Forest Service use only.

Control Number: _____

COVER SHEET

2012 U.S. Forest Service
National Urban and Community Forestry Challenge Cost-Share Grant Program

Proposals are due by 11:59 PM Eastern Standard Time, December 1, 2011

INNOVATION GRANT CATEGORY:
(Estimated total amount available is **$900,000,** approximately $300,000 per category)
(Select only one)

- [x] How Management of Urban and Community Forests Can Help Mitigate Greenhouse Gas Emissions or Help Communities Adapt to Climate Change
- [ ] The Influence of Urban and Community Forests upon Public Health
- [ ] Urban and Community Forestry as Economic Development

PROJECT CONTACT NAME, ORGANIZATION, ADDRESS, PHONE NUMBER, FAX NUMBER AND **EMAIL ADDRESS**:

Bryant Scharenbroch
The Morton Arboretum
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PROJECT TITLE:

Carbon Sequestration and Resiliency of the Urban Forest

FUNDING REQUEST AND MATCH (Note: Matching amount must at a minimum equal requested amount.)

REQUESTED: $ 143,150 + MATCHING: $ 215,404 = TOTAL PROJECT: $ 358,554

OUTREACH:

Note: if one checks "Yes" in either of the boxes below, the applicant will be required to describe either how they plan to outreach to the identified population and/or provide a description of your underserved organization.

Is this project being developed to reach a minority or underserved population? ☑ Yes ☐ No

Is this pre-proposal being submitted by a minority or underserved population (owned/operated/directed) business, organization or college/university? ☐ Yes ☑ No

PROJECT PARTNERS:

NAME: Karel Jacobs

LETTER OF SUPPORT INCLUDED: YES ☑ NO ☐

NAME OF ORGANIZATION:

USTEP Program Chicago State University

MAILING ADDRESS 1:

9501 S. Martin Luther King Drive

CITY: Chicago STATE: IL ZIP CODE: 60628-1598

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60628-1598 kjacobs@csu.edu

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PROJECT PARTNERS Continued:

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LETTER OF SUPPORT INCLUDED: YES ☐ NO ☐

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ABSTRACT: Summarize the proposed project in 200 words or less.

The proposed collaborative project will further understanding of urban forest responses and mitigation potential related to projected climatic change. Currently, stakeholders lack a comprehensive understanding of carbon storage in urban ecosystems, resilience of urban forests to projected climatic fluctuations, and variation in both across an urban continuum. We aim to fill these important knowledge gaps by building upon existing regional-scale urban forest data-sets with intensive sampling of carbon storage in urban soils, dendrochronological analysis of urban tree growth resilience, and development and validation of an urban tree site index. The outcomes of this work will be a more complete understanding of urban ecosystem carbon sequestration and storage potential and likely response of urban trees to projected climate change across a metropolitan region. We will partner with a diverse team of scientists, educators, advocates, and policy-makers to produce and disseminate this knowledge, which is essential to maintaining and promoting the benefits of urban forests. Products will be made available to a diverse audience of professionals, public, and non-traditional partners through a variety of platforms including scientific and professional meetings and publications, education and outreach events, mailings, and interactive web-based tools. Total project cost is $358,554. Federal funding request is $143,150.

PROPOSAL OUTLINE: (The Innovation proposal is not to be more than 10 single spaced pages.) Please make sure each page is numbered and has the project title.

1. **Category Application**

2. Scope and Applicability/Justification- Proposal objectives:

3. Literature Review: (Appendix and cited in narrative where applicable)

4. Organization/Methodology:

5. Product:

6. Collaboration:

7. National Distribution/Technology Transfer of Your Findings:

8. Project Evaluation:

9. Experience/Personnel/Adequacy of Resources: (Appendix)

10. Budget and Funding (Appendix)

Attachments for Appendix:

SF 424, SF 424 (a) and SF 424 (b) (Make sure DUNS number is on SF424 form)
A copy of indirect cost rate or negotiated rate with cognizant Federal agency
List of Literature reviewed and cited. Make sure narrative statements based on the literature review is cited
Letters of Partnership from Partners
Letters of Support from Stakeholders

Proposal to 2012 U.S. Forest Service National Urban and Community Forestry Challenge Cost-Share Grant Program. Category 1. How Management of Urban and Community Forests Can Help Mitigate Greenhouse Gas Emissions or Help Communities Adapt to Climate Change

Due: March 28, 2012

Title: Carbon Sequestration and Resiliency of the Urban Forest

Authors: Bryant Scharenbroch, Ph.D., Soil Scientist[1,2]
Robert Fahey, Ph.D., Forest Ecologist[1]

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Abstract
The proposed collaborative project will further understanding of urban forest responses and mitigation potential related to projected climatic change. Currently, stakeholders lack a comprehensive understanding of carbon storage in urban ecosystems, resilience of urban forests to projected climatic fluctuations, and variation in both across an urban continuum. We aim to fill these important knowledge gaps by building upon existing regional-scale urban forest data-sets with intensive sampling of carbon storage in urban soils, dendrochronological analysis of urban tree growth resilience, and development and validation of an urban tree site index. The outcomes of this work will be a more complete understanding of urban ecosystem carbon sequestration and storage potential and adaptation potential of urban trees to projected climate change across a metropolitan region. We will partner with a diverse team of scientists, educators, advocates, and policy-makers to produce and disseminate this knowledge, which is essential to maintaining and promoting the benefits of urban forests. Products will be made available to a diverse audience of professionals, public, and non-traditional partners through a variety of platforms including scientific and professional meetings and publications, education and outreach events, mailings, and interactive web-based tools. Total project cost is $358,554. Federal funding request is $143,150.

Category Application

The proposed project relates to Category 1: how management of urban and community forests can help mitigate greenhouse gas emissions or help communities adapt to climate change. Research conducted in this project will directly address the role of urban and community forest resources in carbon (C) sequestration and the impact of climatic change on the health and sustainability of the urban forest. The project will provide new knowledge on the C sequestration potential of the urban forest and underlying soil and will validate anecdotal knowledge on the effects and values of the urban forest for climate change mitigation. This new information will be distributed to government and policy-makers to emphasize the previously unaccounted value, which will potentially translate into new economic value and jobs creation. The project will also provide information about the resilience of urban forests to climatic changes that could aid communities in planning how to increase the adaptability of their urban forests and avoid costs associated with the loss of poorly adapted urban trees. The many products (symposium, models/tools, non-technical and scientific publications, etc.) from this research will be distributed by a variety of methods to a broad spectrum of end-users throughout the country. The project will also act as a model for communities around the nation that are interested in obtaining information about urban forest C storage and resilience. The project will be performed by a diverse team of experts from non-profit, government, education, and commercial sectors of urban and community forestry. The project will produce results directly applicable to urban forests at the national, multi-state level, state, and city levels. The project will serve as a model and provide tools for others to assess the resiliency and C sequestration potential of urban and community forests.

Scope and Applicability

The proposed research has three broad objectives. *Objective I: Urban Forest Resilience and Climate Change*. This research will be used to assess how tree growth and sensitivity to soil and climate conditions vary across land-uses and species comprising the urban forest continuum. The project will be used to investigate the resilience of urban trees to extreme climatic events and edaphic constraints. The research will evaluate what specific growing conditions are related to urban tree productivity and the sensitivity and resilience of this productivity to environmental perturbations. This research will provide knowledge on the expected response of urban and community forests to a changing climate and how this response will vary as a function of soil and site conditions. This knowledge will be essential to communities as they work to adapt their forests to projected climate change and could help communities avoid costly replacement of trees that do not respond well to more extreme climate conditions. *Objective II: Carbon Sequestration of Urban Tree and Soils*. The research will provide unique data on C sequestration of urban trees and soils. A significant knowledge gap exists in our knowledge of urban soil C storage and turnover. The project will serve as model to include soil organic C (SOC) storage in C sequestration models for urban and community forests. The data collected in the proposed research will be shared with the USDA Forest Service scientists with the intent of improving the current i-Tree urban forestry analysis and benefits assessment tools to include soil C sequestration. *Objective III: Urban Site Index*. The proposed research will be used to validate an Urban Site Index (USI). Collaboration between the Morton Arboretum Soil Science (MASS) laboratory and the Ohio Department of the Natural Resources has created a preliminary minimum data set to evaluate urban sites. The project will test this field-based toolbox for its

ability to evaluate urban site in relation to tree health. The USI will be an invaluable for matching site characteristics with vegetation tolerances to maximize the urban forest health.

The national target audience of the research includes all stakeholders with an interest in urban and community forestry. Although this proposed work is regionally focused, the project and its many products will have an impact at the national level. The proposed research will be a model for other cities who wish to investigate the C sequestration and resiliency of their urban forests. The sampling and analysis methods used in the proposed project will be thoroughly evaluated to determine the best strategies for future application in other metropolitan regions. Therefore, a major outcome of the proposed research will be a rigorously tested framework for assessing fine-scale variation in urban C storage and urban forest resilience that can then be applied in other regions across the nation. Potential end-users include: government, private businesses, non-profit organizations, and educational institutions. Non-traditional partners, such as those interested in urban agriculture will also benefit from the proposed research. Carbon storage in reclaimed urban agriculture sites is likely to be substantial, and an improved understanding of C storage in urban soils would allow organizations that promote these activities another potential benefit to espouse. This research will be especially timely because of the combined momentum of urban greening initiatives (e.g. Million Trees NYC), urban agriculture movements (e.g. Growing Power), and burgeoning carbon markets. These movements, combined with recent recognition of urban ecosystems as a potential solution for some impacts of climate change, illustrate the need for an improved understanding of urban ecosystems.

The proposed research will engage underserved communities. The Urban Science, Technology, Engineering, and Mathematics, Talent Expansion Program (USTEP) is designed to increase the number of minority undergraduate students pursuing degrees in science, math, engineering, and technology fields. We have partnered with the USTEP program at Chicago State University to engage these students in the proposed research to broaden their knowledge and capabilities in environmental and ecological research. The Morton Arboretum has a long and strong history of connecting with students in underserved communities throughout the Chicagoland region. We have partnered with the Arboretum's Community Trees Program in order to present knowledge attained from this research in Arbor Day programs.

Literature Review

The project will build upon the rich history of scientific study of Chicago's urban forest. Chicago has served as a national model for the study of urban forest health and sustainability. An ordinance in 1909 established Chicago's City Forester and gave control of street trees to the Special Park Commission. In 1989, Chicago Urban Forest Climate Project was commissioned to better understand the effects of vegetation influences on local climate, energy use, and air quality. Following this, the Chicago Division of Forestry was elevated back to Bureau status with increases in budget, professional staff and training to aggressively plant and maintain trees. The Climate Action Plan in 2008 outlined strategies to reduce greenhouse gas emissions. In 2009, Chicago's Urban Forest Agenda addressed future challenges and set sustainable landscape goals for the city. In 2008 and 2010, inventories and assessments of urban forest effects and values were performed in Chicago and the seven county region that makes up the majority of the Chicago metropolitan area using the iTree urban forest inventory approach and modeling programs (Nowak et al. 2009). These data have been used to investigate diverse objectives such as the role of pre-urban vegetation in structuring the modern urban forest (Fahey et al. in review).

This regional-scale combined data set provides a platform for future studies and also serves as a model for understanding urban and community forests in other major metropolitan areas.

Objective I: Urban Forest Resilience and Climate Change. Urban forests play a very important role in climate change mitigation and adaptation. Extreme climatic events, such as drought, floods, and heat waves, are projected to become more common in the future (Meehl et al. 2007). Urban forests may help mitigate some of the effects of these events as well as ameliorating urban heat island impacts and reducing energy consumption (McPherson et al. 1997). Carbon sequestration associated with tree growth in urban areas could have an important mitigating effect on climate change, but this effect is reliant on the health and sustained growth of the trees in the urban landscape (Nowak and Crane 2002). The overall effects that climate change will have on the urban forest are difficult to predict and may be affected by changing urban land-uses and soil conditions (McPherson et al. 1997). The capacity of urban forests to mitigate deleterious climatic changes will depend on maintaining healthy canopy cover. In the long-term, the response of the species that make up the urban forest to general climate warming will be very important to maintaining a healthy forest (Woodall et al. 2010). However, in the near-term the response of trees in the urban landscape to extreme climatic events will likely be more important to maintaining canopy cover.

Trees in metropolitan regions grow in sites that span a wide range of land uses and specific environmental conditions. What is commonly referred to as the urban forest (street trees, landscape plantings, urban parks), is only a small component of a larger continuum that also includes natural areas, agricultural remnants, and interstitial stands. The wide variation in growing conditions across this continuum likely has a strong impact on the growth and resiliency of the trees that make up the urban forest (Iakovoglou et al. 2001). For example, volume of available rooting zone and soil conditions in this zone can have a considerable impact on tree growth (Whitlow and Bassuk 1987, Lindsey and Bassuk 1992). Variables that are linked to specific land-uses, such as pollution associated with transportation corridors, can also affect tree growth (Benoit et al. 1982, Muir and McCune 1988). Environmental factors that occur at a larger scale can also be important, for instance the urban heat island can influence both tree growth and resilience to environmental perturbations such as drought (Cregg and Dix 2001).

