OMB Number: 4040-0004
Expiration Date: 03/31/2012

Application for Federal Assistance SF-424

* 1. Type of Submission:	* 2. Type of Application:	* If Revision, select appropriate letter(s):
☒ Preapplication	☒ New	
☐ Application	☐ Continuation	* Other (Specify):
☐ Changed/Corrected Application	☐ Revision	

* 3. Date Received:	4. Applicant Identifier:
07/15/2013	

5a. Federal Entity Identifier:	5b. Federal Award Identifier:
	14-DG-11132540-098

State Use Only:

6. Date Received by State:	7. State Application Identifier:

8. APPLICANT INFORMATION:

* a. Legal Name:	The University of Tennessee
* b. Employer/Taxpayer Identification Number (EIN/TIN):	62-6001636
* c. Organizational DUNS:	0033878910000

d. Address:

* Street1:	1534 White Avenue
Street2:	
* City:	Knoxville
County/Parish:	Knox
* State:	TN: Tennessee
Province:	
* Country:	USA: UNITED STATES
* Zip / Postal Code:	37996-1529

e. Organizational Unit:

Department Name:	Division Name:
Office of Sponsored Programs	Office, Research & Engagement

f. Name and contact information of person to be contacted on matters involving this application:

Prefix:	Ms.	* First Name:	Barb
Middle Name:			
* Last Name:	Wygant		
Suffix:			

Title:	Sponsored Programs Administrator
Organizational Affiliation:	
* Telephone Number:	865-974-3466
Fax Number:	865-974-2805
* Email:	utkegrants@utk.edu

Application for Federal Assistance SF-424

*** 9. Type of Applicant 1: Select Applicant Type:**

H: Public/State Controlled Institution of Higher Education

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

*** 10. Name of Federal Agency:**

Forest Service

11. Catalog of Federal Domestic Assistance Number:

10.675

CFDA Title:

Urban and Community Forestry Program

*** 12. Funding Opportunity Number:**

USDA-FS-UCF-01-2014

* Title:

2014 National Urban and Community Forestry Grant Program

13. Competition Identification Number:

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

Add Attachment | Delete Attachment | View Attachment

*** 15. Descriptive Title of Applicant's Project:**

Stormwater Goes Green? Investigating the Benefit and Health of Urban Trees in Green Infrastructure Installations

Attach supporting documents as specified in agency instructions.

Add Attachments | Delete Attachments | View Attachments

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant: TN-002 | b. Program/Project: TN-all

Attach an additional list of Program/Project Congressional Districts if needed.

Add Attachment | Delete Attachment | View Attachment

17. Proposed Project:

* a. Start Date: 09/01/2014 | * b. End Date: 08/31/2018

18. Estimated Funding ($):

* a. Federal	200,322.00
* b. Applicant	201,379.00
* c. State	0.00
* d. Local	0.00
* e. Other	9,450.00
* f. Program Income	0.00
* g. TOTAL	411,151.00

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

☐ a. This application was made available to the State under the Executive Order 12372 Process for review on .

☐ b. Program is subject to E.O. 12372 but has not been selected by the State for review.

☒ c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes," provide explanation in attachment.)**

☐ Yes ☒ No

If "Yes", provide explanation and attach

Add Attachment | Delete Attachment | View Attachment

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 218, Section 1001)**

☒ ** I AGREE X Miriam Campo 3/24/14

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: Ms. | * First Name: Miriam

Middle Name:

* Last Name: Campo

Suffix:

* Title: Director, Office of Sponsored Programs

* Telephone Number: 865-974-3466 | Fax Number: 865-974-7400

* Email: utkegrants@utk.edu

* Signature of Authorized Representative: Miriam Campo | * Date Signed: 07/15/2013

ABSTRACT:

Trees have many important functions within the urban environment including air quality improvements, wildlife habitat, and mitigation of the heat island effect; however, their contribution to green infrastructure used for stormwater management is not well understood. There is a critical need to understand the health and role of trees in these systems (specifically compared to other vegetation types) to enable urban foresters and engineers to select the most appropriate plant material to maximize functionality of natural stormwater treatment systems. The goal of this project is to demonstrate the role of trees in bioretention areas in the eastern United States and beyond, and to make recommendations regarding system design and tree species selection to maximize bioretention area functionality and tree health. Tree health and function will be quantified using a field survey of existing systems, a laboratory experiment to compare tree performance to other types of vegetation, and a field performance study of tree-specific stormwater treatment devices. Based on the results of these studies, design guidelines will be developed which explain how best to integrate trees into bioretention areas. These guidelines will be distributed through various internet media, readily available electronic fact sheets, and nationally promoted webinars.

Proposal Narrative Template: *(The Innovation proposal narrative is not to be more than 10 single spaced pages.) Please make sure each page is numbered.*

1. Project Description:

This project will study green infrastructure as a means to manage and mitigate stormwater runoff to improve water quality and restore hydrology. Specifically, the role and health of trees within green infrastructure will be explored, allowing scientific justification for promoting their use in green infrastructure applications. This topic is of national interest given the number of communities in the United States currently under U.S. EPA regulation for stormwater, and the increasing interest in sustainable, natural treatment systems for stormwater.

With the onset of National Pollutant Discharge Elimination System (NPDES) regulations for urban stormwater discharges, municipalities and counties throughout the United States are establishing and refining their stormwater management programs. As part of these programs, green infrastructure approaches are becoming increasingly common as the social, monetary, ecological, and water quality benefits of these methodologies are discovered. Of the green infrastructure approaches utilized for stormwater management, none have gained more notoriety or experienced such widespread acceptance nationally as bioretention areas (sometimes known as rain gardens).

