# *Thank you for your commitment to green initiatives at the University of Illinois. One of the final steps in completing the terms of the funding agreement for your project is the submission of a Final Report with key information about your project. You will also need to submit a detailed report of expenses (if you don't list it within this document) as well as supporting photos to showcase your project.*

# *Please be as accurate as possible in describing the project (including possible setbacks or challenges in meeting the initial goals of the project). Not fully meeting your project's goals will not disqualify you from making future funding requests as long as your reports are as complete and accurate as possible. If you have any questions, please contact the Student Sustainability Committee, at* *sustainability-committee@illinois.edu**.*

**Project Name:** Environment-friendly phosphorus filter from fly ash

**Date of Report Submission:** 12/15/2018

**Project Purpose:**

The aim of this project is to develop ceramic pellets using fly ash and other additives to remove dissolved phosphorus. The outcome of this research will reduce fly ash disposal to the landfill, improve water quality due to a reduction in phosphorus pollution, and also train undergraduate students in research.

**Project Summary:**

Phosphorus (P) has been recognized as the limiting nutrient for eutrophication in most freshwater systems. Natural materials and industrial byproducts such as blast furnace slag, iron oxide tailings, coconut shell-activated carbon, zeolite, goethite, bone char, and biochar have been frequently used to facilitate P removal via sorption and precipitation. Fly ash is another potential P filter material since it is rich in Ca, Fe, and Al oxides. The *specific objectives* of this proposed research project are to: a) optimize the proportion of fly ash and other additives for high P removal and limit heavy metal leaching, b) conduct laboratory experiments to analyze the performance of pellet for dissolved P reduction. The outcome of this research will provide multiple environmental and educational benefits such as a reduction in fly ash disposal to the landfill, improved water quality due to a reduction in phosphorus pollution, and preparing the future generation of scientists and engineers who are well versed in the area of pollution control.

**Summary of Project Expenditures:**

Total Budget: $8350, Total Expenses: $4132.62 (Undergrad hourly: $3867.65, Materials & Supplies: $264.97)

Please see attached spreadsheet for the expenses details.

**Project Progress**

During the summer and fall 2017, we manufactured fly ash pellets and used them in a laboratory experiment to evaluate the performance in removing dissolved phosphorus in the water. We built a laboratory-scale bioreactor and filled the two chambers with woodchips and pellets to remove both nitrogen and phosphorus from the water. The results of this experiment were promising. We published a journal article based on the experiment that we conducted during the 2017-fall semester (please see attached pdf file: Li et al., 2018).

During the spring and summer of 2018, we manufactured a new set of pellets using fly ash, bottom ash, and foaming agents to improve the effectiveness. We evaluated the performance of these new pellets in removing dissolved phosphorus in the water. The results from these experiments indicated that bottom ash might be a better alternative compared to fly ash. We published a journal article based on the experiment that we conducted during the 2018-spring and summer semesters (please see attached pdf file: Zhou et al., 2019).

In addition to the two above mentioned journal articles, we also submitted two research proposals, one to the United States Environmental Protection Agency (US EPA) and the US Department of Agriculture (USDA) for the field testing of the pellets. Unfortunately, both proposals were not funded even though they were received well by the reviewers.

**Problems/Challenges Encountered**

The original deadline for the project was May 15, 2018. We made a new batch of fly ash pellets in the 2018 spring student but did not have time to evaluate it. Therefore, I requested a no-cost extension of the project until August 31, 2018, which was approved by SSC. As I was also able to leverage the support from other sources for this work, I had budget leftover from SSC support. I was able to recruit an undergraduate to work over the 2018 summer to do P absorption and desorption tests.

**Student Involvement and Outreach to Date:**

During fall 2017, an undergraduate hourly worked on this project. The laboratory experiment was conducted by a postdoc working in my lab, and the student helped in water sample collection and analysis. This arrangement helped to leverage the support from SSC with a postdoc to conduct the laboratory experiment.

During the spring and summer of 2018, the laboratory experiment was conducted by a visiting scholar working in my lab, and the undergraduate student helped in water sample collection and analysis.

**Marketing and Promotion Efforts to Date:**

Using the SSC support, we were able to collect preliminary data and publish two journal papers (please see attached pdf files: Li et al., 2018 and Zhou et al., 2019). We acknowledged the support of SSC on those articles.

In addition to the two above mentioned journal articles, we also submitted two research proposals, one to the United States Environmental Protection Agency (US EPA) and the US Department of Agriculture (USDA) for the field testing of the pellets. Unfortunately, both proposals were not funded even though they were received well by the reviewers.

**Additional Comments:**

Any additional comments/relevant information for this report

In addition to the above fields, please provide a detailed accounting of how the funding was spent as well as pictures of the final project in an email to sustainability-committee@illinois.edu. Thank you again for your commitment to sustainability.