

## **Sharon Hartzell – Monroe Project Proposal**

### **Section 1:** *What do you propose to do / what question(s) do you hope to answer?*

My research project, *Land Use Impacts on Metal Accumulation in Vegetation*, will investigate the impact of dust from coal-bearing trains that travel through Williamsburg on vegetation near to the tracks. BNSF Railway is one company that has extensively investigated this loss, as coal dust can compromise the integrity of train track structures.<sup>1</sup> The company has estimated that between 500 pounds and a ton of coal dust can escape from a single car loaded with coal.<sup>2</sup> My project is concerned with the ecosystem impacts of coal dust lost from trains, and will investigate the levels of common metals enriched in coal that may accumulate in vegetation along railroad tracks. My project will compare samples of vegetation along train tracks to samples gathered from elsewhere in the College Creek watershed, and use chemical techniques to analyze the levels of metals enriched in coal that accumulate in this vegetation. This project will assess the impact that land use, particularly for coal-carrying railroad tracks, has on vegetation in ecosystems.

### **Section 2:** *Explain why you want to do this research. What are your goals in undertaking the project, and why is the project you are proposing the best way of achieving these goals? How will this research help further your academic / intellectual development? Why do you find the work exciting?*

As a chemistry and environmental science major, I want to conduct a project that bridges my two academic disciplines, and applies my theoretical understanding of environmental issues to a practical project. In this project, I will be performing chemical analyses of metals in vegetation, as well as gaining experience in environmental field research. I look forward to the opportunity to investigate chemistry problems in the field as well as in the lab, where most of my previous research experiences have taken place. I plan to pursue research related to environmental contamination in graduate school, would like to explore this type of research in my remaining time at William & Mary. I am excited by the opportunity to conduct research here in Williamsburg, and investigate a problem that directly impacts my community.

### **Section 3:** *Explain the relevance of this work in the greater scheme of things / to people besides you and your advisor. Do not use jargon.*

Coal remains a major source of energy in our state and in our country, and the coal cycle has a tremendous impact on the environment, from mining to combustion. This research will investigate another part of the coal cycle – the transport of coal on railways. Coal dust contains a number of metals that can be detrimental to the health of people and ecosystems, by impacting air and water quality and the health of ecosystems. While my project will study coal dust in forest vegetation, the results of my project will be relevant to anyone who resides along train tracks that carry coal, or who obtains agricultural products from farmland adjacent to these tracks. The accumulation of coal dust along railroad tracks has important implications for the ecosystem health and air quality of these areas.

**Section 4:** *What coursework or other experience have you had that has helped prepare you to conduct the research you are proposing?*

As a chemistry major and environmental science major, I have taken a number of courses that have prepared me for this research. In addition to courses in inorganic and analytical chemistry, I have taken courses in geochemistry, geology and biology, coursework that has prepared me to analyze chemical problems in the context of ecosystems. I have worked in chemistry labs for the past three summers, and have gained a familiarity with chemical instrumentation through these experiences. I have also been introduced to field research methods through my geochemistry and biology classes. I am familiar with GIS software, which I will use to help establish connections between land use and my collected data.

**Section 5:** *Discuss your methodology. What is your research plan? Where do you propose to conduct the research and why is it necessary to be there? Describe the timeline, making sure that the project lasts a minimum of seven full-time weeks.*

My research will take place at William & Mary, and I will be sampling areas along railroad tracks in the vicinity of the College, as well as taking control samples from other areas in the College Creek watershed. I will obtain samples from low-hanging vegetation over the railroad tracks, and obtain control samples from the same species of vegetation elsewhere in the College Creek watershed. Since vegetation does not typically contain metals that are enriched in coal, these samples will provide a baseline for measuring contamination in vegetation adjacent to train tracks.