Bioretention areas consist of a sandy soil media underlain by a drainage layer of rock and perforated pipe. These systems are either planted with turf grass, or topped with mulch and planted with trees, shrubs, and grasses. Stormwater enters the system, fills the bioretention basin, and slowly infiltrates into the soil media where it can be filtered, be taken up by plants, be slowly released, evapotranspirate, and/or seep into subsoils. Numerous studies have been performed which document their ability to mitigate the hydrologic and water quality effects of stormwater runoff (Lucas and Greenway 2008, Hutchinson et al. 2011, Pham et al. 2012).

Unfortunately, fairly little thought is given to plants within these systems. Design manuals from states and municipalities often focus solely on selecting plants which will survive the harsh cycle of drought and saturation in the soil media. This leads to a plant palette of turf grass, native grass, shrubs, and trees, which are essentially considered equal in terms of their contribution to the

effectiveness of the system, despite some studies which have shown that this is not the case (Read et al. 2008, Johnston and Balster 2010). While plant survival is an important aspect of bioretention design, knowledge of the specific role and benefit of various plants within bioretention areas is mostly lacking. Although the numerous benefits of trees in urban areas are understood, there is little incentive for regulators to promote them in bioretention areas without a more basic understanding of their role and performance compared to other types of vegetation. It should also be noted that guidance on bioretention design and plant selection is similar throughout the eastern United States. Thus, although this study is being performed in Tennessee and North Carolina, it has substantial national relevance.

This study aims to investigate the benefit and vitality of urban trees in green infrastructure through three studies: (1) a field survey of 50 bioretention areas in Tennessee and North Carolina to evaluate tree health in existing systems and contributing factors, (2) a laboratory mesocosm experiment to compare tree performance in bioretention areas to turfgrass, and (3) a field performance study of tree-specific stormwater treatment devices in Tennessee and North Carolina.

Study 1: A field survey of approximately 50 bioretention areas will be performed in Tennessee and North Carolina to assess tree health in existing systems. Although observing plant health after bioretention construction is a common maintenance activity for stormwater management professionals, no previous work was identified by the investigators in which the health of trees in numerous established bioretention areas was documented. Thus, the extent to which current bioretention designs, species selection, and planting and maintenance promote tree health is unknown. The goals of this study are to determine the overall health of trees planted in bioretention areas, and to determine which basic design parameters and species selections influence tree health. From this data, design specifications for bioretention can be generated which will aid in maximizing tree growth and health.

Tree health will be quantified through measurements of crown conditions (Schomaker et al. 2007). Crown class, position, density, dieback, live crown ratio, and foliar dieback will be estimated by two independent observers using the method of the US Forest Service (2009). Diameter at breast height (DBH), height, crown base, and crown diameter will be measured, and species will be recorded. Basal flare will be used to determine whether trees were planted at or below grade, and scarring of the lower stem from sunscald or mechanical damage will be noted. Leaf samples will be collected for analysis of foliar nutrients. Soil samples will be taken from each bioretention area and measured for pH, CEC, and macronutrient concentration. A particle size analysis will be performed to determine the ratio of silt, sand, and clay present in each system. The dimensions of the bioretention area, depth of soil media, location of tree planting within the area, and maximum level of standing water will be measured, and any shading from adjacent trees or buildings will be noted. Composite crown indicators will be calculated to allow for comparisons between species, and to express tree health on a plot level basis (Zarnoch et al. 2004). Multiple linear regression statistical analyses will be performed to determine if any explanatory variables (soil nutrient concentrations, bioretention media depth, soil media physical properties, soil volume, etc) influence tree health. Within-species analysis will also be performed to determine whether crown dieback or foliar transparency are correlated with any of the soil variables. A general linear model will be used to determine whether there are species differences in tree health, using measurements of crown dieback and foliar transparency which indicate high levels of tree stress.

Study 2: A controlled experiment utilizing mesocosms will be performed to elucidate the differences in performance among various types of vegetation in bioretention areas. As design guidance regarding plant selection for bioretention is not well supported by scientific observation, in particular for species native to the United States, this study will help quantify the pollutant removal and hydrologic benefits of trees in these systems. An understanding of tree function in bioretention systems will aid in assigning proper value to urban trees, adding to their acceptance and promotion in these systems.

Four bioretention mesocosm treatments and one control will be utilized in the experiment. The treatments and control will be replicated five times. The treatments will consist of varying the type of vegetation planted in the mesocosms, while the control mesocosms will remain unplanted. The approach is to test three tree species that differ in their seasonality of growth and rates of water and nutrient uptake, and compare these to a commonly used turfgrass, perennial ryegrass (*Lolium perenne*). Tree species will be selected for widespread use across the southeast and eastern United States, and their ability to tolerate both sandy soils and periodic flooding. Final selections will be informed by consultation with Urban Forestry South and initial assessments of tree health from Study 1. The mesocosms will be approximately 3.5 feet deep and filled with bioretention soil media, consistent with typical design guidance for most communities and states throughout the United States. Bioretention media is a very sandy (~85% sand) soil with approximately 7% fines (usually clay) and 8% organic matter. Sand and rock layers will be placed under the bioretention to facilitate draining of the system, quantification of seepage from the system, and water quality sample collection. One-year-old, bare-root trees will be obtained from a local nursery and planted into the mesocosms, and herbaceous species will be established from seed planted directly into mesocosms. Fertilizer, in the form of water-soluble 10:20:10 NPK at a rate equivalent to 50 kg/ha as recommended for a trees and forbs being planted on a primarily inorganic soil in this region (Burger et al. 2009), and a microbial inoculant will be applied at the time of planting. These will be maintained in a greenhouse where climate is controlled at seasonally average temperatures, watered twice weekly, and fertilized monthly at levels simulating typical stormwater inputs.