In order to adapt the urban forest (and its associated ecosystem services) to future climatic changes, planners need to know how tree growth and resilience to edaphic and climatic conditions vary. Historical growth rates and sensitivity of trees in temperate climates can be assessed using dendrochronology, but this area of research has not been applied to the study of urban forest responses to climatic variation. Therefore, dendrochronological analysis of urban trees and their response to climatic fluctuations presents an important opportunity to fill a significant knowledge gap in our understanding of urban forests and their potential response to future climate and land-use conversion. An improved understanding of the response of urban trees and forests to extreme climatic fluctuations will be essential to the ability of communities to effectively and efficiently adapt to future climate changes. This knowledge could allow communities to avoid costly replanting programs in the future by targeting tree planting campaigns toward species that will respond well to more extreme climatic conditions.

Objective II: Carbon Sequestration of Urban Trees and Soils. Currently, nearly 80% of the US population resides in urban areas, and land area dedicated to urban use continues to expand (Acevedo et al. 2006). The International Panel on Climate Change has identified the importance of protecting and increasing urban C sequestration (IPCC 2007). The importance of urban forest C storage and sequestration will increase as urban lands increase. According to

Churkina et al. (2010), 10% of terrestrial C storage in the conterminous US is occurs in human settlements. Of that 10%, 64% is found in soils, 20% in vegetation, 11% in landfills, and 5% in buildings. Birdsey and Heath (1995) estimate 4.4% of the total US forest C storage is in urban trees. Total C stored in trees and soil for non-urban US forests range from 36 to 203 Mg C ha^{-1}, with a mean value of 77 Mg C ha^{-1} (Smith et al. 2006). Estimates of C storage in tree biomass in seventeen urban forests in United States and Canada range from 4.9 to 37.7 Mg C ha^{-1} (Nowak et al. 2010). Estimates are not available for the C stored in soil for these urban forests. However, Raciti et al. (2011) found C storage in residential soils exceeded nearby forested soils.

The net C storage potential of an urban forest should include: C stored in biomass, soil C storage, the avoided emissions associated with energy reduction, emissions from tree maintenance, and emissions from tree disposal (Nowak et al. 2002). Scharenbroch (2010) presented an approach to model these components to compute net C storage of an urban planting site. In the model, C storage in biomass was computed using allometric equations to predict tree biomass by species from field measurements such as diameter or height (e.g., Ter-Mikaelian and Korzukin 1997; Jenkins et al. 2003). Conversion factors of 1.22 to 1.26 were applied to include belowground biomass (Cairns et al. 1997) and adjust for urban factors (e.g., pruning, compacted soils, etc.), 0.75 to 0.90 were applied (Nowak 1994; McHale et al. 2009). Estimates of energy reductions and associated C savings from urban trees were derived from various sources of literature (McPherson et al. 1993, 1994; Nowak 1994; Nowak et al. 2002; Nowak et al. 2010). Carbon emissions from tree maintenance occur with tree planting, pruning, and removal activities and were modeled (U.S. EPA 1991; Graham et al. 1992; Murrel et al. 1993; Davis 1994). When tree disposal involves chipping and mulching of woody tissues, it is estimated that 50% of biomass C is lost to the atmosphere in the first three years and the remaining 50% is returned to the atmosphere over the next 20 years (Scheu and Schauermann 1994; Nowak et al. 2002). Upon tree death, C is emitted back to the atmosphere or transferred to long-term C storage pools such as soil or wood products. Unfortunately, data is not available for the C estimate that may be transferred to long-term soil C storage pools. Soil C models accept inputs from plant restitution related dynamics in soil C turnover ranging from years to centuries (Parton et al. 1994). Over time, the total SOC increases through the adsorption of atmospheric CO_2, and these increases are seen in the pools of soil C with long residence times (Six et al. 2000a,b). The residence times of C in stable SOM is in millennia, while C in plant residues (leaves, roots, bark, wood) degrades in months to centuries (Lorenz and Lal 2010). With soil depth, residence times of C will tend to increase, as will the proportions of stable SOM in chemically recalcitrant compounds, mineral-associated C, and microbial-derived C.

The major limitation of current urban forest C modeling is that is that they do not accurately account for, or even include soil C sequestration and turnover. Soils are the largest terrestrial pool for organic C in the biosphere (Lal 2004). Urban soils represent 64% of total C found in urban ecosystems (Churkina et al. 2010). Lorenz and Lal (2009) found the C pool in 0.3-m depth to be between 16 and 232 Mg ha^{-1}, and between 15 and 285 Mg ha^{-1} in 1-m depth. Average C storage in Ohio urban forest soils to 1-m depth (147 Mg C ha^{-1}) (Lorenz and Lal 2009) exceeded the C stored in above-ground vegetation in urban forests in New York City (97-145 Mg C ha^{-1}) (Shaw et al. 2009) and Baltimore (116 Mg C ha^{-1}) (Pouyat et al. 2009). Carbon storage in residential soils was found to exceed nearby forested soils of similar types 6.95 vs. 5.44 kg C m^{-2}), soils in residential areas on former agricultural sites have a significant capacity to sequester C (Raciti et al. 2011). The amount of stored C in urban soils is relatively under-studied

(Pouyat et al. 2006), however like other ecological systems the controls on urban soil C storage would include climate, vegetation, relief, parent material, time, and human influences.

Objective III: Urban Site Index. Soil quality is defined as the capacity of soil to function (Karlen et al. 1997). Some important soil functions include: water flow and retention, solute transport and retention, physical stability and support, retention and cycling of nutrients, buffering and filtering of potentially toxic materials, and maintenance of biodiversity and habitat (Larson and Pierce 1994; Doran et al. 1996). The term soil quality also refers to the effects of human use and management on soil functions (Seybold et al. 1999). Some common problems in urban soils include: high bulk density, low porosity, poor soil structure, altered water status, elevated pH and salinity, environmental contaminants, reduced organic matter contents, and altered microbial populations (e.g., Short et al. 1986; Scharenbroch et al. 2005; Scheyer and Hipple 2005; Pouyat et al. 2007). Degraded soil conditions constrain urban tree growth and health (Watson and Neely 1993; Neely and Watson 1998; Watson et al. 2008). An understanding of urban soil quality is imperative for the establishment, growth, and longevity of urban trees.

The goal of matching the right tree to the right site has been elusive. The concept behind USI is to fit trees into environments they can succeed in. Delineating soils on a large scale for tree planting has challenged urban foresters for decades, limiting opportunities for developing diverse community planting designs and maximizing urban forest health. To do this, one must have the ability to recognize the toughest urban sites and understand urban tree hardiness. Trees that are too large for a site or not well suited to a harsh site will be expensive to maintain, have low vigor, and will be short-lived. When completed the USI will be valuable tool to maximize diversity and productivity of the urban forest. The USI could be employed to avoid planting tough trees in good sites and facilitate practice of planting of the least hardy tree that will thrive in a site. Urban trees with longer lifespans and larger maximum sizes have greater potential to sequester more C relative to shorter-lived, smaller trees (Nowak et al. 2002; Scharenbroch 2010). However, urban constraints, such as soil compaction, interrupted nutrient cycling, light and water availability, salts, etc. may limit lifespan and maximum tree sizes (Scharenbroch and Lloyd 2006). Consequently, tolerance to urban stress agents must be considered when evaluating an urban tree's ability to sequester C. The USI will allow planners to strategically plant urban forests to maximize urban forest C sequestration. It is evident the USI can be an effective tool for master planting design. The USI approach theoretically allows for long-term planning with the nursery industry, and creates buy-in by citizens and decision makers. The USI will also have direct application to some non-traditional partners, such as those in the fields of urban agriculture and urban soil description and taxonomy.

Siewert and Miller (2011) created a method to identify and quantify site quality based on eight site and use parameters. Researchers in The Morton Arboretum Soil Science (MASS) laboratory have identified a minimum data set for assessing urban soil quality in relation to tree growth and longevity (Scharenbroch 2011; Scharenbroch and Catania 2011a, b). Recent collaboration efforts between these two groups have moved towards merging the independently derived urban site indices into a standardized, accurate, practical, and field-based method for assessing urban site quality. When validated the USI will be a numerical score attained by a rapid assessment process to quantify urban planting sites based on field observations.

Organization / Methodology

A sub-sample of iTree sampling plots (0.04 ha, approximate density of 1 plot 80 ha^{-1}) from 2008 (745 in City of Chicago, IL) and 2010 (1,400 in surrounding Cook, Du Page, Kane, Kendall,

Lake, McHenry, and Will counties) will be utilized as sample plots for the proposed research. Data collected in the previous sampling efforts included: land-use, ground and tree cover, shrub-layer characteristics, and attributes of individual trees- stem diameter at breast height, tree height, height to base of live crown, crown width, percentage canopy missing and dieback, and distance and direction to residential buildings (iTree Eco User's Manual). The data collected in 2008 and 2010 was used to generate assessments of urban forest effects and values including C storage and annual C sequestration, air pollution removal, and effects of trees on energy use. Biomass for each tree was calculated using equations from the literature, measured tree data, and urban factor adjustments (Nowak 1994).

The total number of plots to be re-sampled will be 5% of the original sample size, or approximately 100 plots. The re-sample plots will be randomly chosen but stratified by land-use types (as recorded in field surveys). In each plot, two increment cores (offset at 90 degrees) will be collected from all trees (>10cm dbh) within plot boundaries at 1.37 m height. Based on tree census data, plots had an average of 7 trees >10cm dbh so sample size is likely to be ~700 core trees. The projected crown area of each tree will be measured with four measurements in cardinal directions of the dripline from the stem of tree. Crown volume will be calculated from canopy height and spread and adjusted for crown shape (Westwood 1993). Increment cores will be mounted on grooved wood blocks, sanded using progressively finer sand paper to help distinguish rings, and analyzed using a Velmex stage micrometer and a Metronics Quick-Chek 1000. The program Measure J2X v4.2 will be used to record annual ring-widths to the nearest 0.001mm. Increment cores will be used to examine tree growth response to historical climate across land-use categories for the major canopy tree species in Chicago region forest (based on 2008 and 2010 tree census data). Based on yearly growth increment data, productivity will be calculated as basal area increment (BAI) and both productivity and variability in productivity (coefficient of variation of BAI) will be correlated with historical climatic records (sensitivity). We will also calculate growth response to known historical extreme climatic events (droughts, floods, heat waves) as resistance (response in year of event) and resilience (response in period following event; D'Amato et. al. 2011). Productivity, sensitivity, resistance, and resilience will be compared among land-use categories and species, and predictive models of the effect of site variables on these factors will be developed. Multiple regression in a model selection framework (Burnham and Anderson 2002) will be used to develop predictive models using SAS v.9.2 (SAS Institute). Above-ground C storage will be estimated based on diameter, species, and urban site factors based on methods of Nowak (1994). Diameter based biomass estimates will be made using regression equations of Jenkins et al. (2004) and Smith et al. (2006).

Soil sampling will occur at two points at a random azimuth and distance (up to 10-m) from plot center. Recently disturbed locations will not be sampled. Undisturbed soil cores will be taken from each point to a 1-m depth using a manual slide hammer sub-soil sampler (3.5 cm diameter; Geoprobe Systems). The soil profile will be photographed for description purposes. The core will be partitioned into 20-cm increments, stored on ice, and returned to the MASS laboratory for characterization. Soil moisture content, bulk density (sans coarse roots and rocks, >2 mm), texture, color, and pH will be measured following methods of Kettler et al. (2001) and Topp et al. (2008). Organic and inorganic C and total N contents will be determined by automated dry combustion with an Elementar Vario EL III CHNOS analyzer (Elementar, Hanau, Germany). Particle size fractionation will be used to separate labile particulate organic matter from recalcitrant OM associated with silt and clay particles (Gregorich and Beare 2008). Organic matter fractionations will be used to relate OM dynamics and soil C residence times. We will

estimate SOC storage at depth (>1-m) following methods of Jobbagy and Jackson (2000). We will first characterize the vertical distribution of SOC within the 1-m depth and then evaluate functions to extrapolate SOC content at depth. We will use one of five functions to relate SOC density or cumulative content with depth in the first meter of soil. Predictive models will then be developed based on soil forming factors in these urban environments. We will investigate the ability to predict urban soil C storage stratified by or from: climate (attained from nearest USGS survey data), above-ground biomass, parent material (attained from USDA NRCS Soil Survey and field descriptions), relief, vegetation type, type of urban land-use, and times since site disturbance (estimated from tree cores). Statistical analysis will be conducted using SAS JMP 7.0 software (SAS Inc., Cary, NC). Multivariate analysis of variance will be used to compare soil C storage for the main and interaction effects of land-use type, time since disturbance, type of vegetation, above-ground biomass. Principal component analyses will be used to identify trends in the dataset. Regression techniques will be used to identify and develop models and also to examine correlations among the responses.

At each plot field assessments will be taken to validate the Urban Site Index (USI). The USI is a numerical score (0-20) based on the soil and site measurements. Site measurements include: total planting area, condition of surface vegetation, and surface compaction, speed limit of street, number of traffic lanes on street, type of parking on street, and block length between traffic control devices. Soil measurements include: depth of A horizon, penetration resistance, texture, aggregate stability, organic matter (predicted from color), pH, and electrical conductivity. These soil analyses will be performed on the 0-20 cm sections of the two 1-m cores from each plot following methods of Nelson and Sommers (1996), Kettler et al. (2001), Angers et al. (2008), and Topp et al. (2008). The second step of the USI evaluation will be to rate urban tree hardiness. Established trees that are 20-50 cm DBH, 20-50 years old, and represented by at least five trees per species on the site (fewer for unique species) will be evaluated. Qualitative tree health will be scored following protocols of Siewert and Miller (2011) and also Scharenbroch and Catania (2011b). Rating databases will be created for urban tree species with the qualitative rating and the USI score. Species tolerances will be established by selecting the lowest USI score in which the tree condition rates as good. A similar approach has been performed in Ohio urban forests and to date, they have established species hardiness for 48 species. The data collected in this research will be used to validate the USI model, increase the species hardiness database, and identify regional differences among species. Statistical analysis will be conducted using SAS JMP 7.0 software (SAS Inc., Cary, NC). Analysis of variance will be used to test main and interaction effects of land-use type, time since disturbance, and species. Principal component analyses will be used to identify trends in the dataset. Regression techniques will be used to assess correlations among the soil and tree responses. The timeline for the proposed research is listed in Table 1 in the Appendix.