I will use acid digestion methods to digest plant samples, and assess levels of metals in the acid using spectroscopic techniques. The exact techniques of acid digestion and analysis may differ based on what metals are found to be present in initial samples, and their relative temperatures of volatilization. Coal is enriched in a number of metals, including arsenic, mercury, copper, zinc, lead, nickel, molybdenum, and selenium.<sup>3,4,5</sup> Initial analysis using ICP-MS (Inductively coupled plasma mass spectrometry), which can measure a number of metals simultaneously, will help to determine which metals present in the highest levels. This will allow me to focus further analysis on a smaller suite of metals. As the project advances, methods will be devised to test selectively for metals that are contained in coal dust residue on the surface of plants, to distinguish between coal dust deposits and any uptake that has occurred from the soil.

GIS software will be used to determine sampling areas, and to map results. Using GIS, I will investigate correlations between levels of metals in vegetation and land use of the area. Samples will be taken directly adjacent to the tracks, and at distances ranging to 500 meters, to determine the range of coal dust effects.

The project will begin with initial sampling along the railroad tracks and analysis to determine the most highly accumulated metals. Within the first few weeks of summer, I will strive to narrow my metal list to a few highly present metals that I will sample for more extensively throughout the rest of the session. As the summer progresses, I will analyze my collected data using GIS software for measurable correlations between land use and metal accumulation.

**Section 6:** *Describe your final product. Consult with your Monroe project advisor on the format that is most appropriate to your project and discipline. While the final product may be an academic paper (written in accordance with the standards, expectations, and format of the discipline), it might also be something else such as a creative work (novel, painting, etc.).*

My final product for the summer will be a research report containing my findings, including numerical data and maps created using GIS software. I will maintain a laboratory notebook with recorded data, which will then be compiled into a report.

**Section 7:** *Will this project lead to further work, such as continued lab work, an independent study during the academic year, a portfolio, or, eventually, an Honors project? Describe.*

I plan to continue this summer research throughout my senior year as an Honors Project. As I continue the project through the year, I will continue to sample my study areas, and perform more extensive analysis of the data I have gathered. Depending on my findings, I may extend my study area to include new areas with different land uses. I will also use laboratory methods to determine the extent to which metal accumulation is related to surface deposition, as opposed to metal uptake from the soil.

#### References:

1 BNSF Railway (2012). *Coal dust frequently asked questions*. Retrieved from <http://www.bnsf.com/customers/what-can-i-ship/coal/coal-dust.html>

2 Hocutt, C.H. (2011). *Comments on Public Notice POA-2007-1586: The proposed Port Mackenzie Railroad extension, Knik Arm, Upper Cook Inlet, Alaska, with emphasis on Fisheries and Cook Inlet Beluga Whale*. On behalf of the Appalachian Center for the Economy and the Environment. Retrieved from [http://www.stb.dot.gov/filings/all.nsf/6084f194b67ca1c4852567d9005751dc/ebbcb6a8311b2d1852578cc00725697/\\$FILE/Exhibit%204%20Hocutt%20report.pdf](http://www.stb.dot.gov/filings/all.nsf/6084f194b67ca1c4852567d9005751dc/ebbcb6a8311b2d1852578cc00725697/$FILE/Exhibit%204%20Hocutt%20report.pdf)

3 Diehl, S.F., Goldhaber, M.B., Hatch, J.R. (2004). Modes of occurrence of mercury and other trace elements in coals from the warrior field, Black Warrior Basin, Northwestern Alabama. *International Journal of Coal Geology* 59, pp 193-208. Retrieved from <http://blackwarriorriver.org/pdf/Coal%20Geology%20Article.pdf>

4 Diehl, S.F., Goldhaber, M.B., Koenig, A.E., Lowers, H.A., Ruppert, L.F. (2012). Distribution of arsenic, selenium, and other trace elements in high pyrite Appalachian coals: Evidence for multiple episodes of pyrite formation. *International Journal of Coal Geology* 94, pp 238-249. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0166516212000249>

5 Kolker, A. (2012). Minor element distribution in iron disulfides in coal: A geochemical review. *International Journal of Coal Geology*, 94. Pp 32-43. Retrieved from <http://www.sciencedirect.com/science/article/pii/S016651621100228X>