After six to twelve months of plant establishment in the mesocosms, the systems will be dosed with artificial stormwater on 16 occasions, four trials for each season over a year. Mid-morning transpiration rates will be measured through flooding cycle, where foliage is present. The amount of stormwater draining through the system will be quantified and sampled for water quality. Water quality samples will be tested for nitrogen species, phosphorus species, and metals. Effluent concentrations will be compared to those in the artificial stormwater to determine changes in water quality through each system. Seasonal differences in nutrient removal rates between vegetative treatments will be compared to determine the consistency of system performance. Effluent seepage volume will be compared to determine if the volume of stormwater retained by each system varies. Bioretention systems which maximize runoff retention are desirable as they reduce the amount of runoff entering receiving waters. Trees and grasses will be harvested after the final cycle in summer or fall, to determine leaf area and root system volume and distribution.

Green infrastructure is intended to mimic or restore the hydrology of developed areas to that of natural conditions. As natural hydrology is characterized by high amounts of evapotranspiration and infiltration, the degree to which evaporation and/or transpiration is promoted by various bioretention configurations is an important factor in determining its overall effectiveness. Load cells will be placed under three of the replicates for each mesocosm treatment and the control. These load cells will be used to determine changes in system weight prior to, during, and after each trial run. Changes in weight after a trial run can be used to quantify evapotranspiration rates for each bioretention mesocosm, and thus how various species compare.

An additional mesocosm study will be performed solely to evaluate differences in tree growth in two types of soil: bioretention media and tree planting media. Three mesocosms will be constructed with each soil type, with all six mesocosms being planted with the same tree species. Tree health will be measured quarterly throughout a two year period. These meoscosms are intended to support observations made in Study 3 on two Silva Cells being studied in Wilmington, NC, with varied soil type. Tree growth data will be paired with water quality and hydrologic data to determine if a given soil media performs best in all aspects studied in this project.

Study 3: Specialized types of green infrastructure controls which function similar to bioretention cells, but rely solely on trees for the vegetated component of the system, are being produced and implemented in North America. One such system is the Silva Cell, an "off the shelf" green infrastructure practice which promotes tree growth (by providing an uncompacted soil matrix) and is of interest for stormwater treatment applications (Figure 1). Stormwater from roadways and other impervious areas is routed through the Silva Cell soil media, where it is treated through interactions with the soil, tree roots, and microorganisms. Quantification of the performance of these systems would aid in promoting their use by engineers and designers in development applications. It should be noted that other, similar products exist that can be considered for this project.

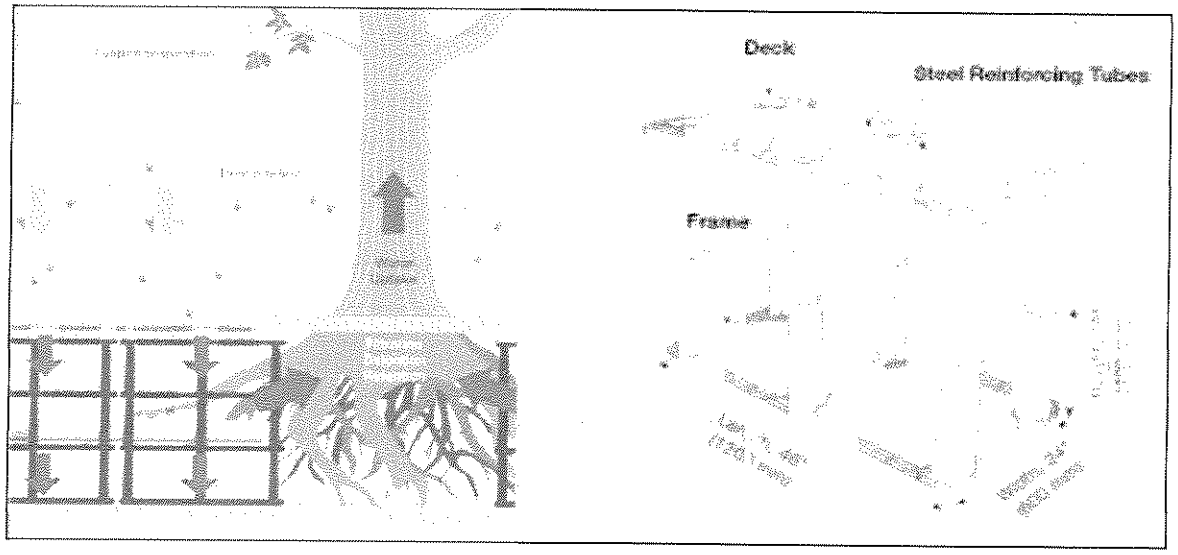

Figure 1: Typical cross-section of the Silva Cell suspended pavement system (www.deeproot.com)

Four Silva Cell (or similar system) installations will be monitored as part of this study. Two of the cells have been constructed in Wilmington, NC, and preliminarily studied for water quality treatment and stormwater runoff retention. Two additional cells will be constructed on the campus of the University of Tennessee at Knoxville and monitored similarly to those in Wilmington, NC. The goal of this study will be to document the performance of the Silva Cells, and thus give regulators scientific data with which to determine how to credit these systems as part of their MS4 management programs. For the systems in Wilmington, NC, addition insights can be gained by studying the systems nearly three years after installation and comparing their performance to

preliminary data collected over the first year of operation. It is expected that the trees will be large enough after three years to transpire substantially more water, improving their performance for urban hydrologic mitigation.

Stormwater flows will be monitored at the inlet and outlet of each system using weirs and automatic samplers with water level recorders. The automatic samplers will also be used to collected water quality samples from the inlet and outlet of each system, allowing a quantification of system performance. Samples will be tested for nitrogen species, phosphorus species, total suspended sediments, and metals. Comparisons will be made to bioretention cells studied in scientific literature to determine if Silva Cells and similarly designed stormwater controls (such as bioretention areas) can be considered equivalent in terms of stormwater management performance. Such observations will help remove the obstacle of determining how to credit these systems and will promote the usage of these products within the stormwater management community.