Products

- The Morton Arboretum will host a one-day symposium in 2014 or 2015 on the effects and values of the urban forest. The proposed research will be featured at the symposium. A call will be advertised to invite scientists and practitioners to speak at the symposium on related research and projects. The symposium will be open to the public and professionals for a nominal fee. We will offer Continuing Education Credits through the International Society of Arboriculture for participants.

- A website will be created for the proposed research to describe the project, provide progress, and house products for end-users. The Information Technology and Marketing Staff at The Morton Arboretum will assist in creating the website.
- Web-based predictive models and mapping tools of tree species growth response to climate as a function of land-use and soil conditions for Chicago region. The tools will act as a model for similar tools in other urban areas. The models and mapping tools (free) will be available to planners to support tree planting initiatives.
- An urban forest C storage model will be created. Inputs for the above-ground C storage will include: species, diameter, and urban factor adjustments. The soil sub-model will predict total urban soil C storage (1-m and beyond) based on soil formation factors of climate, organisms, relief, parent material, time, and anthropogenic influence. The model will have direct application for detailed estimation of urban soil C storage for Midwestern urban forests. The model will be applicable to urban forests throughout the US to attain coarse estimates of urban soil C storage. Future research will focus on refining the model for these other regions. The model will be free of charge and housed on the project website. The data will be made available to USDA – Forest Service Scientists for inclusion into the iTree urban forest modeling efforts. The C model will be available (free) to planners and public.
- The proposed research will create a validated Urban Site Index. The USI will be available free of charge on the project website. The website will contain items such as: introductory material, field data collection information, collaboration details, and current species hardiness ratings. The model can be used by the public and planners to map urban sites and match these sites with tree hardiness.
- A manuscript from "Objective I: Urban Forest Resilience and Climate Change" will be submitted to Urban Ecosystems and presented at the 2014 annual meeting of the Ecological Society of America (ESA) in Sacramento, CA. We will work with the Urban Ecology section of ESA to submit this paper as part of their annual special session on urban ecology. The ESA is a non-traditional partner to urban forestry, which we hope to foster future collaboration with the proposed research.
- A manuscript from "Objective II: Carbon Sequestration of Urban Trees and Soils" will be submitted to Soil Science Society of America. This journal was chosen as a non-traditional partner to urban forestry with the intention of expanding the influence of the research into others fields, such as urban agriculture and urban soil taxonomy and classification. The paper will be presented at the 2014 Annual Soil Science Society of America in Long Beach, CA.
- A manuscript from "Objective III: Urban Site Index" will be submitted to Urban Forestry and Urban Greening. The paper will be presented at the 2014 International Society of Arboriculture meeting in Milwaukee, WI. Non-technical handouts for each objective will be created and mailed to federal, state, and local urban forestry coordinators. We will print 20,000 color copies, 3-pages each. Handouts will be available on request to all callers for at least one year from date of completion.
- The project will involve underserved communities by engaging and training students in the USTEP program on urban ecology and environmental science.
- A graduate student (M.S., Ph.D., or post-doc) from either Northern Illinois University or Chicago State University will be invited to participate on the project. The proposed research will train and develop the career of a much-needed scientist in urban ecology, with emphasis in soil science and forestry.

Collaboration

The project will be a collaborative effort among non-profit institutions (The Morton Arboretum, ISA Urban Tree Growth & Longevity Working Group, Chicago Wilderness, Midwest Ecological Landscape Association), federal agencies (USDA – Forest Service), state (Ohio Department of Natural Resources), local government (City of Chicago), universities (Chicago State University, Northern Illinois University), and the commercial sector (Bartlett Tree Experts) (Table 1 of Appendix). The project team was intentionally selected to broaden influence across the various sectors of urban and community forestry. The Morton Arboretum is a leader in urban and community forestry and experts from many departments (Research, Community Trees, Marketing, Public Relations, Information Technology, and Education) will assist on the project. The USDA – Forest Service are leaders in the field of modeling the effects and values of the urban forest. We have partnered with key personnel to assist as consultants and to share the data with upon project completion to ensure project results can be most effectively utilized. Government and commercial partners will assist with logistics of field data collection and tailoring products to be of most use to their end-users. Students from the Northern Illinois and Chicago State Universities will be trained in urban ecology. We have partnered with the Chicago State University, Urban Science, Technology, Engineering, and Mathematics Talent Expansion Program (USTEP). This is a NSF-funded program to encourage minority students to study urban ecology and forestry. Collaboration with the USTEP program will entail an educational two-day experience and field exercise led by the project PI's on urban trees and soil. USTEP students will be hired as field and laboratory assistants to collect and analyze the tree and soil data on the proposed research.

National Distribution / Technology Transfer of Your Findings

The results will be distributed to end-users through a number of platforms that have been identified as the preferred methods by a 2007 review of US Forest Service Technology Transfer in Urban and Community Forestry. A national-scale symposium on urban forest effects and values will be held at The Morton Arboretum. All products will be posted on the project website. All information and products on the website will be available to others free of charge. The website will be maintained for a minimum of five years (2019) following the completion of the research and symposium. Research results will also be presented at national and local conferences. We will target traditional urban forestry organizations (International Society of Arboriculture) and also non-traditional professional conferences (e.g., Soil Science Society of America and Ecological Society of America) to present these results. Results from each of the three objectives will be published in peer-reviewed, scientific manuscripts. Three non-technical one-page handouts will be created to summarize the project and distribute the results to the general public. Copies of the handouts will be sent to federal and state urban forestry coordinators. Handouts will be available on request free of charge for at least one year from date of completion.

This research will serve as a model for other communities wishing to model C sequestration and resiliency. Our methodology will available on the project website, and we will work with interested partners in using our protocols. Over the past few years the Urban Tree Growth & Longevity (UTGL) Working Group under International Society of Arboriculture (http://urbantreegrowth.org/) has been developing a collaborative network of scientists and managers interested in monitoring urban forest growth. We will work with UTGL Working Group to reach out to future partners. The Chair of UTGL is Greg McPherson, USDA-Forest

Service and the Vice Chair is Bryant Scharenbroch (PI on this proposal). The results will be shared with the USDA Forest Service scientists with the intent of refining their iTree modeling programs (e.g., the soil C storage estimate). Locally, the results will be shared with the Urban Forestry Task Force of Chicago Wilderness, the City of Chicago, and the Midwest Ecological Landscape Association. We will work with collaborators from Bartlett Tree Experts to make the results most transferable and useful for commercial arboriculture.

The team of collaborators will help distribute results to end-users. All partners will assist in distribution of results through email and listservs. The Public Relations, Community Trees, Marketing and Education staff at The Morton Arboretum have great expertise in translating and distributing technical information to the general public and media. The key words to describe the project for electronic searches are: urban forest health, urban forest resilience and resistance, urban forest carbon sequestration, urban soil carbon sequestration, and urban site index.

Project Evaluation

The results will increase public knowledge of the importance of urban and community forestry. The Morton Arboretum has a high a profile in regards to urban forestry in the Chicago region and throughout the world. We will utilize this profile and the staff within the Research, Community Trees, Public Relations, Marketing, and Education programs to deliver the message of project to the media and also directly to the public. During the granting period, we will measure success by our ability to meet the three described objectives and specific steps outlined in the previous sections. We will include a feedback module on the project's website for users to describe how the data has been of value to them and also how its usefulness could be improved upon. The Morton Arboretum symposium will be open to the public and professionals interested in the topic area. We will evaluate the success of the project in regard to heightening the public's awareness of the importance of urban and community forestry with response surveys and feedback evaluations given to all symposium participants. We will host a meeting of project partners upon conclusion of the symposium to conduct an internal review of project success. We will target three areas for the evaluation: what could have been improved upon during planning and implementation, what was done well, and what is the future direction of the research.

Experience / Personnel / Adequacy of Resources

The project team is comprised of leaders in the field of urban forest and soil descriptions, inventory, and modeling. Many of the team members have been active participants in the ecological study of Chicago's urban forest and also urban forests throughout the US. The personnel, facilities, equipment, supplies, and time is adequate to carry out all objectives of the project. The following partners and collaborators will compromise the project team. The specific involvement of each team member is listed in Table 1 of the Appendix.

- Bryant Scharenbroch, Ph.D., Soil Scientist, The Morton Arboretum. Principal investigator. Previous research has examined urban forest C sequestration (Scharenbroch 2010, 2012), soil C dynamics in urban soils (Scharenbroch et al. 2005; Scharenbroch and Lloyd 2006), soil C and N cycling in old growth forests (Scharenbroch and Bockheim 2007, 2008a, 2008b), and in C changes with forest encroachment in prairie systems (Scharenbroch et al. 2010). Bryant is Vice Chair of the Urban Tree Growth & Longevity Working Group.
- Robert Fahey, Ph.D., Forest Ecologist, The Morton Arboretum. Principal investigator. Previous research has focused on dendrochronology in upper Great Lakes forests (Fahey 2011), effects of land-use on tree growth resilience in urban locations (Fahey et al. in press),

and impacts of pre-urban vegetation on modern urban forest composition and structure (Fahey et al. in review).

- Dave Nowak, Ph.D., Research Forester, USDA Forest Service, Urban Forests, Human Health, and Environmental Quality. Dave is project leader for the iTree model and is an expert in quantifying and modeling urban forest effects and values.
- Thomas Dilley, Natural Resource Specialist, USDA Forest Service Northeastern Area. Tom is chair on the Urban Forestry Task Force of Chicago Wilderness. Tom was involved with the Chicago tree census in 2008 and a leader in the urban forestry.
- Joe McCarthy, M.S., Senior City Forester, Chicago Bureau of Forestry. Joe will assist with coordination of field collection and project result dissemination in Chicago.
- Eve Pytel, Assistant Director, Clean Air Counts, Metropolitan Mayors Caucus. Director of 274 member municipalities of Chicago Metro Mayors Caucus.
- Alan Siewert and Stephanie Miller, Urban Foresters, Ohio Department of Natural Resources. Alan and Stephanie are experts in assessing urban site quality.
- Scott Jamieson, M.S., Vice President of Inventory Solutions, Bartlett Tree Experts. Scott is also on the executive board of Midwest Ecological Landscape Association.
- Karel Jacobs, Ph.D., Associate Professor of Biology, Chicago State University. Karel is an urban ecologist and an advisor on the USTEP program at Chicago State University.
- Mike Konen, Ph.D. Associate Professor of Geography, Northern Illinois University. Mike is a soil scientist with expertise in soil classification and C cycling.
- Megan Dunning, Ph.D., Manager of Community Education and Outreach, The Morton Arboretum. Megan has organized numerous successful symposia and conferences.
- Beth Corrigan, Community Trees Project Coordinator, The Morton Arboretum. Carrie assisted with the 2010 Chicagoland tree census. Beth has experience in creation and dissemination of non-technical project handouts.
- Graduate student, to be named. Graduate student (M.S., Ph.D., or post-doc) from Northern Illinois University or Chicago State University.

Budget Justification

The total project cost is $358,554 (Appendix, Table 2). We are requesting $143,150 of this amount from the US Forest Service. The non-federal match of $215,404 is from The Morton Arboretum. Additional matching funds will be provided by graduate student stipends during the academic year from partnering universities or colleges. These matching funds are not currently listed in the budget. The majority of the projects costs ($176,805) are labor for field sampling and laboratory work, and also the match for project hours of Scharenbroch, Fahey, and Dunning. Travel expenses ($9,550) are for fieldwork and presentation of results at ISA (Milwaukee, WI), ESA (Sacramento, CA), and SSSA (Long Beach, CA) in 2014. Laboratory and field supplies ($13,000) will cover consumables for 700 tree cores and 1000 soil samples. The symposium costs are approximated at $20,000. Website creation and hosting is approximated at $4,000. Creation, printing, and mailing of 20,000 non-technical handouts is estimated at $14,000. Manuscript publication fees are estimated at $2,000. The Federal Indirect Overhead Cost Recovery Rate for TMA is 49.80% ($119,199) to be applied as a match. No funds will be spent to purchase trees or plants, food, equipment greater than $5,000 or on capital improvements to property. Details and further explanation of all these costs are provided in Table 2 of the Appendix.

The Morton Arboretum-2012 NUCFAC Proposal

Table 1. Tasks, deadlines, primary investigators and partners for the proposed research.

