

Rec  
10/5/15

1



## MTSU Clean Energy Initiative Project Funding Request

There are five (5) sections of the request to complete before submitting. See <http://www.mtsu.edu/sga/cleanenergy.shtml> for funding guidelines. Save completed form and email to [cee@mtsu.edu](mailto:cee@mtsu.edu) or mail to MTSU Box 57.

1. General Information	
Name of Person Submitting Request	
<b>Dr. Mary Farone</b>	
Department/Office	Phone # (Office)
<b>Biology</b>	<b>904-8341</b>
MTSU Box #	Phone # (Cell)
<b>MTSU Box 0060</b>	
E-mail	Submittal Date
<b>Mary.farone@mtsu.edu</b>	<b>October 5, 2015</b>

2. Project Categories (Select One)			
Select the category that best describes the project.			
<input checked="" type="checkbox"/>	Energy Conservation/Efficiency	<input checked="" type="checkbox"/>	Sustainable Design
<input type="checkbox"/>	Alternative Fuels	<input type="checkbox"/>	Other
<input type="checkbox"/>	Renewable Energy		

3. Project Information	
<p>a. Please provide a brief descriptive title for the project.</p> <p><b>b. The project cost estimate is the expected cost of the project to be considered by the committee for approval, which may differ from the total project cost in the case of matching funding opportunities. Any funding request is a 'not-to-exceed' amount. Any proposed expenditure above the requested amount will require a resubmission.</b></p> <p>c. List the source of project cost estimates.</p> <p>d. Provide a brief explanation in response to question regarding previous funding.</p>	
3a. Project Title	
<b>Bioremediation of Parking Lot Runoff for Stormwater Reclamation</b>	
3b. Project Cost Estimate	
Bioremediation Project Total Request	\$8859.00

Modern Water RaPID Assay Carcinogenic PAHs	\$ 1,100.00
Supelcosil LC-PAH HPLC Column	\$700.00
HPLC Vials	\$ 325.00
Strata X Solid Phase Extraction 100 ct 1 mL tubes	\$ 600.00
Fisher Scientific HPLC Grade Acetonitrile (5 L)	\$ 500.00
Fisher Scientific Certified ACS Methanol (2 L)	\$ 200.00
Millipore syringe microfilters 100 ct	\$ 250.00
Soil DNA extraction reagents	\$ 494.00
Bacterial sequencing primers	\$ 150.00
Bacterial sequencing reagents	\$ 1540.00
Disposable micropipette tips	\$ 1000.00
Gene Cloning Kit	\$1000.00
Bacterial growth reagents and supplies	\$1000.00
3c. Source of Estimate	
EPA; Fisher Scientific Co.; GE Healthcare; Illumina; JJS, research publications	
3d. If previous funding from this source was awarded, explain how this request differs?	
This project has not been previously funded.	

#### 4. Project Description

(Completed in as much detail as possible.)

- a. The scope of the work to be accomplished is a detailed description of project activities.
- b. The benefit statement describes the advantages of the project as relates to the selected project category.
- c. The location of the project includes the name of the building, department, and/or specific location of where the project will be conducted on campus.
- d. List any departments you anticipate to be involved. Were any departments consulted in preparation of this request? Who? A listing may be attached to this form when submitted.
- e. Provide specific information on anticipated student involvement or benefit.
- f. Provide information for anticipated future operating and/or maintenance requirements occurring as a result of the proposed project.
- g. Provide any additional comments or information that may be pertinent to approval of the project funding request.

##### 4a. Scope: Work to be accomplished

We propose to perform a metagenomic survey of soil bacteria present in the stormwater basins on MTSU campus. After the survey, supplementation will be performed to test for increased abundance of bacteria capable of remediating hydrocarbons that are common contaminants from automobiles. Additional plate based assays to enrich and grow bacteria of interest for more detailed analysis will be performed.

To assess degradation of hydrocarbons that are present, bacterial cells from the hydrocarbon plates will be grown in minimal broth containing hydrocarbons as the only nutrient source. The degradation of hydrocarbons in the supernatants will be measured using an enzyme-linked immunosorbent assay (ELISA). This assay method will also be used to test hydrocarbon contamination present in the soil of the rainwater basin before and after supplementation. These samples will be further analyzed by HPLC, Gas and Mass spectroscopy techniques.

##### 4b. Scope: Benefit Statement

Developing appropriate management for stormwater reclamation results in a multifaceted benefit for MTSU and Murfreesboro community at large. The use of stormwater storage basins as holding vessels for stormwater may provide habitat for wildlife, such as waterfowl. These storage basins may serve as water features which will greatly increase the aesthetics of campus. Additionally, the water contained in these basins may also provide a useful reservoir that will be used for irrigation of MTSU grounds allowing for improved landscaping and healthier green spaces.