2. Originality and Innovation:

This research is original in its goal to elucidate the benefits of trees in green infrastructure utilized for stormwater management, a gap in the scientific knowledgebase that has not been well explored. Stormwater and green infrastructure design manuals nationwide give no regard to the potential differences in performance between various types of vegetation. This can be attributed, in part, to a lack of scientific knowledge as to how plant selection contributes to water quality improvements and hydrologic performance in bioretention areas utilized in green infrastructure systems. Few studies have evaluated the specific contributions of trees in bioretention areas, and those studies were performed in Australia with species native to that country. Further, no studies have identified the differences in evapotranspiration or seasonal effectiveness realized by various types of plants in these systems. As green infrastructure systems utilized for urban stormwater management are intended to replicate natural hydrology, determining the evapotranspiration rates of trees and other plants in bioretention cells is a timely and original research objective.

Finally, evaluating the ability of current bioretention area design standards to foster a desirable environment for urban trees in an innovative concept, expanding beyond the typical hydrologic and water quality analyses made on these systems. Consideration of bioretention as a component of the overall green infrastructure system is novel within the stormwater management community, yet bioretention areas have the potential to provide substantial habitat, shade, and other ecosystem services. The more conducive bioretention is for tree vitality, the more these benefits will be realized.

3. Literature Review

Bioretention cells have become a widely implemented and versatile stormwater management practice and component of green infrastructure systems nationwide. These devices have been shown to mitigate the hydrologic impacts of urban stormwater, and sequester numerous types of pollutants, including metals, nutrients, and sediment (Davis et al. 2009). However, there are numerous design characteristics of bioretention that may influence performance, yet have not been studied in detail. One such design parameter is plant selection (Davis et al. 2009). State design manuals for bioretention typically give basic guidance on plant selection based on aesthetics, species diversity, and basic knowledge on which plants can survive the repeated wetting / drying cycles experienced in these systems. Knowledge as to how various types of vegetation perform in bioretention areas will inform the plant selection process, allow better design guidance, and promote species with a high degree of performance.

Plant functional traits, such as transpiration rate and nutrient uptake rate, as well as the seasonal pattern of growth and/or function differ greatly between species. Evergreen conifers and broadleaved trees differ in anatomy, length of growing season, and leaf longevity, which influence the timing of maximum water use and nutrient uptake (Ewers et al. 2005). In a Missouri suburb, seasonal and total differences in evapotranpiration were found between land areas containing evergreen trees, broadleaved trees, and turfgrass (Peters et al. 2011), with grasses contributing more than trees to water flux. However, the authors note a great influence of climate and species. In Washington state, raingardens containing shrubs were found to reduce stormwater discharge by half compared to those containing turfgrass (Johnston and Balster 2010).

Plants have been shown to positively affect the performance of bioretention cells in column studies performed on species native to Australia by Read et al. (2008), Bratieres et al. (2008), and mesocosm studies by Lucas and Greenway (2008). Read et al. (2008) evaluated twenty native Australian species in a study to determine the influence of plant species on pollutant removal in bioretention areas. Species ranged from herbaceous species, to mat-forming shrubs, to small trees. Control columns were left unplanted. Significant differences were found between unplanted columns and those planted with the native species, supporting similar observations by Lucas and Greenway (2008) and Bratieres et al. (2008), and illustrating the value of plants as part of bioretention systems. Further analysis showed that variations in performance existed among species, with trees representing two of the top six performing plants. It should be noted that the columns utilized in the study by Reed et al. (2008) only contained approximately 14 inches of planting media. As tree roots can grow substantially deeper than this depth, and deeper relative to such species as turf grass, a shallow depth may not let the true effectiveness of trees be observed.

Both Reed et al. (2008) and Bratieres et al. (2008) illustrate how differences in plant physiology can influence performance. Thus, studies performed on species native to the United States, and for this study native to the Eastern United States, may yield varying results. None of the studies referenced above evaluated how hydrologic performance and evapotranspiration vary with plant species. These aspects of bioretention performance are considered as valuable as pollutant removal.

The hydrologic and water quality impacts of a single street tree have not been documented, but city-scale modeling suggests a healthy urban forest can have a modest impact on runoff volume. The urban forest in Dayton, Ohio (22% of municipal land cover) was estimated to reduce runoff volume by 7% when compared to a modeled scenario without any urban trees (Sanders 1986). Interception of rainfall is the primary mechanism by which street trees mitigate the impacts of urban runoff. Xiao et al. (1998) reported mean rainfall interception up to 36% during summer in California, and noted that interception factors were greatest during the water quality event (1 inch storm). However, the impact of trees receiving direct runoff from impervious surfaces could further modify urban hydrology; this has not yet been studied in the literature.

Two Silva Cell systems are currently being studied in Wilmington, NC for water quality improvement and hydrologic mitigation. One has sandy bioretention media (specifically targeting stormwater treatment) and the other has a tree planting media (specifically targeting tree health). For the purposes of the study, both systems were lined with an impermeable membrane, but soil storage has resulted in an approximately 25% volume reduction for the small watersheds (~0.1 acres). Reduction in TN and TP concentrations exceeded 50%, while TSS reductions were 62% and 86% for the two Silva Cell systems. Concentrations of copper, lead, and zinc – three common heavy metals in stormwater, were reduced by greater than 80%. These preliminary results show the potential to use Silva Cells for their combined benefits – stormwater treatment and urban forestry. Not only are stormwater benefits realized, but air quality and urban heat island

effects are ameliorated by urban trees, while simultaneously providing carbon sequestration and canopy interception benefits (Rosenfeld et al. 1998; Akbari et al. 2001).