Task	***Deadline***	***Primary***	***Partners***
Submit proposal	Mar-2012	Scharenbroch, Fahey	N/A
Funding awarded	Summer-2012	N/A	N/A
Project start state	September 01, 2012	N/A	N/A
Launch website	Dec-2012	Scharenbroch, Fahey	Corrigan, Dunning
Collect tree data	Dec-2013	Fahey	Jacobs
Collect soil data	Dec-2013	Scharenbroch	Konen
Analyze tree data	Dec-2013	Fahey	Dwyer
Analyze soil data	Dec-2013	Scharenbroch	Konen
Develop objective I models	Mar-2014	Fahey	Dwyer, Nowak
Write objective I paper	Jun-2014	Fahey	Dwyer, Nowak
Present objective I at ESA	Aug-2014	Fahey	Scharenbroch
Develop objective II model	Mar-2014	Scharenbroch	Nowak
Write objective II paper	Jun-2014	Scharenbroch	Nowak
Present objective II at SSSA	Oct-2014	Scharenbroch	Konen
Develop objective III model	Mar-2014	Scharenbroch	Konen
Write objective III paper	Jun-2014	Scharenbroch	Siewert, Miller
Present objective III at ISA	Aug-2014	Scharenbroch	Siewert, Miller
Write and distribute handouts	Mar-2015	Scharenbroch, Fahey	All
Host symposium	Mar-2015	Dunning	Scharenbroch, Fahey
Project end date	Mar-2015	N/A	N/A
Submit report to NUCFAC	Annually	Scharenbroch, Fahey	N/A

The Morton Arboretum - 2012 NUCFAC Proposal

Table 2. Budget narrative table.

Item	***Federal Funds (requested)***	***Non-federal Match***	***Total***	***Source of Match***
Personnel*	87,350	56,100	143,450	TMA
Labor overhead**	16,525	16,830	33,355	TMA
Travel***	4,775	4,775	9,550	TMA
Lab and field supplies^	6,500	6,500	13,000	TMA
Website^^	2,000	2,000	4,000	TMA
Symposium^^^	10,000	10,000	20,000	TMA
Printing#	10,000	0	10,000	N/A
Distribution##	4,000	0	4,000	N/A
Manuscript fees###	2,000	0	2,000	N/A
Subtotal	143,150	96,205	239,355	TMA
Indirect overhead+	0	119,199	119,199	TMA
Total	$143,150	$215,404	$358,554	TMA

*Personnel:

- Tree fieldwork with one full time RA (1,000 hours @ $17/hr) = $17,000
- Soil fieldwork with one part time RA (1,000 hours @ $11/hr) = $11,000
- Soil fieldwork with one part time RA (1,000 hours @ $11/hr) = $11,000
- Tree labwork with one full time RA (1,050 hours @ $17/hr) = $17,850
- Soil labwork with one full time RA (500 hours @ $17/hr) = $8,500
- Soil labwork with one part time RA (2,000 hours @ $11/hr) = $22,000
- Matching B. Scharenbroch salary (1,000 hours @ $34/hr) = $34,000
- Matching R. Fahey salary (500 hours @ $34/hr) = $17,000
- Matching M. Dunning salary (150 hours @ $34/hr) = $5,100

**Labor overhead:

- Tree fieldwork with one full time RA (0.30 * 1,000 hours @ $17/hr) = $5,100
- Soil fieldwork with one part time RA (0.08 * 1,000 hours @ $11/hr) = $880
- Soil fieldwork with one part time RA (0.08 * 1,000 hours @ $11/hr) = $880
- Tree labwork with one full time RA (0.30 * 1,050 hours @ $17/hr) = $5,355

- Soil labwork with one full time RA (0.30 * 500 hours @ $17/hr) = $2,550
- Soil labwork with one part time RA (0.08 * 2,000 hours @ $11/hr) = $1,760
- Matching B. Scharenbroch salary (0.30 * 1,000 hours @ $34/hr) = $10,200
- Matching R. Fahey salary (0.30 * 500 hours @ $34/hr) = $5,100
- Matching M. Dunning salary (0.30 * 150 hours @ $34/hr) = $1,530

***Travel:

- B. Scharenbroch and R. Fahey to attend ESA 2014 in Sacremento, CA ($4,450)
- B. Scharenbroch to attend SSSA 2014 in Long Beach, CA ($3,000)
- B. Scharenbroch to attend ISA 2012 in Milwaukee, WI ($1,000)
- Travel for fieldwork (10 miles at $0.55 per mile at 200 plots) = $1,100

^Laboratory and field supplies:

- Consumables for collecting and processing soil samples (100 plots @ 2 cores and 5 depths per plot @ $12/sample) = $12,000
- Consumables for processing 700 tree cores = $1,000

^^Website: hosting and development costs estimated at $4,000. Hosting fees are for a 10-year contract.

^^^Symposium:

- Speaker travel and lodging ($10,000)
- Meals ($7,500)
- Printing and mailing ($2,500)

#Printing: non-technical project summaries @ 20,000 color copies, 3-pages each.

##Distribution: copies will be sent to federal and state urban forestry coordinators and will be available on request to all callers for at least one year from date of completion.

###Manuscript fees: page charges for Urban Ecosystems, Soil Science Society of America, and Urban Forestry & Urban Greening.

+ Indirect overhead: federal indirect overhead cost recovery rate is 49.80% of project subtotal = $119,199 to be applied as a match.

GRANTS.GOV™

Grant Application Package

Opportunity Title:	2012 National Urban and Community Forestry Cost Share G
Offering Agency:	Forest Service
CFDA Number:	10.675
CFDA Description:	Urban and Community Forestry Program
Opportunity Number:	USDA-FS-UCF-01-2012
Competition ID:	
Opportunity Open Date:	10/14/2011
Opportunity Close Date:	12/01/2011
Agency Contact:	Nancy Stremple Urban Forestry Program Splst E-mail: nstremple@fs.fed.us Phone: 202-205-7829

This electronic grants application is intended to be used to apply for the specific Federal funding opportunity referenced here.

If the Federal funding opportunity listed is not the opportunity for which you want to apply, close this application package by clicking on the "Cancel" button at the top of this screen. You will then need to locate the correct Federal funding opportunity, download its application and then apply.

☐ **I will be submitting applications on my behalf, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.**

*** Application Filing Name:** The Morton Arboretum

Mandatory Documents

Move Form to Complete

Move Form to Delete

Mandatory Documents for Submission

SF424 Mandatory Form
Assurances for Non-Construction Programs (SF-42
Budget Information for Non-Construction Program

Optional Documents

Move Form to Submission List

Move Form to Delete

Optional Documents for Submission

Instructions

1 **Enter a name for the application in the Application Filing Name field.**

- This application can be completed in its entirety offline; however, you will need to login to the Grants.gov website during the submission process.
- You can save your application at any time by clicking the "Save" button at the top of your screen.
- The "Save & Submit" button will not be functional until all required data fields in the application are completed and you clicked on the "Check Package for Errors" button and confirmed all data required data fields are completed.

2 **Open and complete all of the documents listed in the "Mandatory Documents" box. Complete the SF-424 form first.**

- It is recommended that the SF-424 form be the first form completed for the application package. Data entered on the SF-424 will populate data fields in other mandatory and optional forms and the user cannot enter data in these fields.

- The forms listed in the "Mandatory Documents" box and "Optional Documents" may be predefined forms, such as SF-424, forms where a document needs to be attached, such as the Project Narrative or a combination of both. "Mandatory Documents" are required for this application. "Optional Documents" can be used to provide additional support for this application or may be required for specific types of grant activity. Reference the application package instructions for more information regarding "Optional Documents".

- To open and complete a form, simply click on the form's name to select the item and then click on the => button. This will move the document to the appropriate "Documents for Submission" box and the form will be automatically added to your application package. To view the form, scroll down the screen or select the form name and click on the "Open Form" button to begin completing the required data fields. To remove a form/document from the "Documents for Submission" box, click the document name to select it, and then click the <= button. This will return the form/document to the "Mandatory Documents" or "Optional Documents" box.

- All documents listed in the "Mandatory Documents" box must be moved to the "Mandatory Documents for Submission" box. When you open a required form, the fields which must be completed are highlighted in yellow with a red border. Optional fields and completed fields are displayed in white. If you enter invalid or incomplete information in a field, you will receive an error message.

3 **Click the "Save & Submit" button to submit your application to Grants.gov.**

- Once you have properly completed all required documents and attached any required or optional documentation, save the completed application by clicking on the "Save" button.
- Click on the "Check Package for Errors" button to ensure that you have completed all required data fields. Correct any errors or if none are found, save the application package.
- The "Save & Submit" button will become active; click on the "Save & Submit" button to begin the application submission process.
- You will be taken to the applicant login page to enter your Grants.gov username and password. Follow all onscreen instructions for submission.

OMB Number: 4040-0002
Expiration Date: 8/31/2008

APPLICATION FOR FEDERAL ASSISTANCE SF-424 - MANDATORY

Version 01.1

*** 1.a. Type of Submission:**

- [X] Application
- [ ] Plan
- [ ] Funding Request
- [ ] Other

* Other (specify)

*** 1.b. Frequency:**

- [X] Annual
- [ ] Quarterly
- [ ] Other

* Other (specify)

*** 1.d. Version:**

- [X] Initial
- [ ] Resubmission
- [ ] Revision
- [ ] Update

*** 2. Date Received:**

Completed by Grants.gov upon submission.

STATE USE ONLY:

3. Applicant Identifier:

5. Date Received by State:

4a. Federal Entity Identifier:

6. State Application Identifier:

4b. Federal Award Identifier:

1.c. Consolidated Application/Plan/Funding Request?

Yes [X] No [ ] Explanation

7. APPLICANT INFORMATION:

*** a. Legal Name:**

The Morton Arboretum

*** b. Employer/Taxpayer Identification Number (EIN/TIN):**

36-1505770

*** c. Organizational DUNS:**

068478197

d. Address:

* Street1:

4100 Illinois Route 53

Street2:

* City:

Lisle

County:

DuPage County

* State:

IL: Illinois

Province:

* Country:

USA: UNITED STATES

* Zip / Postal Code:

60532

e. Organizational Unit:

Department Name:

Division Name:

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

Prefix:

* First Name:

Bryant

Middle Name:

* Last Name:

Scharenbroch

Suffix:

PhD

Title: Urban Landscape Soil Scientist

Organizational Affiliation:

The Morton Arboretum

* Telephone Number: 630-725-2071

Fax Number: 630-719-2421

* Email: bscharenbroch@mortonarb.org

OMB Number: 4040-0002
Expiration Date: 08/31/2008

APPLICATION FOR FEDERAL ASSISTANCE SF-424 - MANDATORY

Version 01.1

*** 8a. TYPE OF APPLICANT:**

M: Nonprofit with 501C3 IRS Status (Other than Institution of Higher Education)

* Other (specify):

b. Additional Description:

*** 9. Name of Federal Agency:**

Forest Service

10. Catalog of Federal Domestic Assistance Number:

10.675

CFDA Title:

Urban and Community Forestry Program

11. Areas Affected by Funding:

12. CONGRESSIONAL DISTRICTS OF:

* a. Applicant: IL-13

b. Program/Project: IL-All

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

Add Attachment | Delete Attachment | View Attachment

13. FUNDING PERIOD:

a. Start Date: 10/01/2012

b. End Date: 03/31/2015

14. ESTIMATED FUNDING:

* a. Federal ($): 143,150.00

b. Match ($): 215,404.00

*** 15. IS SUBMISSION SUBJECT TO REVIEW BY STATE UNDER EXECUTIVE ORDER 12372 PROCESS?**

- [ ] a. This submission 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 State for review.
- [x] c. Program is not covered by E.O. 12372.

OMB Number: 4040-0002
Expiration Date: 08/31/2008

APPLICATION FOR FEDERAL ASSISTANCE SF-424 - MANDATORY

Version 01.1

*** 16. Is The Applicant Delinquent On Any Federal Debt?**

Yes ☐ No ☒ Explanation

17. 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 ☒

** This 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:	* First Name:
Ms.	Carol

Middle Name:

* Last Name: Largey

Suffix:	* Title:
	Manager of Corporate and Foundation Relations

Organizational Affiliation: The Morton Arboretum

* Telephone Number: 630-719-5709

* Fax Number: 630-719-2421

* Email: clargey@mortonarb.org

* Signature of Authorized Representative: Completed by Grants.gov upon submission.

* Date Signed: Completed by Grants.gov upon submission.

Attach supporting documents as specified in agency instructions.

Add Attachments | Delete Attachments | View Attachments

APPLICATION FOR FEDERAL ASSISTANCE SF-424 - MANDATORY

*** Consolidate Application/Plan/Funding Request Explantion**

Category Application
The proposed project relates to Category 1: how management of urban and community forests can help mitigate greenhouse gas emissions or help communities adapt to climate change. Research conducted in this project will directly address the role of urban and community forest resources in carbon (C) sequestration and the impact of climatic change on the health and sustainability of the urban forest. The project will provide new knowledge on the C sequestration potential of the urban forest and underlying soil and will validate anecdotal knowledge on the effects and values of the urban forest for climate change mitigation. This new information will be distributed to government and policy-makers to emphasize the previously unaccounted value, which will potentially translate into new economic value and jobs creation. The many products (symposium, models/tools, non-technical and scientific publications, etc.) from this research will be distributed by a variety of methods to a broad spectrum of end-users throughout the country. The project will be performed by a diverse team of experts from non-profit, government, education, and commercial sectors of urban and community forestry. The project will produce results directly applicable to urban forests at the national, multi-state level, state, and city levels. The project will serve as a model and provide tools for others to assess the resiliency and C sequestration potential of urban and community forests.