In addition to aesthetic improvements, by holding stormwater in

reserve, the volume of rainwater received by Murfreesboro stormwater system will be greatly reduced. The reduction in stormwater volume will lead to a reduction in the operating cost for the city of Murfreesboro. These savings may be passed onto MTSU in the form of Stormwater User Fee Credits. All of these benefits are contingent on the appropriate management of MTSU's stormwater collection.

The goals of this study are to determine the population of soil organisms present in the rainwater basin adjacent to the science building and to improve the bioremediation potential of native soil organisms. These studies will allow for the development of supplementation strategies to increase the prevalence of bacteria capable of degrading petroleum hydrocarbons present in runoff from parking lots. This means that the water in the basin and downstream watershed will have reduced amounts of contaminating hydrocarbons. The improved water quality may allow MTSU to develop stormwater basins onsite that are utilized for irrigation where non-potable water is a viable option. This leads to increase reclamation of rainwater runoff, thereby decreasing the volume of stormwater processing required. MTSU would benefit by having a reduced energy footprint in the community. Therefore, this study of oil-degrading bacteria is part of environmentally friendly and energy-efficient means of improving water consumption at MTSU.



#### 4. Project Description (continued)

##### 4c. Location of Project (Building, etc.)

Science Building

Department of Biology

2080- for general lab procedures

2070- sequencing

2093- data analysis

Department of Chemistry

3080- for chemical analysis

Stormwater basin adjacent to Science building and Alumni Dr.

##### 4d. Participants and Roles

Dr. Mary Farone MTSU Biology- Project Director and Soil metagenomics and supplementation studies

Dr. Anthony Farone MTSU Biology- Oversee ELISA based testing

Dr. Paul Kline MTSU Chemistry- Oversee HPLC based analysis

##### 4e. Student participation and/or student benefit

Brock Arivett – PhD student – MTSU Department of Biology

Undergraduate students from the Biology and Chemistry Departments will be recruited to participate in the research. The project will allow students to gain research hours for credit towards their degree, provide them with opportunities to apply for URECA funding, and present their research.

Brock, under the supervision of Drs. Mary and Tony Farone, would carry out experiments necessary for the metagenomic survey for the bioremediation of petroleum hydrocarbons and will be involved in the characterization of bacteria under different supplementation conditions. Brock and other students will also perform sequence analyses.

Under the guidance of Dr. Kline, Brock and undergraduate students

will perform the necessary experiments in chromatography and spectrometry to further quantitate hydrocarbons present in the soil to assess the success of bacterial remediation.

The students will gain knowledge skills, and experience in scientific research. Included in the techniques the students will master in this work are the operation and data analysis of mass spectral data, enzyme-linked immunosorbent assay (ELISA), DNA sequencing, and bioinformatics analysis.

The MTSU campus, surrounding watersheds, and the community at large will benefit from improved bioremediation and reclamation of rainwater runoff. Reduced energy expenses will be realized because of the reduced volume of stormwater treatment, a major expense for municipalities such as Murfreesboro.

#### 4f. Future Operating and/or Maintenance Requirements

Future operating requirements may involve the addition of foliage, such as reed plants, with remediating bacteria to drainage basins that are known to work in synergy to improve remediation. This would be low initial cost and would likely be a self-propagating system.

Maintenance requirements could involve the installation of pumps into stormwater basins for the collection and distribution of water to be used for irrigation across campus. This would be an infrastructure project outside the scope of this proposal.

#### 4g. Additional Comments or Information Pertinent to the Proposed Project

## 5. Project Performance Information

Provide information if applicable.

- a. Provide information on estimated annual energy savings stated in units such as kW, kWh, Btu, gallons, etc.
- b. Provide information on estimated annual energy cost savings in monetary terms.
- c. Provide information on any annual operating or other cost savings in monetary terms. Be specific.
- d. Provide information about any matching or supplementary funding opportunities that are available. Identify all sources and explain.

5a. Estimated Annual Energy Savings (Estimated in kW, kWh, Btu, etc.)

5b. Annual Energy COST Savings (\$)

Stormwater reuse is very cost effective and used by many communities and utilities in Florida and California as well as universities, such as Rutgers University and the University of Nebraska. Water costs for stormwater reuse range from \$0.12 - \$0.50 per kgal (thousand gallons) versus \$2.00 - \$5.00 per kgal for potable water. The University of North Carolina at Chapel Hill was able to incorporate non-potable sources to account for 27% of its water usage annually.

If MTSU is able to use 27% reclaimed water, a substantial savings would be realized by the university.

5c. Annual Operating or Other Cost Savings. Specify. (\$)

This study would be complimentary to MTSU Stormwater Program that is co-permitted with the City of Murfreesboro. The reduction, if any, because of improved bioremediation is uncertain.

5d. Matching or Supplementary Funding (Identify and Explain)

The Biology and Chemistry Departments will provide funding in the form of additional supplies and available equipment.

---