4. Project planning and timeline

Project timeline:
9/1/2014 – 8/31/2018

Tasks	2014	2015				2016				2017				2018		
	Aug-Dec	Jan-Mar	Apr-June	July-Sept	Oct-Dec	Jan-Mar	Apr-June	July-Sept	Oct-Dec	Jan-Mar	Apr-June	July-Sept	Oct-Dec	Jan-Mar	Apr-June	July-Sept
Grant awarded																
Study 1																
Identify sites for field surveys																
Visit sites, collect measurements and samples																
Project assessment and revision if needed																
Compile data, analyze																
Study 2																
Construction of mesocosms																
Plant establishment																
Set up experiment, perform trials																
Project assessment and revision if needed																
Compile data, analyze																
Study 3																
Design of Silva Cells for Knoxville installation																
Build Silva Cells																
Install monitoring equipment																
Monitor sites, collect and analyze samples																
Project assessment and revision if needed																
Compile data, analyze																
Develop fact sheet, deliver webinar, deliver workshop																
Project assessment of technology transfer																
Manuscript preparation and reporting of results																

5. Product

In addition to producing an anticipated three peer reviewed journal articles and a detailed final report, a set of design guidelines (i.e. fact sheets) will be developed to help designers and regulators understand how best to integrate trees into green infrastructure for stormwater management. These design guidelines are expected to be the most useful and widely disseminated product of this study, and will document both the performance of trees in stormwater management systems and best practices for ensuring their health in green infrastructure applications for stormwater management. Specifically, tree selection, design parameters to ensure tree health, the performance of tree based stormwater management systems, and the shortcomings of current design standards will all be discussed. The guidelines will be made available for download on the U.S. Forest Service Urban and Community Forestry website, advertised on the U.S. Forest Service Twitter account, and broadcast through both the U.S. Environmental Protection Agency's (U.S. EPA) Green Infrastructure and National Pollutant Discharge Elimination System Listservs. The final product will be in a digital format to facilitate reaching a wide audience with ease.

6. Collaboration

The project team spans two nationally respected universities in the University of Tennessee at Knoxville and North Carolina State University. Studying sites across both states allows both greater national relevance, and collaboration with entities such as the City of Wilmington, NC, and the Facilities Services Division of the University of Tennessee Campus. Both will act as partners who will help build, monitor, and maintain the systems being studied as part of the field evaluation of this project. This project will reach out to underserved populations by working through the Knox County Adopt-A-Watershed Program (AAW) coordinated by the University of Tennessee's Water Resources Research Center. AAW is a cross-curricular, service-learning program that uses agiven school's watershed as a living laboratory. This program annually involves 20 to 25 teachers and about 1800 students, with greater than 50% coming from economically disadvantaged homes. Specifically, this program will expose the students of West High School to the benefits of trees, the need for stormwater management, and how scientific studies are performed. The tree growth vs. soil type mesocosm evaluations discussed under Study 2 will be implemented and run by students in this program. Last, the project team will include Dudley Hartel of Urban Forestry South, USDA Forest Service, who will help refine monitoring protocols related to tree health, help identify critical information needed by regional stormwater engineers, and help broadcast the study results and conclusions to a wider audience

7. National Distribution/Technology Transfer of Findings

After receiving feedback from reviewers, the investigators revisited the distribution plan and agreed that the outreach component of the pre-proposal was too focused on targeting U.S. Forest Service employees, who are already well aware of the benefits of urban trees and green infrastructure. The team has re-designed the outreach plan to focus on national dissemination of the project objectives, results, and recommendations to designers, planners, and regulators. National media outlets such as Twitter and email listservs will still be utilized to inform stakeholders of this project and its products. However, in addition to posting the digital version of the design guidelines on the U.S. Forestry Service Urban and Community Forestry website, additional outlets have also been identified. As an Extension Specialist, Dr. Hunt has access to the national Cooperative Extension network (eXtension) where the project results and design

guidelines can be posted for use by Cooperative Extension employees across the country to educate the intended audience of designers, planners, and regulators.

Dr. Hunt will also include the information in his stormwater Best Management Practice design and performance training events, which are well attended, and have become nationally sought after. These workshops have taken place 58 times in the past 2 years in 9 states and 5 countries. Two (free) 2-hour webinar-style workshops documenting the project outcomes and design recommendations are still proposed, but a national audience will be targeted. The project team has experience delivering webinars through the U.S. EPA's Green Infrastructure Webcast Series, which could possibly be used as the conduit for promoting and delivering the presentations. Utilizing an established webinar series, such as this, would aid in disseminating the study to a wide audience, give the study national exposure, and draw upon established promotional avenues. The study results will be presented at a minimum of two national and/or international conferences to expose the scientific community to the findings. This will catalyze new research questions by the research community to continue to advance the science. Finally, results from this project are expected to be documented via multiple journal articles, further reaching national and international audiences.

Specific keywords for this study include: Trees, Stormwater, Green Infrastructure, Bioretention, Health, Mesocosm, Pollutants, Hydrology

8. Project Evaluation:

Formative evaluation of the project will be made at specific critical points in each of the three studies, as indicated in the timeline. Project collaborators will meet to discuss progress and initial results, and make appropriate changes to study designs and data collection based on preliminary tests, and any identified concerns. Summative evaluation will be included in the final project report, and will consist of the number of publications and presentations at professional meetings, evaluation of secondary and post-secondary student involvement in the project, and webinar attendance and evaluations. By the end of the fourth year of this project, two nationally advertised webinars will be presented. The webinars will target a minimum of 200 attendees. This is considered attainable based on discussions with non-profit organizations that perform similar webinars. As the targeted audience is generally familiar with webinars as a media for continued education, this method of reaching stakeholders is considered viable. Digital evaluation sheets will be sent to attendees to determine the perceived benefit of the training. Between the first and second trainings, the number of attendees and evaluations sheets will be compiled, analyzed, and used to improve the second training. This evaluation process and the success of the trainings will be described and documented in the project final report. This goal of educating a minimum of 400 professionals through 2 webinars within the four years of the study is considered specific, measurable, attainable, relevant, and time-bound (SMART).