Scope and Applicability
The proposed research has three broad objectives. Objective I: Urban Forest Resilience and Climate Change. This research will be used to assess how tree growth and sensitivity to soil and climate conditions vary across land-uses and species comprising the urban forest continuum. The project will be used to investigate the resilience of urban trees to extreme climatic events and edaphic constraints. The research will evaluate what specific growing conditions are related to urban tree productivity and the sensitivity and resilience of this productivity to environmental perturbations. This research will provide knowledge on the expected response of urban and community forests to a changing climate and how this response will vary as a function of soil and site conditions. Objective II: Carbon Sequestration of Urban Tree and Soils. The research will provide unique data on C sequestration of urban trees and soils. A significant knowledge gaps exists in our knowledge of urban soil C storage and turnover. The project will serve as model to include soil organic C (SOC) storage in C sequestration models for urban and community forests. The data collected in the proposed research will be shared with the USDA Forest Service scientists with the intent of improving the current i-Tree urban forestry analysis and benefits assessment tools to include soil C sequestration. Objective III: Urban Site Index. The proposed research will be used to validate an Urban Site Index (USI). Collaboration between the Morton Arboretum Soil Science (MASS) laboratory and the Ohio Department of the Natural Resources has created a preliminary minimum data set to evaluate urban sites. The project will test this field-based toolbox for its ability to evaluate urban site in relation to tree health. The USI will be an invaluable planning tool for matching site characteristics with vegetation tolerances to maximize the health and sustainability of the urban forest.

The national target audience of the research includes all stakeholders with an interest in urban and community forestry. Potential end-users include: government, private businesses, non-profit organizations, and educational institutions. Non-traditional partners, such as those interested in urban agriculture will also benefit from the proposed research.

APPLICATION FOR FEDERAL ASSISTANCE SF-424 - MANDATORY

*** Applicant Federal Debt Delinquent Explanation**

OMB Number: 4040-0007
Expiration Date: 06/30/2014

ASSURANCES - NON-CONSTRUCTION PROGRAMS

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
Completed on submission to Grants.gov	Manager of Corporate and Foundation Relations
* APPLICANT ORGANIZATION	* DATE SUBMITTED
The Morton Arboretum	Completed on submission to Grants.gov

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	$	$	$ 143,150.00	$ 215,404.00	$ 358,554.00
2.						
3.						
4.						
5. Totals		$	$	$ 143,150.00	$ 215,404.00	$ 358,554.00

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				
a. Personnel	$ 87,350.00	$ 56,100.00	$	$	$ 143,450.00
b. Fringe Benefits	16,525.00	16,830.00			33,355.00
c. Travel	4,775.00	4,775.00			9,550.00
d. Equipment					
e. Supplies	6,500.00	6,500.00			13,000.00
f. Contractual	2,000.00	2,000.00			4,000.00
g. Construction					
h. Other	26,000.00	10,000.00			36,000.00
i. Total Direct Charges (sum of 6a-6h)	143,150.00	96,205.00			$ 239,355.00
j. Indirect Charges		119,199.00			$ 119,199.00
k. TOTALS (sum of 6i and 6j)	$ 143,150.00	$ 215,404.00	$	$	$ 358,554.00
7. Program Income	$	$	$	$	$

SECTION C - NON-FEDERAL RESOURCES

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e)TOTALS
8. Forest Service Urban and Community Forestry Program	$ 215,404.00	$	$	$ 215,404.00
9.				
10.				
11.				
12. TOTAL (sum of lines 8-11)	$ 215,404.00	$	$	$ 215,404.00

SECTION D - FORECASTED CASH NEEDS

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$ 23,858.00	$	$	$	$ 23,858.00
14. Non-Federal	$ 36,902.00				36,902.00
15. TOTAL (sum of lines 13 and 14)	$ 60,760.00	$	$	$	$ 60,760.00

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. Forest Service Urban and Community Forestry Program	$ 95,434.00	$ 23,858.00	$	$
17.				
18.				
19.				
20. TOTAL (sum of lines 16 - 19)	$ 95,434.00	$ 23,858.00	$	$

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges: $239,355

22. Indirect Charges: $119,199

23. Remarks: See attached Federally Negotiated Indirect Cost Rate Letter

File Code: 1440-1/1580-1
Date: September 15, 2011

NONPROFIT ORGANIZATION
INDIRECT COST NEGOTIATION AGREEMENT

The Morton Arboretum
4100 Illinois Route 53
Lisle, IL 60532-1293

The indirect cost rate contained herein is for use on contracts, grants, and cooperative agreements with the Federal Government to which 2 CFR Part 230 (OMB Circular A-122) applies, subject to the limitations contained in Section II (A) of this agreement. The rate was negotiated by The Morton Arboretum and the U.S. Department of Agriculture, Forest Service, in accordance with the authority contained in Appendix A, Section E of the regulations.

SECTION I: Rate

Type	From	To	Rate	Applicable to:
Predetermined	1/1/2012	12/31/2012	49 .80%	All Programs

Allocation Base

- Modified Total Direct Cost- Direct salaries and wages, direct materials and supplies, and other direct cost, excluding items. To determine the amount of reimbursable indirect costs, the base components stated above should be added together and multiplied by the above rate.

- Expenditures Excluded and/or not Allowable: Capital expenditures and other distorting items, and unallowable costs per 2 CFR Part 230.

SECTION II: General

A. LIMITATIONS: Use of the rate contained in this agreement is subject to any statutory or administrative limitations and is applicable to a given grant or contract only to the extent that funds are available. Acceptance of the rate agreed to herein is predicated upon the conditions : 1) that no costs other than those incurred by the grantee/contractor via an approved central service cost allocation plan were included in its indirect cost pool as finally accepted and such incurred costs are legal obligations of the grantee/contractor and allowable under the governing cost principles, 2) that the same costs that have been treated as indirect costs have not been claimed as direct costs, 3) that similar indirect costs have been accorded consistent treatment, and 4) that the information provided by the grantee/contractor which was used as a basis for acceptance of the rate agreed to herein is not subsequently found to be materially inaccurate.

B. AUDIT: Adjustments to amounts resulting from audit of the cost allocation plan upon which the negotiation of the agreement was based will be compensated for in subsequent negotiation.

C. CHANGES: If a fixed or predetermined rate is contained in this agreement, it is based on the organization structure and accounting system in effect at the time the proposal was submitted. Changes in the organizational structure or changes in the method of accounting for costs which affect the reimbursement resulting from use of the rate in this agreement require the prior approval of the authorized representative of the responsible negotiation agency. Failure to obtain such approval may result in subsequent audit disallowances.

D. PREDETERMINED RATE: The predetermined rate contained in this agreement is based on an estimate of costs which will be incurred during the period for which the rate applies and is not subject to adjustment.

E. NOTIFICATION OF FEDERAL AGENCIES: Copies of this document may be provided to other Federal offices as a means of notifying them of the agreement contained herein.

F. SPECIAL REMARKS: Federal programs currently reimbursing indirect costs to the Department/Agency by means other than the rate cited in this agreement should be credited for such costs and the applicable rate cited here should be applied to the appropriate base to identify the proper amount of indirect costs allocable to the program. However, awards providing for indirect cost rate ceilings will be subject to the ceilings stipulated in the award, or the rates in this agreement, whichever are lower

File Code: 1440-1/1580-1
Date: September 15, 2011

By the Non-Profit Agency	By the Responsible Federal Agency
The Morton Arboretum	USDA-Forest Service
Timothy E. Wolkober	Anthony Lo
Signature	Signature
Timothy E. Wolkober	Anthony Lo
Printed Name	Printed Name
Vice President of Finance and Chief Financial Officer	Branch Chief, Resource Audit
Title	Title
September 26, 2011	September 15, 2011
Date	Date

Negotiated by:
Therese Wall, Auditor
Resource Audit Branch
505-563-7399
twall@fs.fed.us

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The Morton Arboretum - 2012 NUCFAC Proposal

Statement of Key Personnel Qualifications

Bryant Scharenbroch, Ph.D., a Soil Scientist with expertise in urban soil C dynamics and urban ecosystem biogeochemical cycling. Bryant's previous research has examined urban forest C sequestration (Scharenbroch 2010, 2012), soil C dynamics in urban soils (Scharenbroch et al. 2005; Scharenbroch and Lloyd 2006), soil C and N cycling in old growth forests (Scharenbroch and Bockheim 2007, 2008a, 2008b), and in C changes with forest encroachment in prairie systems (Scharenbroch et al. 2010).

Robert Fahey, Ph.D. is a Forest Ecologist with expertise in forest resiliency and modeling ecosystem processes. Previous research has focused on dendrochronology in forests of the upper Great Lakes region (Fahey 2011), effects of land-use on resilience of trees in urban locations (Fahey et al. in review), and impacts of pre-urban vegetation on modern urban forest composition and structure (Fahey et al. in review).

BRYANT CHAD SCHARENBROCH *Curriculum Vitae*

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Web: www.masslaboratory.org

EDUCATION

- University of Wisconsin-Madison. 2007. Ph.D. Soil Science. Advisor: Bockheim, J.G.
- University of Idaho. 2003. M.S. Plant Science. Advisor: Lloyd, J.E.
- University of Wisconsin-Stevens Point. 2001. B.S. Forest Management.
- University of Wisconsin-Stevens Point. 2001. B.S. Urban Forestry.

PROFESSIONAL EXPERIENCE

- ***Soil Scientist***. 2007-current. Department of Research. The Morton Arboretum. Research pertaining to urban soil quality, urban plant and ecosystem health, urban biogeochemical cycling, and urban soil genesis and classification.
- ***Research Assistant***. 2003-2007. Department of Soil Science. UW-Madison. Thesis: Biogeochemical cycling and soil organic matter dynamics in old growth forest gaps.
- ***Teaching Assistant***. 2001-2003. Department of Plant, Soil, and Entomological Sciences. U. Idaho. Thesis: Soil organic matter cycling and nitrogen availability in urban soils.
- ***Soil Technician***. 2001. Lumberjack RC&D in cooperation with the USDA Forest Service. Rhinelander, WI. Evaluated soil and litter for forest health assessments.
- ***Forest Technician***. 2000. Wisconsin Department of Natural Resources. Plymouth, WI. Silviculture in state forests and private conservation reserve program lands.
- ***Petty Officer***. 1993-1997. United States Navy. Demonstrated leadership skills in a diversified workplace. Enlisted and Honarable Discharge.
- ***Farmhand***. 1985-1993. Initiative and strong work ethic at a young age as a farmhand on Scharenbroch family farm and other Wisconsin dairy farms.

PUBLICATIONS IN PRINT (PEER REVIEWED)

- Scharenbroch, B.C., Catania, M., Treasurer, W., and Brand, V. 2011. Lab assays on the effects of aerated compost tea and fertilization on soil biochemical properties and denitrification in A and Bt horizon soils. Arboriculture and Urban Forestry 37:269-276.
- Scharenbroch, B.C., 2011. Urban Trees for Carbon Sequestration. In (Ed.). Lal, R. and Augustin, B. Proceedings from the Carbon Sequestration in Urban Ecosystem. Columbus, OH. Springer Verlag. DOI.10/1007.978-94-007-2366-5.
- Scharenbroch, B.C. and D. Johnston. 2010. A microcosm study of the common night crawler earthworm (*Lumbricus terrestris*) and physical, chemical and biological properties of a designed urban soil. Urban Ecosystems 14:119-134.

- Scharenbroch, B.C., Flores-Mangual, M.L., Lepore, B., Bockheim, J.G. and Lowery. B. 2010. Tree encroachment impacts on storage and dynamics of carbon in a sandy prairie in the lower Wisconsin River valley, USA. Soil Science Society American Journal 74:956-968.
- Scharenbroch, B.C. 2009. A Meta-analysis of studies in the Journal Arboriculture and Urban Forestry relating to organic materials and impacts on soil, tree, and environmental properties. Arboriculture and Urban Forestry. 35:221-231.
- Scharenbroch, B.C. 2009. Assessing the impacts of organic materials using a meta-analytical approach. In (Eds.). Watson, G.W., Costello, L., Scharenbroch, B.C., and Gilman, E. Proceedings from The Landscape Belowground III. Lisle, IL.
- Scharenbroch, B.C. and J.G. Bockheim. 2008. Gaps and soil carbon dynamics in old growth northern hardwood-hemlock forests. Ecosystems. 11:426-441.
- Scharenbroch, B.C. and J.G. Bockheim. 2008. The effects of gap disturbance on nitrogen cycling and retention in late-successional northern hardwood-hemlock forests. Biogeochemistry. 87:231-248.
- Scharenbroch, B.C. and J.G. Bockheim. 2007. Impacts of forest gaps on soil properties and processes in old growth northern hardwood-hemlock forests. Plant Soil. 294:219-233.
- Scharenbroch, B.C. and J.G. Bockheim. 2007. Pedodiversity in an old-growth northern hardwood forest in the Huron Mountains, Upper Peninsula, Michigan. Canadian Journal of Forest Research. 37:1106-1117.
- Scharenbroch, B.C. and J.E. Lloyd. 2006. Particulate organic matter and soil nitrogen availability in urban landscapes. Arboriculture and Urban Forestry. 32:180-191.
- Scharenbroch, B.C., Lloyd, J.E., and J.L. Johnson-Maynard. 2005. Distinguishing urban soils with physical, chemical and biological properties. Pedobiologia. 49:283-295.
- Scharenbroch, B.C. and J.E. Lloyd. 2004. A literature review of nitrogen availability indices for use in urban landscapes. Journal of Arboriculture. 30:214-230.

