BIOGRAPHICAL SKETCH

Ryan Wigner grew up in Nashville. He obtained a Bachelor of Science in Civil and Environmental Engineering from Tennessee Tech University in December, 2016. He also earned his Engineer Intern certification. His area of emphasis is in environmental engineering.

EDUCATION

B.S., Civil and Environmental Engineering

Tennessee Tech University, 2016

College of Engineering

TENNESSEE TECH

The Department of

Civil and Environmental Engineering

Announces the Thesis Defense

of

Ryan Wigner, E.I.

In Partial Fulfillment of the Requirements

For the degree of

Master of Science in Civil Engineering

Monday, December 17th 2018

3:15 pm

Held in

Prescott Hall, Room 225

Tennessee Tech University

FIELD OF STUDY

Civil and Environmental Engineering

THESIS TOPIC

POTENTIAL CONTRIBUTIONS OF ATMOSPHERIC DEPOSITION TO NITRATES AND AMMONIA IN TENESSEE'S HIGHWAY STORMWATER RUNOFF

EXAMINING COMMITTEE

Dr. Tania Datta (Chair), CEE

Dr. Alfred Kalyanapu, CEE

Dr. Lenly Weathers, CEE

ABSTRACT

Stormwater runoff from rapidly expanding built environment is a global water pollution problem, known to negatively impact the ecosystem and public health. Although a multitude of pollutants are present in stormwater runoff, nitrates (NO_3^-) and ammonia (NH_3) generated from highways are of particular interest to this study. These nitrogen species can come from adjoining land-use practices, vegetative decay, vehicular emissions and atmospheric deposition. Much work has been done to assess the contributions of NO_3^- and NH_3 in highway runoff from most mentioned sources, however, atmospheric deposition as a source is still poorly understood. Therefore, the goal of this study was to elucidate atmospheric deposition's contribution to NO_3^- and NH_3 pollution in Tennessee's highway runoff, and to determine potential influence of meteorological parameters and drainage area characteristics on the wet deposition of NO_3^- and NH_3. Flow-weighted stormwater runoff and composite wet deposition samples were collected over a period of nineteen months at three sites across Tennessee: a peri-urban site at Putnam County, with moderate average daily traffic (ADT) and high perviousness; a rural site at Sumner County, with residential and agricultural land-use and a curb and gutter drainage system; and an urban site at Knox County, with high ADT and largely impervious drainage. Results show that the lowest stormwater event mean concentration (EMC) for NH_3 and NO_3^-, with an average value of 0.09 and 0.10 mg N/L, respectively, was observed at the Putnam County site, while the Sumner County site reported the highest stormwater NH_3 and NO_3^- EMC at 0.20 and 0.38 mg N/L, respectively. The Sumner site also had the highest mean wet deposition NH_3 concentration, indicating an influence of the adjoining land-use and drainage system on pollutants. A strong statistical correlation was found between wet atmospheric NO_3^- and stormwater NO_3^- at Putnam County, suggesting potential contributions of wet deposition of NO_3^- to stormwater runoff. Similarly, the Knox County site, which was 100% impervious, exhibited a strong correlation between wet atmospheric NH_3 and stormwater EMC NH_3. To our surprise, a correlation was also found between wet atmospheric NH_3 and NO_3^- concentrations at most sites, which could result from ammonium nitrate deposition. Dual stable isotopic ($\delta^{18}O$ and $\delta^{15}N$) analysis validated the contributions of atmospheric NO_3^- to stormwater runoff, with the average stormwater $\delta^{18}O$ signature of 24‰. Findings from principal component analyses (PCA) indicated wind speed and antecedent dry period to have the most influence on pollutant concentrations in wet deposition and stormwater runoff.