9. Experience/Personnel/Adequacy of Resources:

An interdisciplinary team has been assembled for this project, including experts trained in forestry, ecological engineering, and stormwater management using green infrastructure. The project team includes Dr. Jon Hathaway (UTK), Dr. Jennifer Franklin (UTK), Dr. William Hunt (NCSU), and Dr. John Schwartz (UTK), each of which brings unique skills and expertise to this project. The project team has performed studies similar to all three research studies proposed

herein, providing valuable experience in field monitoring of stormwater treatment practices, mesocosm studies, and field surveys of stormwater practices. For instance, the project team has monitored over 50 stormwater practices for water quality and/or hydrologic performance over their careers. Further, with AAW having been in place for 17 years and being highly respected by Knox County School administrators, it will provide a programmatic structure for the project team to conduct a portion of their research with underprivileged high school students. Finally, the University of Tennessee has ample space for the mesocosm analyses at nearby research farms, and has confirmed its willingness to construct two stormwater practices on campus (as matching funds) to facilitate the field monitoring portion of this project. In short, a robust research team and partners have been assembled which is highly experienced, has the necessary resources, and is enthusiastic to perform this project.

10. Budget Justification:

The project team will cost share approximately 51% of the total project cost, including portions of salary, tuition, overhead, sample analysis, and Silva Cell design and construction. A Ph.D. student will be hired to oversee and perform the majority of this project. His/her duties will include visiting and taking measurements of trees in green infrastructure applications as part of Study 1, constructing and performing experiments on mesocosms as part of Study 2, and helping install and monitor the practices described in Study 3. After data is collected, the student will perform QA/QC, compile the data, analyze it, and document it in reports and peer reviewed journal articles. The Principal Investigators will assist with monitoring plans, experimental setup, data analysis, review all reports and articles, co-author the design guidance fact sheets, and help deliver webinars.

Travel costs consist primarily of mileage for visiting the substantial number of sites targeted for measurements under Study 1. Some overnight lodging will also be required due to the long distances traveled away from the University of Tennessee. Visits are tentatively planned for Nashville, Knoxville, and Chattanooga in TN, and Asheville, Charlotte, Greensboro, Durham, Raleigh, and Cary in NC.

Supplies for this study include soil sample analysis, water quality sample analysis, materials for mesocoms (soil media, containers, stone, plants), pressure transducers, load cells, and chemicals for making artificial stormwater. The automatic samplers required for Study 3 (approximately 6) are already owned by the project team, are in good condition, and will be redeployed for this project. Additional monitoring materials include miscellaneous metal, wood, tubing, and hardware required for construction and installation of equipment.

Overhead for the University of Tennessee is being waived by the University as cost share.

Budget Item	Quantity / Description	Federal Funds (requested)	Non-Federal Cash Match	Total	Source of Matching Funds
Personnel					
Hathaway - UTK	5% of salary for 4 yrs (3% inflation)	-	17,781	**17,781**	Univ. of TN
Schwartz - UTK	0.05% of salary for 4 yrs (3% inflation)	2,131	-	**2,131**	
PhD student - UTK	4 years (3% inflation)	63,085	28,955	**92,040**	Univ. of TN
Franklin - UTIA	4 years, $500/year	1,760	-	**1,760**	
undergrad - UTIA	20 hours per week, 24 weeks, $10/hour	5,184	-	**5,184**	
Labor from Facilities Services	Construction of Silva Cells	-	2,222	**2,222**	Univ. of TN
Fringe Benefits					
Hathaway - UTK	Fringe 35%	-	6,223	**6,223**	Univ. of TN
Schwartz - UTK	Fringe 34%	725	-	**725**	
PhD student - UTK	Health Benefits (5% inflation)	4,159	1,892	**6,051**	Univ. of TN
Franklin - UTIA	Fringe 26%	440	-	**440**	
undergrad - UTIA	Fringe 8%	320	-	**320**	
Benefits from Facilities Services	Fringe 35%	-	778	**778**	Univ. of TN
Travel					
Study 1 - Mileage	2564 miles, $0.47/mile	1,205	-	**1,205**	
Study 1 - Hotel and Per Diem	8 nights, $80/night hotel, $56 per diem	1,088	-	**1,088**	
Study 1 - Mileage	692 miles, $0.47/mile	325	-	**325**	
Supplies					
Study 1					
Sampling Materials	200	200	-	**200**	
Soil Analysis	50 Samples, $50/sample	2,500	-	**2,500**	
Study 2					
Mesocosm Materials	Soil, Rock, Containers, Plants	4,035	-	**4,035**	
Pressure Transducers	25 Transducers, $500/per	12,500	-	**12,500**	
Load Cells	15 Load Cells $500/per	7,500	-	**7,500**	
Materials	Mixing Tank, Pump, Metal for Weirs	3,650	-	**3,650**	
Sample Analysis	500 Samples, $50/sample	12,500	12,500	**25,000**	Univ. of TN
Study 3					
Materials	Metal for Weirs, Tubing, Tools	6,000	-	**6,000**	
Sample Analysis	40 Samples, $50/sample	2,000	-	**2,000**	
Materials from Facilities Services	Materials for Silva Cells	-	2,000	**2,000**	Univ. of TN
Contractual					
Subaward to NC State (Hunt)	Staff Salaries, Mileage, Sample Analysis	30,017	9,450	**39,467**	NC State Univ.
Other					
Tuition	4 years (6% inflation)	38,998	17,698	**56,696**	
Total Direct		**200,322**	**99,499**	**299,821**	
Indirect	-	-	111,330	**111,330**	
Total Costs		200,322	210,829	**411,151**	

BUDGET INFORMATION - Non-Construction Programs

OMB Number: 4040-0006
Expiration Date: 06/30/2014

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. National Urban and Community Forestry Challenge Cost Share Grant	10.675	$	$	$ 200,322.00	$ 210,829.00	$ 411,151.00
2.						
3.						
4.						
5. Totals		$	$	$ 200,322.00	$ 210,829.00	$ 411,151.00