PUBLICATIONS IN PREPARATION (PEER REVIEWED)

- Scharenbroch, B.C., Boelter, B., Jacobs, K.A., and Bowles, M.L. 201x. Two decades of low-intensity prescribed fire increases soil nutrient availability in a Midwestern oak (*Quercus*) forest. Geoderma. In Review. 01/05/10.
- Scharenbroch, B.C. and Catania, M. 201x. A soil quality index for urban trees. Part I. identifying physical, chemical, and biological properties for an urban soil quality minimum data set. Arboriculture and Urban Forestry. In review. 09/14/11.
- Scharenbroch, B.C. and Catania, M. 201x. A soil quality index for urban trees. Part II. testing the urban soil quality minimum data set for predicting urban tree properties. Arboriculture and Urban Forestry. In review. 09/14/11.
- Scharenbroch, B.C. and Watson, G.W. 201x. The effects of six common amendments on urban soil quality and tree health. Urban Forestry and Urban Greening. In preparation.
- Scharenbroch, B.C. and Johnston, D. 201x. Diversity of soil bacteria and fungi in a compacted urban soil in response to compost, aerated compost tea, wood-chip mulch, and an inorganic fertilizer. Soil Biology and Biochemistry. In preparation.
- Scharenbroch, B.C., Bowles, M. Howard, S., and Jacobs, K. 201x. Soil ecology of restored prairies in the Chicagoland region. Restoration Ecology. In preparation.

- Scharenbroch, B.C. 201x. Best management practices for urban soils. International Society of Arboriculture. In preparation.

GRANTS AND FUNDING RECIEVED

- Scharenbroch, B.C. McPherson, G., Peterson, W. Roman, L. Peper, P., Bartens, J., and Dunning, M. 2011. Funding for the Urban Tree Growth Conference. The Morton Arboretum. September 12-13, 2011. International Society of Arboriculture, Arboriculture Research & Education Academy, Davey Tree, Bartlett Tree Experts, United States Department of Agriculture Forest Service, Utility Arborist Association, Kramer Tree Specialists. ***$26,000***.
- Lupfer, T. Rosenberg, R. and Scharenbroch, B.C. 2010. Sustainable sites initiative landscape retrofit at Shay's Folly. Illinois Green Infrastructure Grant Program for Stormwater Management. ***$64,630***.
- Scharenbroch, B.C. and K. Fite. 2010. Biochar and its potential as an arboricultural amendment. Tree Research & Education Endowment. Hyland R. Johns Grant. ***$24,600***.
- Scharenbroch, B.C. 2008. A survey of litter and soil invertebrates in burned oak forests. Wildlife Preservation Fund. Illinois Department of Natural Resources. ***$13,475***.
- Scharenbroch, B.C. 2008. Impacts of aerated compost teas on trees, soils, and the environment. Tree Research & Education Endowment. Hyland R. Johns Grant. ***$24,720***.
- Scharenbroch, B.C. 2008. A soil quality index for arboriculture. Tree Research & Education Endowment. John Z. Duling Grant. ***$7,500***.
- Scharenbroch, B.C. and G. Watson. 2007. Towards improving soil biology and organic matter for urban tree health. Tree Research & Education Endowment. Hyland R. Johns Grant. ***$17,500***.
- Scharenbroch, B.C. and J.E. Lloyd. 2001. Particulate organic matter in urban soils. Tree Research & Education Endowment. John Z. Duling Grant. ***$5,000***.
- Scharenbroch, B.C. 2001. Funding for climbing equipment and materials for Arboriculture Tree Climbing. PlSc/REC 106. Associated Students University of Idaho Grant. ***$1,000***.

PRESENTATIONS

- Scharenbroch, B.C. Managing urban soils for tree health. American Society of Consulting Arborists Annual Meeting. Lake Tahoe, NV. 12/03/11.
- Scharenbroch, B.C. A soil quality index for urban trees. American Society of Consulting Arborists Annual Meeting. Lake Tahoe, NV. 12/02/11.
- Scharenbroch, B.C. Managing urban soils for tree health. Illinois Arborist Association Annual Conference and Trade Show. Tinley Park, IL. 10/26/11.
- Scharenbroch, B.C. and Catania, M. A soil quality index for urban trees. Urban Tree Growth Conference. The Morton Arboretum, Lisle, IL. 09/12/11.
- Scharenbroch, B.C. Compaction and remediation of urban soil. International Society of Arboriculture. Sydney, Australia. 07/28/11.
- Scharenbroch, B.C. Managing urban soils for tree health. Minnesota Shade Tree Conference. Minneapolis, MN. 03/16/11.
- Scharenbroch, B.C. Urban soils and tree health. Philadelphia International Flower Show. Philadelphia, PA. 03/08/11.

- Scharenbroch, B. What lies beneath: understanding urban soils. Autumn Tree Care Experts Seminar. Chicago Botanic Garden, Glencoe, IL. 02/15/11.
- Scharenbroch, B. and K. Fite. Getting to the root of site sustainability. Sustainable site development, trends, challenges, and innovations. Bartlett Tree Experts. Chicago Botanic Garden, Glencoe, IL. 01/27/11.
- Scharenbroch, B.C. Urban soil. IL Arborist Association NEMF luncheon. The Morton Arboretum, Lisle, IL. 11/18/10.
- Scharenbroch, B.C., Boelter, B., Jacobs, K., Bowles, M. and M. Cole. Impacts of 23 years of low-intensity prescribed fire on soil properties in a midwestern oak forest. International annual meeting of Soil Science Society of America. Long Beach, CA. 11/02/10.
- Scharenbroch, B.C. Urban soil. Coll. DuPage. Glen Ellyn, IL. 11/08/10.
- Scharenbroch, B.C. Organic amendments for urban trees. Chicago Trees Iniative. Center for Green Technology, Chicago, IL. 09/27/10.
- Scharenbroch, B.C. Arboriculture and compost tea. International Society of Arboriculture. Chicago, IL. 07/28/10.
- Scharenbroch, B.C. Soil. DuPage County Teacher's Association. The Morton Arboretum, Lisle, IL. 02/19/10.
- Scharenbroch, B.C. Urban trees for carbon sequestration. Urban Ecosystem Carbon Conference. Columbus, OH. 04/14/10.
- Scharenbroch, B.C. Measuring and the importance of soil organic matter. Tools of the Trade Seminar Series. The Morton Arboretum, Lisle, IL. 02/04/10.
- Scharenbroch, B.C. Urban soil. Coll. DuPage. Glen Ellyn, IL. 11/13/09.
- Scharenbroch, B.C., Flores-Mangual, M., Lepore, B., Bockheim, J.G., and B. Lowery. Tree encroachment impacts storage and dynamics of carbon in a sandy prairie in the lower Wisconsin River valley, USA. International annual meeting of Soil Science Society of America. Pittsburgh, PA. 11/03/09.
- Scharenbroch, B.C., Watson, G., and P. Kelsey. Urban soils and tree roots. American Society of Landscape Architecture. Chicago, IL. 09/20/09.
- Scharenbroch, B.C. Urban soil. Northern Illinois University. DeKalb, IL. 09/11/09.
- Scharenbroch, B.C. Earthworms and structural soil. International Society of Arboriculture. Providence, RI. 07/28/09.
- Scharenbroch, B.C. Urban soil problems and solutions. Minnesota Shade Tree Conference. Minneapolis, MN. 03/17/09.
- Scharenbroch, B.C. Old growth gaps and biogeochemical cycling. University of Illinois – Chicago. Chicago, IL. 03/02/09.
- Scharenbroch, B.C. Urban soil organic matter. Chicago State University. Chicago, IL. 11/10/08.
- Scharenbroch, B.C. Urban soil. Coll. DuPage. Glen Ellyn, IL 10/16/08.
- Scharenbroch, B.C. Urban soil organic matter. Landscape Belowground III International Conference. Lisle, IL. 10/07/08.
- Scharenbroch, B.C. Urban soil ecology. Illinois Arborist Association. Allerton Park, IL. 06/12/08.
- Scharenbroch, B.C. Urban soil compaction. Illinois IPM State Team Meeting. The Morton Arboretum. Lisle, IL. 04/10/08.
- Scharenbroch, B.C. Old growth forest gaps and soil C dynamics. The Morton Arboretum. Lisle. IL. 11/28/07.
- Scharenbroch, B.C. The origin of an urban soil. Illinois Arborist Association Annual Conference and Trade Show. Tinley Park, IL. 11/06/07.

- Scharenbroch, B.C. Soils and biogeochemical cycling in gaps of old growth northern hardwood-hemlock forests. Soil Science Seminar Series. Ph.D. defense. UW-Madison. 06/12/07.
- Scharenbroch, B.C. Soil biology for arboriculture. Healthy trees: A story of soils and roots workshop. The Morton Arboretum. Lisle, IL. 06/06/07.
- Scharenbroch, B.C. Urban landscape site and soil assessment: Parallels and POM. The Urban Forestry Institute at Rainbow Treecare workshop. St. Paul, MN. 03/19/07.
- Scharenbroch, B.C. Urban soil properties and processes. The Morton Arboretum. Lisle, IL. 11/29/06.
- Scharenbroch, B.C. Biodiversity and carbon, filling in gaps of old-growth forests. Annual meeting of the Huron Mountain Wildlife Foundation. Big Bay, MI. 07/31/06.
- Scharenbroch, B.C. Distinguishing urban soils with physical, chemical, and biological characteristics. WAA Annual Conference and Trade Show WDNR Urban Forestry Conference. Green Bay, WI. 02/06/06.
- Scharenbroch, B.C. and B. Lepore. Pine Encroachment and Soil Carbon Dynamics in a Dry Prairie in the Lower Wisconsin River Valley. Soil Science Seminar Series. UW. Madison, WI. 01/20/06.
- Scharenbroch, B.C. Biogeochemical cycling in boreal spodosol systems. Environmental Biogeochemistry. UW. Madison, WI. 04/18/05.
- Scharenbroch, B.C. Soil dynamics of gaps in old growth northern hardwood-hemlock ecosystems in the upper Great Lakes region, USA. Soil Science Seminar Series. Ph.D. prospectus. UW. Madison, WI. 04/13/05.
- Scharenbroch, B.C. Soil organic matter dynamics and nitrogen availability in urban soils. Plant Science Seminar Series. M.S. defense. UI. Moscow, ID. 12/05/03.
- Scharenbroch, B.C. Organic matter and nitrogen availability in urban soils. PNW ISA Annual Conference. Sun River, OR. 09/25/03.
- Scharenbroch, B.C. What should arborists know about soil organic matter cycling and nitrogen availability. International Society of Arboriculture Conference. Montreal, Canada. 07/25/03.
- Scharenbroch, B.C. Introducing the Student Society of Arboriculture to the Pacific Northwest. Coeur d'Alene, ID. 06/04/03.
- Scharenbroch, B.C. and J.E., Lloyd, J.E. Plant Health Care: The Soil. International Society of Arboriculture Conference, Seattle WA. 07/27/02.
- Scharenbroch, B.C. Soil organic matter dynamics and nitrogen availability in urban soils. Moscow Tree Commission. Moscow, ID. 04/20/02.
- Scharenbroch, B.C. The effects of organic mulching and fertilization on soil organic matter, soil microbial activity, and nitrogen cycling in ornamental landscapes. Plant Science Seminar Series. M.S. prospectus. UI. Moscow, ID. 08/11/01.

CONFERENCES, SYMPOSIA, AND WORKSHOPS ORGANIZED

- Midwest Urban Tree Care Forum. A Tour and Tradeshow for Students in Urban Forestry and Urban Greening. 2012. Conference Committee: Scharenbroch, B.C., Toney, A., Brink, J. and Ropollo, D. Chicago, IL. 04/13 and 04/14/11.
- Urban Tree Growth Conference. An International Meeting and Research Symposium. 2011. Conference Committee: Scharenbroch, B. McPherson, G. Roman, L., Peper, P., Bartens, J., Peterson, W., Dunning, M., Hauer, R., Grabosky, J. Lily, S., and Leibowitz, R. The Morton Arboretum, Lisle, IL. 09/12 and 09/13/11.

- Midwest Urban Tree Care Forum. A Tour and Tradeshow for Students in Urban Forestry and Urban Greening. 2011. Conference Committee: Scharenbroch, B.C., Toney, A., Brink, J. and Noark, M. Chicago, IL. 03/25 and 03/26/11.
- Midwest Urban Tree Care Forum. A Tour and Tradeshow for Students in Urban Forestry and Urban Greening. 2010. Conference Committee: Scharenbroch, B.C., Toney, A., Noark, M., and Ropollo, D. Chicago, IL. 03/23 and 03/24/10.
- Landscape Belowground III. 2008. Conference Committee and Proceedings Editors: Watson, G.W., Gilman, E., Scharenbroch, B.C., and Costello, L. The Morton Arboretum, Lisle, IL. 10/07/08 to 10/08/08.
- Healthy trees. Urban Soils and Roots Workshop. 2007. Workshop Committee: Watson, G.W. and Scharenbroch, B.C. The Morton Arboretum. Lisle, IL. 06/06/07.

PROFESSIONAL MEMBERSHIPS

- Ecological Society of America. 2001-present.
- International Society of Arboriculture. 2001-present.
- Soil Science Society of America. 2003-present.
- Illinois Soil Classifiers Association. 2007-present.
- International Committee on Anthropogenic Soils. 2007-present.
- Midwest Ecological Landscape Association. 2008-present.
- Urban Tree Growth & Longevity Working Group. 2010-present.

EDITIORIAL AND PEER REVIEWER

- Arboriculture Urban Forestry. Associate Editor and Peer-reviewer 2008-present.
- Soil Science Society of America Journal. Peer-reviewer 2008-present.
- Urban Forestry and Urban Greening. Peer-reviewer 2007-present.
- Forest Ecology and Management. Peer-reviewer 2008-present
- HortScience. Peer-reviewer 2009-present.
- Ecosystems. Peer-reviewer 2010-present.
- Cites and the Urban Environment. Peer-reviewer 2010-present.

