition, water and nutrients are valuable resource that can be recovered from wastewater. An innovative system based on synergistic cooperation between microbial electrolysis cells (MECs) and forward osmosis (FO) has been developed at Virginia Tech. MECs oxidize organic matters in wastewater for electricity generation, which drives the recovery of ammonia. Ammonia is then used as a draw solute in FO for recovering high-quality water from the treated wastewater from MECs. In this project, the developed system will be examined for treating the effluent from anaerobic digesters. The REU participant will work with a graduate student and obtain hands-on experiences in reactor setup and operation, and chemical analysis. The participant will be a part of multidisciplinary team and learn the knowledge in engineering, electrochemistry, materials, and biotechnology. The results will be presented in major conferences, and a research paper will be highly desired.

Project ID#6 (A&B): Implementation of a Raspberry Pi-based System for Processing and Remote Access of High Frequency Environmental Data and Hydrologic Analysis; Mentors: Drs. Lohani and Dymond
A Learning Enhanced Watershed Assessment System (LEWAS) (old name: LabVIEW Enabled Watershed Assessment System) lab was established on Virginia Tech campus for remotely assessing high frequency water quality and quantity data from a creek that flows through the campus. A water quality sonde provides the capability to sense temperature, conductivity, dissolved oxygen, turbidity, and pH of water. A flow meter and an ultrasonic sensor measure the flow in a real time. In addition, a weather station has also been integrated into LEWAS to allow real-time monitoring of weather parameters like precipitation, temperature, humidity, etc. The data is shared with remote clients via Wireless LAN through a user interface. Seven NSF/REU
participants have worked in this lab since 2008. In 2014, a Raspberry Pi, a single board computer with LINUX environment, based system was conceived and partly implemented to collect data from the LEWAS sensors and store these in a database. Ultimately, a user will be able to access the high frequency data from this database through an interactive user interface. This project will engage two REU participants who will work in the LEWAS lab. Participant one will learn to calibrate the LEWAS sensors and collect data, conduct hydrologic analysis of high frequency (every 3-5 min) water data and develop case studies to demonstrate use of high frequency data in environmental monitoring. Please pick project ID: 6A if you are interested in the hydrologic analysis work. Participant two will participate in integrating the hardware and software components of the Raspberry Pi system using programming languages such as Python, PHP and SQL. Please pick project ID: 6B if you are interested in the Raspberry Pi system work. The REU participants will be mentored by 2 PhD student/s along with Drs. Lohani and Dymond. Each participant will write a research paper to document her/his research experiences.

Project ID#7: Investigation of the occurrence and fate of 4-nonylphenol, an endocrine disruptor, in urban-impacted watersheds; Mentor: Dr. Xia
Due to rapid urbanization in the State of Virginia and nationwide, many watersheds are increasingly affected by urban activities. Nutrient loading and biological indicators have been the focus for water quality monitoring in the affected watersheds. Limited effort has been devoted to assessing the occurrence of organic contaminants associated with urban activities. The objective of this REU project is to assess urban impact on the water quality of Stroubles Creek Watershed and the New River Watershed by monitoring the levels of 4-nonylphenol, an anthropogenic organic compound, often used as an indicator for urban impact. The REU student will participate in a team effort to assess how leaky sewer systems affect stormwater water quality and Stroubles Creek water quality by investigating the occurrence and levels of anthropogenic chemical indicator such as 4-nonylphenol as well as human pathogens in the stormwater and receiving surface stream. The REU student will learn latest techniques for analysis of organic contaminants in environmental samples and gain hands on experience with the state-of-the art analytical instrument such as gas chromatography-tandem mass spectrometry (GC/MS/MS). The REU student will be working with graduate students under Dr. Xia’s guidance and is expected to write up the results and present the work at a research conference.

Project ID#8: Water Conservation and Waterborne Disease Nexus of Faucets; Mentors: Drs. Pruden and Edwards
*Legionella pneumophila* is an opportunistic pathogen found in building plumbing. *L. pneumophila* can cause Legionnaire’s Disease (severe pneumonia) in immuno-compromised individuals, hospitalizing 8,000 to 18,000 people each year and is responsible for a majority of the waterborne disease deaths in the U.S. At the same time, society is striving to become more energy and water sustainable, prompting installation of low (and lower) flow faucets in hospitals, schools, and homes around the country. Limited sampling to date has raised concern about these new “green” faucets, because they seem to have much higher levels of *L. pneumophila* than normal faucets. This research would be the first to systematically study this issue. In addition to operating a plumbing rig to generate samples and explore the relationship between *L. pneumophila*, flow rates, and flow volumes, the REU student would monitor *L. pneumophila* levels via qPCR and agar plating. Temperature, TOC, ICP and 16S rRNA genes (total bacteria) will also be quantified. The overall goal is to determine if the prior sampling results correctly indicated a systemic problem with low flow faucets causing higher *L. pneumophila*, and to
consider what can be done about it. The plumbing rig will be constructed and ready for the REU to lead experiments summer 2015 in collaboration with a graduate student and under the direction of Drs. Edwards/Pruden. The REU student will write up the results and be encouraged to present work at conferences.
Appendix 3

Recreational Activities around Blacksburg, Virginia

Virginia Tech is located in Blacksburg, Virginia and surrounded by the Blue Ridge Mountains. The Appalachian Trail runs through the area and affords many hiking trails. Other hiking trails off the Appalachian Trail include a 2-mile hike to the Cascades Waterfall and Wind Rock, which affords panoramic views of nearby mountain ridges. The New River is located nearby providing kayaking, canoeing, inner tube floating, and fishing during the summer. Other outdoor activities include mountain biking at Pandapas Pond, road biking the Blue Ridge Parkway, and walking, running or biking the Huckleberry trail. The Salem Avalanche, a Class A Affiliate of the Houston Astros, play in nearby Salem, VA.

Live music in both indoor and outdoor venues is available. Friday Night Jamboree in Floyd, VA has been listed as one of the two best places to hear bluegrass music in the United States. Friday nights on Henderson Lawn (located on campus and next to downtown) is an opportunity to hear live music free during the summer. Several restaurants provide live music throughout the week such as Jazz and Bluegrass. Unique eating experiences include local eateries such as Mike’s Grill (burgers and fries), More than Coffee (Mediterranean cuisine), Cabo Fish Taco, Boudreaux’s (Cajun style food), The Cellar (Greek cuisine), Gillie’s (vegetarian fare), Excellent Table (Ethiopian fare) as well as numerous coffee shops located next to campus. Next to campus is The Lyric, a non-profit venue that shows weekly movies and with occasional live performances and a large stadium style movie theatre is located 5 miles away in Christiansburg adjacent to the New River Mall. This is just a sample of the wide varieties of things to do and see in and around Blacksburg.
Pictures from the Summer 2014 Site

FIELD TRIPS

- Wastewater treatment plant
- NOAA National Weather Service forecast station
- Water treatment plant

SOCIAL EVENTS

- End of summer cookout at Claytor Lake
- Enjoying at McAfee Knob
Fun at Claytor Lake   Barbecue in VT Campus