Standard Form 424A (Rev. 7- 97)
Prescribed by OMB (Circular A -102) Page 1

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY (1)	(2)	(3)	(4)	Total (5)
	National Urban and Community Forestry Challenge Cost Share Grant	N/A			
a. Personnel	$ 72,160.00	$ 48,958.00	$	$	$ 121,118.00
b. Fringe Benefits	5,644.00	8,893.00			14,537.00
c. Travel	2,618.00	0.00			2,618.00
d. Equipment	0.00	0.00			
e. Supplies	50,885.00	14,500.00			65,385.00
f. Contractual	30,017.00	9,450.00			39,467.00
g. Construction	0.00	0.00			
h. Other	38,998.00	17,698.00			56,696.00
i. Total Direct Charges (sum of 6a-6h)	200,322.00	99,499.00			$ 299,821.00
j. Indirect Charges	0.00	111,330.00			$ 111,330.00
k. TOTALS (sum of 6i and 6j)	$ 200,322.00	$ 210,829.00	$	$	$ 411,151.00
7. Program Income	$	$	$	$	$

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SECTION C - NON-FEDERAL RESOURCES

	(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e)TOTALS
8.	National Urban and Community Forestry Challenge Cost Share Grant	$ 201,379.00	$ 0.00	$ 9,450.00	$ 210,829.00
9.					
10.					
11.					
12. TOTAL (sum of lines 8-11)		$ 201,379.00	$	$ 9,450.00	$ 210,829.00

SECTION D - FORECASTED CASH NEEDS

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$ 86,013.00	$ 21,504.00	$ 21,503.00	$ 21,503.00	$ 21,503.00
14. Non-Federal	$ 88,471.00	22,118.00	22,118.00	22,118.00	22,117.00
15. TOTAL (sum of lines 13 and 14)	$ 174,484.00	$ 43,622.00	$ 43,621.00	$ 43,621.00	$ 43,620.00

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

	(a) Grant Program	FUTURE FUNDING PERIODS (YEARS) (b)First	(c) Second	(d) Third	(e) Fourth
16.	National Urban and Community Forestry Challenge Cost Share Grant	$ 34,393.00	$ 28,658.00	$ 51,258.00	$
17.					
18.					
19.					
20. TOTAL (sum of lines 16 - 19)		$ 34,393.00	$ 28,658.00	$ 51,258.00	$

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges: $200,322

22. Indirect Charges: $0 (Cost Shared $75,877)

23. Remarks: Expenses in Budget Item H. are tuition payments for PhD student

ASSURANCES - NON-CONSTRUCTION PROGRAMS

Public reporting burden for this collection of information is estimated to average 15 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Office of Management and Budget, Paperwork Reduction Project (0348-0040), Washington, DC 20503.

PLEASE DO NOT RETURN YOUR COMPLETED FORM TO THE OFFICE OF MANAGEMENT AND BUDGET. SEND IT TO THE ADDRESS PROVIDED BY THE SPONSORING AGENCY.

NOTE: Certain of these assurances may not be applicable to your project or program. If you have questions, please contact the awarding agency. Further, certain Federal awarding agencies may require applicants to certify to additional assurances. If such is the case, you will be notified.

As the duly authorized representative of the applicant, I certify that the applicant:

1. Has the legal authority to apply for Federal assistance and the institutional, managerial and financial capability (including funds sufficient to pay the non-Federal share of project cost) to ensure proper planning, management and completion of the project described in this application.

2. Will give the awarding agency, the Comptroller General of the United States and, if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.

3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.

4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.

5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. §§4728-4763) relating to prescribed standards for merit systems for programs funded under one of the 19 statutes or regulations specified in Appendix A of OPM's Standards for a Merit System of Personnel Administration (5 C.F.R. 900, Subpart F).

6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C. §§1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. §794), which prohibits discrimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U.S.C. §§6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination on the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) §§523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. §§290 dd-3 and 290 ee-3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. §§3601 et seq.), as amended, relating to nondiscrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and, (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.

7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally-assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.

8. Will comply, as applicable, with provisions of the Hatch Act (5 U.S.C. §§1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.

9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. §§276a to 276a-7), the Copeland Act (40 U.S.C. §276c and 18 U.S.C. §874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§327-333), regarding labor standards for federally-assisted construction subagreements.

10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program and to purchase flood insurance if the total cost of insurable construction and acquisition is $10,000 or more.

11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§1451 et seq.); (f) conformity of Federal actions to State (Clean Air) Implementation Plans under Section 176(c) of the Clean Air Act of 1955, as amended (42 U.S.C. §§7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended (P.L. 93-523); and, (h) protection of endangered species under the Endangered Species Act of 1973, as amended (P.L. 93-205).

12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers system.

13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. §470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. §§469a-1 et seq.).

14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.

15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. §§2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.

16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§4801 et seq.) which prohibits the use of lead-based paint in construction or rehabilitation of residence structures.

17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act Amendments of 1996 and OMB Circular No. A-133, "Audits of States, Local Governments, and Non-Profit Organizations."

18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations, and policies governing this program.

SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL	TITLE
	Asst. Director of Sponsored Programs
APPLICANT ORGANIZATION	DATE SUBMITTED
The University of Tennessee	August 21, 2014

OMB APPROVAL NO. 0991-0002

U.S. DEPARTMENT OF AGRICULTURE

CERTIFICATION REGARDING DRUG-FREE WORKPLACE REQUIREMENTS (GRANTS) ALTERNATIVE I - FOR GRANTEES OTHER THAN INDIVIDUALS

This certification is required by the regulations implementing Sections 5151-5160, of the Drug-Free Workplace Act of 1988 (Pub. L. 100-690, Title V, Subtitle D; 41 U.S.C. 701 et seq.), 7 CFR Part 3017, Subpart F, Section 3017.600, Purpose. The January 31, 1989, regulations were amended and published as Part II of the MAY 25, 1990, Federal Register (pages 21681-21691). Copies of the regulations may be obtained by contacting the Department of Agriculture agency offering the grant.

