BioResources concentration and chromium concentration. The chromium and nitrate concentrations are expected to be higher downstream and at the site of the spill than upstream of the spill. The parameters measured to water quality were pH, nitrate levels, total dissolved oxygen, turbidity and chromium concentration measured using Atomic Absorption Spectrophotometry. Chromium concentrations were positively correlated, increasing with subsequent locations after the spill. The pH and nitrate levels in both soil and water samples were lowest at Location 5, directly downstream of the spill, and then increased to levels similar to upstream data values, possibly due to the topography of the area and exposure to deposits. Since all organisms depend on soil and water to survive, understanding the changes in water and soil quality above and below a coal ash spill provides a baseline for interpreting all other changes in the environment.

Introduction: The US Environmental Protection Agency estimates that there were more than 735 billion pounds of coal ash across the United States in 2012 (EPA 2014). On February 2, 2014, one of those failed when a storm water pipe broke and allowed coal fly ash from the coal ash pond of the closed Duke Energy Power Plant on the Dan River near Eden, NC. The coal ash pond contained 39,000 tons of coal ash into the Dan River (Miller 2014). The longer-term effects of the coal ash spill on water and soil quality have not been explored in depth. In this experiment, soil and water samples from 8 locations along the Dan River were collected almost a year after the spill in order to determine what effects, if any, the coal ash had on water and soil quality surrounding the Dan River coal ash spill site. In controlled laboratory experiments on water, an increase in coal ash has been correlated with a decrease in pH, and one study attributed the lowered water pH to the sulfate ions present in coal ash (Webster 1986, Guthrie 1982). An increase in nitrate content in soil is also significantly correlated with an increase in coal fly ash (Cecko 2010). The EPA has found that higher concentrations of nitrate are related with higher levels of the toxic Chromium VI, sometimes pushing above levels deemed safe for drinking (Kossen 2009). These are the parameters that were chosen to assess water and soil quality.

Test Performed: Water samples were taken for temperature, pH, dissolved oxygen, nitrate concentration, and total dissolved solids. Soil samples were tested for temperature, pH, nitrate concentration and chromium concentration.

Results: On the banks, we found that chromium concentration was highest at Location 1 (29.3 ± 0.035) (Figure 1). Chromium concentration was significantly different from chromium levels of nearly all other locations (Table 1, n=3, t-test, p>0.05). In the channel, there was a significant difference between chromium content upstream of the spill site and downstream of the spill site (Table 1, n=3, t-test, p<0.05) and Location 6 varied significantly from chromium levels of nearly all other locations (Table 1, n=3, t-test, p<0.05). The pH of soil, which remained primarily acidic, did not differ between a few locations. While there was a significant difference between soil pH on the banks upstream of the spill site, the soil pH downstream of the spill site was not significantly different from the pH of the soil in the channel upstream (5.426 ± 0.070) and downstream of the spill site (5.299 ± 0.098) (Table 3). The nitrate levels in the soils collected from the banks showed a statistical trend with two-sample t-tests, specifically if Location 8 is compared to the other locations (Table 3). The nitrate levels were significantly different from Location 8 (p<0.05), which help to support this trend. No new trend was defined for the channel samples (Table 4). Additional samples were performed, comparing the upstream locations (L1, L2, and L4), the downstream locations (L5, L6, L7, and L8), and the soil sample collected from the spill. However, there was no significant difference between the pH of the soil upstream and spill site or downstream and spill site.

Discussion: Our hypothesis that there would be a significant difference between Cr concentrations (except at L7) and water nitrate, water and soil pH, and turbidity upstream and downstream of the spill site was supported by the results. Our Cr results are similar to Cr concentrations measured by the EPA near Draper, which are above the limits of Cr at US EPA, Frequent Questions on Coal Ash Rule; 2014 (cited 2015 Jan 2). The low pH of soil at the spill site in this study disagreed with the earlier studies that suggest basic coal ash can neutralize acids soils, and the EPA found slightly higher water pH levels at Draper Landing than we did for our samples in 2013, 2014. The coal ash contaminated Location 5 could be a collection point for acids washing down the river. Water nitrate levels were shown to be significantly higher downstream than upstream of the coal ash site, showing similar results to those received through the training exercise. The turbidity did show a significant difference at a few locations. Location 1 (1.625 ± 0.072) was significantly different in turbidity compared to Location 2, 3, 4, 5, 6, and 8, and Location 6 varied similarly from Location 1, Location 5, and Location 8 (Table 4). The curve in the river at Landing than we did for our sample (Pan 2011, UCSR 2014). The water pH at Location 5 could be a collection point for acids washing down the river. The turbidity did show a significant difference at a few locations. Location 1 (1.625 ± 0.072) was significantly different in turbidity compared to Location 2, 3, 4, 5, 6, and 8, and Location 6 varied similarly from Location 1, Location 5, and Location 8 (Table 4). The curve in the river at Landing than we did for our sample (Pan 2011, UCSR 2014). The water pH at Location 5 could be a collection point for acids washing down the river. The turbidity did show a significant difference at a few locations. Location 1 (1.625 ± 0.072) was significantly different in turbidity compared to Location 2, 3, 4, 5, 6, and 8, and Location 6 varied similarly from Location 1, Location 5, and Location 8 (Table 4). The curve in the river at Landing than we did for our sample (Pan 2011, UCSR 2014). The water pH at Location 5 could be a collection point for acids washing down the river. The turbidity did show a significant difference at a few locations. Location 1 (1.625 ± 0.072) was significantly different in turbidity compared to Location 2, 3, 4, 5, 6, and 8, and Location 6 varied similarly from Location 1, Location 5, and Location 8 (Table 4). The curve in the river at Landing than we did for our sample (Pan 2011, UCSR 2014). The water pH at Location 5 could be a collection point for acids washing down the river.