AWARDS

- Scharenbroch, B.C. 2010. Recognition Award for Research Chair for the Illinois Arborist Association. 2009-2010.
- Scharenbroch, B.C. 2007. William and Anne Manierre Award. In recognition of excellence in scientific research concerning the natural history of the Huron Mountains. Value $500.

GRADUATE STUDENT MENTORING

- Vytas Pabedinskas. 2011-current. Urban vermicomposting and agriculture. University of Arizona. Ph.D. student.
- Doug Johnston. 2010-current. Biogeochemical cycling in Chicago greenroofs. University of Illinois-Chicago. Ph.D. student.
- Michelle Catania. 2010-current.Urban soil science. Northern Illinois University.
- Sara Dreiser. 2011. Forest soil characterization in Chicagoland. Knox College.

- Charles Flower. 2009-current. Impacts of emerald ash borer on forest gap dynamics and biogeochemical cycling. University of Illinois-Chicago. Ph.D. student.
- Scott Howard. 2008-2011. Soil ecology and prairie restorations in the Chicago. Eastern Illinois University. M.S. student.
- Brenda Boelter. 2008-2010. Survey of litter and soil invertebrates in burned oak forests. Chicago State University. M.S. student.

UNDERGRADUATE STUDENT MENTORING

- Remmy Lammering. 2011. Remediation of compacted urban soil. Oregon University.
- Mallory Boracci. 2011-current. Urban soil classification with GIS. Wheaton College.
- Abigail Gardner. General soil science. Downers Grove North High School.
- Ray Koenig. 2009-2011. General soil science. North Central College.
- Brian Bengston. 2011-current. General soil science. Naperville North High School.
- Janelle Brinley. 2011. Biochar and arboriculture. Wheaton College.
- Erick Bustria. 2011-current. Biochar and arboriculture. College of DuPage.
- Ellen Raimondi. 2011. Soil ecology and restored prairies. Northern Illinois University.
- Ashley Warren. 2011. Soil ecology and restored prairies. Northern Illinois University.
- Joyce Tanzosh. 2010. General soil science. Ohio State University.
- Sancheev Ravichandra. 2010. General soil science. High school student.
- Jeremy Lederhouse. 2009. General soil science. Northern Illinois University.
- Ali Mir. 2009. General soil science. Loyola University.
- David Kizior. 2009. Soil nitrogen analyses. North Central College.
- Christina Campagnolo. 2009. General soil science. Benedictine University.
- Ryan Hulet. 2009. General soil science. Naperville North High School.
- Mary Anderson. 2008. General soil research. Benedictine University. .
- Amy Rains. General soil science. Benedictine University.
- Lauren Frevert. 2008. Earthworms and structural soil. Aurora College.
- Leslie Esguerra. 2008. Ion chromatography and atomic emission spectroscopy. North Central College.
- Abby Farning. 2008. Inductively coupled plasma-optical emission spectroscopy. North Central College.
- Kathy Gongaware. 2008. Inductively coupled plasma-optical emission spectroscopy. North Central College.
- Tara Madziarek. 2008. Ion chromatography. North Central College. .
- Britney Rathsack. 2006-2007. Carbon cycling in old growth forests. University of Wisconsin – Madison.

TEACHING

- Introduction to Soil Science. Fall 2008 and 2010. Associated Colleges of the Chicago Area. The Morton Arboretum. Lecture and Laboratory Instructor. Original course developed. 4 credits.
- Soil Science for Horticulture. Fall 2008, 2009, 2010, and 2011. College DuPage. Guest Lecturer. 4 credits.
- Environmental Biogeochemistry. Spring 2007. U. Wisconsin-Madison. Guest Lecturer. 3 credits.
- Arboriculture Tree Climbing. Fall 2003. U. Idaho. Lecture and Laboratory Instructor. Original course developed. 2 credits.

- Principles of Horticulture. Spring 2003. U. Idaho. Laboratory Instructor and Lecturer. Original course developed. 3 credits.
- Arboriculture. Spring 2002. U. Idaho. Laboratory Instructor and Lecturer. 4 credits.
- Plant Propagation. Spring 2002. U. Idaho. Laboratory Instructor. 3 credits.
- The Science of Plants in Agriculture. Fall 2001, 2002. U. Idaho. Laboratory Instructor. 4 credits.

OTHER SERVICE AND PROFESSIONAL DEVELOPMENT

- Girl Scouts of America tree planting projects. Darien, IL. 2011.
- Arbor day presentations to various high schools and elementary schools. Moscow, ID and Chicago, IL. 2002-current.
- Central States Forest Soils Workshops. 2007-current.
- Role of the Supervisor. The Professional Development Academy. North Central College. Naperville, IL. 2007.
- Various fundraising and education activities for youth rugby. Madison, WI and Chicago, IL. 2003-current.
- Soil Foodweb Sustainable Studies Institute Workshops. Winters, CA. 2007.
- Moscow Tree Commission. Moscow, Idaho. 2002-2003.
- Tenure Review Committee for Soil Science Assistant Professor D. Strawn. University of Idaho. Moscow, ID. 2003.
- President and Founder. University Idaho Student Society of Arboriculture. Moscow, ID. 2002-2003.
- Earth day tree climbing event coordinator. University of Idaho. Moscow, ID. 2002-2003.
- Green-space reclamations. University of Idaho. Moscow, ID. 2002-2003.
- Urban park creation. Eagle Scout project. Moscow, ID. 2002.

Robert T. Fahey

Forest Ecologist
The Morton Arboretum
4100 Illinois Route 53
Lisle, IL 60532
Phone: 630-719-2419
Email: rfahey@mortonarb.org

Education

PhD **2011**
University of Wisconsin-Madison
Major: Forest and Wildlife Ecology
Dissertation: "Establishment and persistence of early successional pine species in late-successional landscapes of the Great Lakes region" 212 p.

Master of Science **2005**
Oregon State University
Major: Forest Science, *Minor:* Botany
Thesis: "Patterns in understory vegetation communities across canopy gaps in young, Douglas-fir forests of western Oregon" 153 p.

Bachelor of Science **2001**
Cornell University
Major: Natural Resources

Publications

Fahey, R.T., M. Bowles, and J. McBride. (In review). Origins of the Chicago urban forest: composition and structure in relation to pre-settlement vegetation and modern land-use. *Arboriculture and Urban Forestry.*

Fahey, R.T., M.B. Bialecki, and D.R. Carter. (In review). Tree growth and resilience to extreme drought across an urban land-use gradient. *Arboriculture and Urban Forestry.*

Fahey, R.T., C.G. Lorimer, and D.J. Mladenoff. (In prep). Habitat heterogeneity and life-history strategies influence presettlement distributions of early-successional tree species in a late-successional hemlock-hardwood landscape For submission to *Landscape Ecology.*

Fahey, R.T. and C.G. Lorimer. (In prep). Establishment and persistence of pine populations in late-successional forests: the influence of variation in habitat-mediated disturbance regimes. For submission to *Ecological Monographs.*

Fahey, R.T. and C.G. Lorimer. (In prep). Competitive status of eastern white pine reintroduced into mesic hemlock-northern hardwood stands. For submission to *Forest Ecology and Management.*

Fahey, R.T. and C.G. Lorimer. (In prep). Forest transitions at pre-settlement white pine locations in the mesic hemlock-hardwood forests of northern Wisconsin. For submission to *The Journal of the Torrey Botanical Society.*

Fahey, R.T. and K.J. Puettmann. 2008. Determination of gap influence extent based on patterns in understory plant communities. *Forest Ecology and Management*, 255: 2801-2810.

Fahey, R.T. and K.J. Puettmann. 2007. Ground-layer disturbance and initial conditions influence gap partitioning of understorey vegetation. *Journal of Ecology*, 95: 1098-1109.

Suarez, E.R., Tierney, G.L., Fahey, T.J., and **Fahey, R.T.** 2006. Exploring patterns of exotic earthworm distribution in a temperate hardwood forest in South-Central New York, USA. *Landscape Ecology*, 21: 297-306

Bohlen, P.J., P.M. Groffman, T.J. Fahey, M.C. Fisk, E.R. Suarez, D.M. Pelletier, and **R.T. Fahey**. 2004. Ecosystem consequences of exotic earthworm invasion of north temperate forests. *Ecosystems*, 7:1-12

Presentations

Fahey, R.T. and M. Bowles, Spetember 2011. Understanding the Chicago urban forest continuum. Contributed Oral Presentation at the Urban Tree Growth Workshop, Lisle, IL.

Fahey, R.T. and C.G. Lorimer, June 2011. Competitive status of underplanted eastern white pine in mesic hemlock-hardwood forests: can gap-based restoration succeed? Contributed Oral Presentation at the North American Forest Ecology Workshop, Roanoke, VA.

Fahey, R.T. C.G. Lorimer, and D.J. Mladenoff. August 2010. Persistence of Eastern White Pine in Hemlock-Hardwood Forests: An Early-successional Species in a Late-successional Landscape. Contributed Oral Presentation at Ecological Society of America Annual Meeting, Pittsburgh, PA.

Fahey, R.T., and C.G. Lorimer. August 2008. Eastern White Pine in Hemlock-Northern Hardwood Forests: Habitat Relationships and Change from Pre-settlement Condition. Contributed Poster at Ecological Society of America Annual Meeting, Milwaukee, WI

Fahey, R.T., C.G. Lorimer. April 2008. Pre-settlement distributions of eastern white pine and development of predictive habitat models. Contributed Paper at US Regional Association of the International Association for Landscape Ecology Annual Symposium, Madison, WI.

Fahey, R.T., K.J. Puettmann, and S.D. Berryman. August 2005. Patterns in understory vegetation distributions across gap openings in variable density thinned forest stands in western Oregon. Contributed Paper at Ecological Society of America Annual Meeting, Montreal, Quebec.

Fahey, R.T. and K.J. Puettmann. April 2005. Patterns in understory vegetation across gap openings in a variable-density thinned stand in western Oregon. Poster for: Science and the Northwest Forest Plan: Knowledge Gained Over a Decade, Portland, OR.

Fahey, R.T., K.J. Puettmann, and S.D. Berryman. March 2005. Patterns in understory vegetation across gap openings in a variable-density thinned stand in western Oregon. Poster for: Northwest Scientific Association Annual Meeting, Corvallis, OR.

Berryman, S.D., **R.T. Fahey**, and K.J. Puettmann. August 2004. Characterizing vegetation response to variable density thinning in young Douglas-fir forests of western Oregon. Poster for: Balancing Ecosystem Values: Innovative Experiments for Sustainable Forestry, Portland, OR.

Grants Awarded

- Fahey, R.T. 2011. Restoration of native pine species in Great Lakes coastal environments. Illinois-Indiana Sea Grant College Program. $8795.
- Fahey, R.T. and C.G. Lorimer. 2007-8. The origin and perpetuation of emergent white pines in hemlock-northern hardwood forests. Huron Mountain Wildlife Foundation. $4983
- Fahey, R.T. 2006. Ecology and restoration of supercanopy white pine in mesic hemlock-northern hardwood forests. Garden Club of America: Ecological Restoration Grant. $8000

Teaching Experience

- Forest and Wildlife Ecology 410: Principles of Silviculture. Volunteer lab teaching assistant and occasional lecturer. Spring 2007, 2008, 2009, 2010.
- Plant Pathology 123: Plants, Pathogens, and People. Co-instructor. Fall 2008.

Work Experience

- **Forest Ecologist** – *October 2010-present*
  The Morton Arboretum, Lisle, IL

- **Graduate Research Assistant** - *June 2006-2010*

Department of Forest and Wildlife Ecology, University of Wisconsin-Madison

- **Graduate Research Assistant** - *January 2004-December 2005*
  Department of Forest Science, Oregon State University, Corvallis, OR

- **Field Crew Leader -** *Fall 2003 & Summer 2004*
  Silviculture Lab, Department of Forest Science, Oregon State University, Corvallis, OR

- **Field Crew Leader/Technician** - *Summer 2002 & 2003*
  HJ Andrews Experimental Forest, Blue River, OR

- **Field Technician** - *Spring 2002*
  TERRA-PNW Lab - Oregon State University, Corvallis, OR

- **Field/Lab Technician** - *Fall 1997-Fall 2001*
  Department of Natural Resources, Cornell University, Ithaca, NY

- **Research Intern** - *Summer 2000*
  Cornell University – Arnot Teaching and Research Forest, Van Etten, NY

- **Field Technician** - *Summer 1999*
  Department of Environmental Science, Policy, and Management, UC Berkeley, Berkeley, CA

- **Field Technician** - *Summer 1997 & 1998*
  Hubbard Brook Experimental Forest, Thornton, NH

Honors/Awards

- UW Vilas Travel Award - *2010*
- HHMI Program in Scientific Teaching Fellow - *2009*
- Garden Club of America Fellowship in Ecological Restoration - *2007*
- Oregon State University Department of Forest Science Hayes Fellowship - *2005*
- Member Xi Sigma Pi Forestry Honor Society - *2005*

Service

- Wisconsin Ecology Group Graduate Representative for the Forest and Wildlife Ecology Department

Reviewer for:
- Journal of Ecology
- Plant Ecology
- Rhodora
- European Journal of Forest Research
- Journal of the Torrey Botanical Society

The Morton Arboretum - Carbon Sequestration and Resiliency of The Urban Forest
Project Partners - 2012 NUCFAC

PROJECT PARTNERS:

NAME: Karel Jacbobs, Ph.D.