(BEFORE COMPLETING CERTIFICATION, READ INSTRUCTIONS ON REVERSE)

Alternative I

A. The grantee certifies that it will or will continue to provide a drug-free workplace by:

(a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;

(b) Establishing an ongoing drug-free awareness program to inform employees about --

(1) The dangers of drug abuse in the workplace;

(2) The grantee's policy of maintaining a drug-free workplace;

(3) Any available drug counseling, rehabilitation, and employee assistance programs; and

(4) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;

(c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a):

(d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will --

(1) Abide by the terms of the statement; and

(2) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction;

(e) Notify the agency in writing, within 10 calendar days after receiving notice under subparagraph (d)(2) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position, title, to every grant officer on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice shall include the identification number(s) of each affected grant;

(1) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or

(2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency;

(g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (a), (b), (c), (d), (e) and (f).

Form AD-1049 (REV 5/90)
Microsoft Word 2000

U.S. DEPARTMENT OF AGRICULTURE

Certification Regarding Debarment, Suspension, and Other Responsibility Matters - Primary Covered Transactions

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 7 CFR Part 3017, Section 3017.510, Participants' responsibilities. The regulations were published as Part IV of the January 30, 1989 Federal Register (pages 4722-4733). Copies of the regulations may be obtained by contacting the Department of Agriculture agency offering the proposed covered transaction.

(BEFORE COMPLETING CERTIFICATION, READ INSTRUCTIONS ON REVERSE)

(1) The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:

(a) are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) have not within a three-year period preceding this proposal been convicted of or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

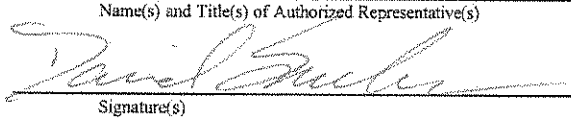
(d) have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

(2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

The University of Tennessee — Organization Name

Stormwater Goes Green? In — PR/Award Number or Project Name

David Smelser, Assistant Director - Office of Sponsored Programs — Name(s) and Title(s) of Authorized Representative(s)



Signature(s)

3-24-14

Date

Form AD-1047 (1/92)

B. The grantee may insert in the space provided below the site(s) for the performance of work done in connection with the specific grant:

Place of Performance (Street address, city, county, State, zip code)

The University of Tennessee - 415 John D Tickle Building

851 Neyland Drive

Knoxville, TN 37996-2313

Check ☐ if there are workplaces on file that are not identified here.

The University of Tennessee	Stormwater Goes Green? Investigating the Benefit and Health of Urban T
Organization Name	Award Number or Project Name

David Smelser, Assistant Director - Office of Sponsored Programs

Name and Title of Authorized Representative

David Smelser 3-24-14

Signature Date

Instructions for Certification

1. By signing and submitting this form, the grantee is providing the certification set out on pages 1 and 2.

2. *The certification set out on pages 1 and 2 is a material representation* of fact upon which reliance is placed when the agency awards the grant. If it is later determined that the grantee knowingly rendered a false certification, or otherwise violates the requirements of the Drug-Free Workplace Act, the agency, in addition to any other remedies available to the Federal Government, may take action authorized under the Drug-Free Workplace Act.

3. Workplaces under grants, for grantees other than individuals, need not be identified on the certification. If know, they may be identified in the grant application. If the grantee does not identify the workplaces at the time of application, or upon award, if there is no application, the grantee must keep the identity of the workplace(s) on file in its office and make the information available for Federal inspection. Failure to identify all known workplaces constitutes a violation of the grantee's drug-free workplace requirements.

4. Workplace identifications must include the actual address of buildings (or parts of buildings) or other sites where work under the grant takes place. Categorical descriptions may be used (e.g., all vehicles of a mass transit authority or State highway department while in operation, State employees in each local unemployment office, performers in concert halls or radio studios).

5. If the workplace identified to the agency changes during the performance of the grant, the grantee shall inform the agency of the change(s), if it previously identified the workplaces in question (see paragraph three).

6. Definitions of terms in the Nonprocurement Suspension and Debarment common rule and Drug-Free Workplace common rule apply to this certification. Grantees' attention is called, in particular, to the following definitions from these rules:

   ``Controlled substance'' means a controlled substance in Schedules I through V of the Controlled Substances Act (21 U.S.C. 812) and as further defined by regulation (21 CFR 1308.11 through 1308.15);

   ``Conviction'' means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes;

   ``Criminal drug statute'' means a Federal or non-Federal criminal statute involving the manufacture, distribution, dispensing, use, or possession of any controlled substance;

   ``Employee'' means the employee of a grantee directly engaged in the performance of work under a grant, including: (i) all ``direct charge'' employees; (ii) all ``indirect charge'' employees unless their impact or involvement is insignificant to the performance of the grant; and, (iii) temporary personnel and consultants who are directly engaged in the performance of work under the grant and who are on the grantee's payroll. This definition does not include workers not on the payroll of the grantee (e.g., volunteers, even if sued to meet a matching requirement; consultants or independent contractors not on the grantee's payroll; or employees of subrecipients or subcontractors in covered workplaces).

Certification Regarding Lobbying

(Submit this form attached to your SF-424 proposal)

Certification for Contracts, Grants, Loans, and Cooperative Agreements
The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with this Federal contract, grant, loan or cooperative Agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

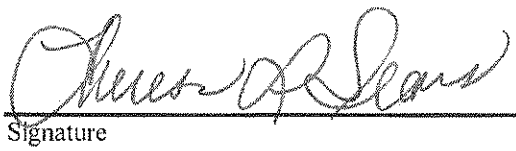
This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

The University of Tennessee "Stormwater Goes Green" 10.675

Organization Name | Project Name & CFDA Number

Theresa Sears, Assistant Director, Office of Sponsored Programs

Name and Title of Authorized Representative



Signature

8/6/14

Date