LETTER OF SUPPORT INCLUDED: YES ☑ NO

NAME OF ORGANIZATION: Chicago State University

MAILING ADDRESS: 9501 S. Martin Luther King Dr.

CITY: Chicago STATE: IL ZIP 60628-1598

PHONE: 773-995-2338

NAME: Joseph J. McCarthy

LETTER OF SUPPORT INCLUDED: YES ☑ NO

NAME OF ORGANIZATION: Chicago Bureau of Forestry

MAILING ADDRESS: 2352 S Ashland, Floor

CITY: Chicago STATE: IL ZIP: 60608

PHONE: 312-746-5254

NAME: Alan Siewert and Stephanie Miller

LETTER OF SUPPORT INCLUDED: YES ☑ NO

NAME OF ORGANIZATION: Ohio DNR Division of Forestry

MAILING ADDRESS: 2045 Morse Road, Building H-1

CITY: Columbus STATE: OH ZIP: 43229-6693

PHONE: 614-265-6694

Bryant Scharenbroch
Soil Scientist
The Morton Arboretum

November 29, 2011

Dear Bryant,

I have contacted the organizers of the NSF-funded Urban STEM Talent Expansion Program (USTEP) here at Chicago State University, and we are supportive of your grant proposal and the idea to include a field educational experience for our students in the coming year. As you know, the aim of the USTEP program is to encourage minority students to participate in STEM disciplines by learning about and conducting research on various STEM topics. Our program specifically targets Urban Ecology and Urban Forestry research topics, and so I believe there is strong overlap in our collective objectives .

I wish you luck in obtaining the grant to conduct the very worthwhile research on carbon sequestration by urban forests, and look forward to finalizing the details of our participation.

Sincerely,

Karel Jacobs, Ph.D.
Associate Professor &
Coordinator of Secondary Education
Department of Biological Sciences
Chicago State University
9501 S. Martin Luther King Dr.
Chicago, IL 60628-1598
t. 773.995.2338
kjacobs@csu.edu

RE: Letter of Partnership for NUCFAC 2012 Pre-Proposal

Date: 11/28/11 at 12:31 pm CST

Bryant,

I am willing and able to assist the proposed collaborative project by assisting in the coordination of field collection of data within the city of Chicago, aide in the development of Objective 1 models and dissemination of project results within the city of Chicago. I can help post information on the City's website as well pursue posting it on the Chicago Trees Initiative site (if still online in 2012-2013).

I am interested in utilizing results that may assist in making recommendations that would relate to adaptation to climate change such as increasing soil volume and soil quality (improvements etc) especially when trees are planted in constrained sites (narrow parkways and tree pits).

Based on Forestry in-house data, 93% of Chicago street trees are located in residential areas and 7% in commercial areas. 77% are planted in medium sized tree lawns (5-10 feet wide) 9.9% in large lawns (>10 feet) , 7.7% in small tree lawns (<5 feet) and 5.5% in tree pits. This data is 17 years old but we have more recent data from 2003 that is raw data that still needs to be analyzed to calculate these percentages. In addition to the UFORE study, we have conducted two Random Sample studies (Nina Bassuk and Richard Jaenson methodology J. Arboriculture 18:171-183 1992) of our street trees; one in 1994 and one in 2003.

Joe

Joseph J. McCarthy

Senior City Forester

Department of Streets and Sanitation

Bureau of Forestry

2352 S Ashland, 3rd Floor

Chicago, Illinois 60608

Ph: 312-746-5254

Fax: 312-743-8030

Letter of Partnership for Alan Siewert and Stephanie Miller

Conference: International Society of Arboriculture

Location: Portland, Oregon, USA

Date: August 11-15, 2012

Submission: Workshop

Duration: 8 hours

Title: An Urban Site Index for Arboriculture and Urban Forestry

Authors: Alan Siewert, Urban Forester, Ohio DNR Division of Forestry
Stephanie Miller, Urban Forester, Ohio DNR Division of Forestry
Bryant Scharenbroch*, Ph.D., Soil Scientist, The Morton Arboretum

*Corresponding author
Email: bscharenbroch@mortonarb.org
Phone: 630-725-2071
Address: The Morton Arboretum, 4100 Illinois Route 53, Lisle, IL 60532

Abstract (100 words maximum):

Urban site quality assessments are imperative for improving urban tree and forest management. Recent collaboration among researchers has moved towards merging independently derived urban site indices (USI) into an accurate and practical method for assessing urban site quality. The USI can be an effective tool for diversification and long-term planning of the urban forest. The proposed workshop will present, discuss, and employ USI in classroom and field settings. The workshop will engage participants in four specific activities: (1) introduction to USI, (2) taking the USI measurements, (3) using the USI to map neighborhoods, and (4) utilizing the USI in master planting design.

Extended abstract (300 words maximum):

Urban site quality assessments are needed to improve our ability to manage urban soils and trees. Delineating soils on a large scale for municipal tree planting plans has challenged urban foresters for decades, limiting opportunities for developing diverse community planting designs. State of Ohio Urban Foresters have created a systematic method, the Urban Site Index (USI) to identify and quantify site quality based on eight site and use parameters. Researchers with the Morton Arboretum Soil Science laboratory have also identified a minimum data set for assessing urban soil quality in relation to tree growth and longevity. The urban soil quality minimum data set includes eight soil physical, chemical, and biological measurements. Recent

collaboration among these two groups have moved towards testing and merging independently derived urban site indices into a standardized, accurate, practical, and field-based method for assessing urban site quality.

Urban foresters and community managers are charged with the challenging task of creating a diverse urban forest. The USI can be an effective tool to employ towards the goal of diversification in master planting design. The USI offers new opportunities for communities to utilize site sensitive species usually discounted as street trees. The USI approach theoretically allows for long-term planning with the nursery industry, creates buy-in by citizens and decision makers, and allows for USI ground truthing.

The proposed workshop will present and discuss these urban site indices and the current state of knowledge pertaining to urban site index. Specifically, the workshop will engage participants in four specific activities: (1) introduction to USI (1.5 hours in classroom); (2) taking the USI measurements (1.5 hours in field); (3) using the USI to map neighborhoods (1.5 hours in field and classroom); and, (4) utilizing the USI in master planting design (1.5 hours in classroom).

Biographies:

Alan Siewert is a native of Wisconsin where he earned his Bachelor of Science degree in Urban Forestry from the University of Wisconsin-Stevens Point in 1984. In 1987 he came to northeast Ohio for an internship at the Holden Arboretum. Following the internship he worked as a project manager with ACRT Inc. then of Kent, Ohio. In 1990, Alan became the regional urban forester for the Ohio Department of Natural Resources, Division of Forestry. In this position Alan assists communities in 11 counties of northeast Ohio in managing their urban forest resource. Alan is a member of the International Society of Arboriculture (ISA) (since 1987), and the Ohio Chapter of the ISA (since 1988). He has served as the Chairman of the Tree Academy for the 1996 international convention in Cleveland, as a member of the Ohio Chapter Board of Directors 1994-2002, and as President 1998-99. He has also serves as Ohio's Certification Liaison 1998 to 2008 and chair of the International Certification Liaisons Committee 2001-2006 and as a board member to the ISA's certification board of directors 2007-2010. Alan is a Board Certified Master Arborist earning his certification in 1989. In 2001, Alan was honored by the International Society of Arboriculture with their Honorary Life membership for his years of dedicated service to the Certified Arborist Program and the Ohio Chapter. Alan is an accomplished speaker and educator and is the co-author of the national awarding-winning Tree Commission Academy. Alan has spoken on various urban forestry and arboriculture topics. He has appeared at the International Society of Arboriculture's International Conference in Stanford in 1999, Baltimore in 2000, Montreal in 2003, and Minneapolis in 2006 and is a regular speaker at the Ohio Tree Care Conference, North Coast Urban Forestry Conference, and The OSU Short Course as well as many other programs. Alan currently resides in Parkman Ohio with his wife, Anne, and their two children.

Stephanie Miller is a Regional Urban Forester with the Ohio DNR, Division of Forestry. Stephanie is a 1992 graduate of Purdue University with a Bachelor of Science degree in Forestry

with an Urban Forestry option. Prior to her position with the Ohio Division of Forestry, Stephanie was a Utility and Urban Forester with ACRT, Inc in Michigan and Ohio and a Service Forester with the Ohio Division of Forestry. As an Urban Forester, she assists Northwest Ohio communities with their urban forest management by providing technical and organizational tree care assistance, administering the Tree City USA program, and managing the development and delivery of Tree Commission Academy. Stephanie has been a member of ISA since 1992, is a Certified Arborist and Municipal Specialist, and is a member of the 2011 Ohio Tree Care Conference Planning Committee. She is also an active member of the Society of American Foresters and has been the Ohio SAF's Chair, Urban Forestry Chair, and Communications Chair. She was recently named a SAF Fellow, has served on the SAF Communications Committee, and has been a presenter at three SAF National Conventions. Stephanie is a frequent speaker and writer on a variety of urban forestry and arboricultural topics in Ohio and nationally and is the co-author of the national awarding-winning Tree Commission Academy. She is the Committee Chair of Findlay, Ohio's Cub Scout Pack 309 and Registration Chair for the Hancock County Open Arms Domestic Violence *Walk a Mile In Her Shoes* annual fundraiser. Stephanie lives in Findlay, Ohio with her husband, Greg, and their two sons.

Bryant Scharenbroch is a Soil Scientist at the Morton Arboretum in Lisle, IL. Bryant received a Ph.D. in Soil Science from the U. Wisconsin-Madison, a M.S. in Plant Science from U. Idaho, and B.S. degree from U. Wisconsin - Stevens Point in Urban Forestry and Forest Management. He is the primary investigator of the Morton Arboretum Soil Science laboratory, which has three primary focus areas: 1) improvement of urban soils for landscape trees; 2) urban ecosystem biogeochemical cycling; 3) urban soil genesis and classification. He is published in numerous peer-reviewed scientific journals and has presented at many international and regional meetings. Bryant is an Associate Editor for Arboriculture and Urban Forestry. Bryant's research has been funded by the International Society of Arboriculture TREE Fund, Illinois Department of Natural Resources, United States Department of Agriculture, and National Science Foundation. He is a member of the Soil Science Society of America, Ecological Society of America, Illinois Soil Classifiers Association, International Society of Arboriculture, Chicago Wilderness, Midwest Ecological Landscape Association, and International Committee on Anthropogenic Soils.

USDA United States Department of Agriculture | Forest Service | Northern Research Station | 5 Moon Library SUNY-ESF Syracuse, NY 13210

nrs.fs.fed.us/units/urban/ dnowak@fs.fed.us Fax: (315) 448-3216 Phone: (315) 448-3200

Date: November 29, 2011

Dr. Bryant Scharenbroch
Soil Scientist
The Morton Arboretum
4100 Illinois Route 53
Lisle, IL 60532-1293

Dear Dr. Scharenbroch,

Thank you for the opportunity to participate within your proposed NUCFAC project: Carbon Sequestration and Resiliency of the Urban Forest. I would be happy to participate in this project by providing guidance and suggestions as needed and to incorporate your results within the i-Tree model related to carbon in urban soils and trees. Good luck with the proposal.

Sincerely,

David J. Nowak
Project Leader

United States Department of Agriculture | **Forest Service** | **Northeastern Area State and Private Forestry** | **1992 Folwell Avenue St. Paul, MN 55108**

Date: 11- 28-11

To: Nancy Stremple,
Executive Staff to NUCFAC
USDA Forest Service
Sidney Yates Building (1- Central)
201 14th Street S.W., MS-1151
Washington, DC 20250-1151:

I'm writing this letter of support for the upcoming NUCFAC 2012 grant opportunities on behalf of the Morton Arboretum. I have worked at a professional and personal level with the Arboretum for a number of years and as a concerned citizen and natural resource professional. I value their research, applied science and excellent work results. They consistently strive towards applying emerging scientific methodology towards the resolution of real world natural resource problems and environmental issues. I believe their proposed study in the area of Carbon Sequestration and Resiliency of the Urban Forest will yield valuable data and a focused understanding of the issue for years to come.

Sincerely,

Thomas Dilley
Natural Resources Specialist
U.S.D.A. Forest Service
Northeastern Area, State and Private Forestry
1033 University Place Suite 360
Evanston Illinois 60201
phone# 847 866 9311 x 14
cell # 847-997-7776
fax # 847 866 9506
tdilley@fs.fed.us

Metropolitan Mayors Caucus

November 29, 2011

Bryant Scharenbroch, PhD
Soil Scientist
The Morton Arboretum
4100 Illinois Route 53
Lisle, IL 60532-1293

Dear Mr. Sharenbroch:

Thank you for contacting the Metropolitan Mayors Caucus with regard to your to National Urban and Community Forestry Challenge Cost-Share Grant Program proposal. The Caucus is pleased to offer its support and partnership for your effort.

Increasing understanding of urban forest responses and mitigation potential related to projected climatic change would be very beneficial to the 274 member municipalities of the Metropolitan Mayors Caucus. Currently, stakeholders lack a comprehensive understanding of carbon storage in urban ecosystems, the resilience of urban forests to projected climatic fluctuations, and variation in these factors across a continuum of urban site conditions. Filling in these important knowledge gaps with existing data would greatly inform the decisions of urban foresters and policy makers resulting in better understanding of the potential for urban ecosystems to sequester and store carbon and the likely response of urban trees to projected climate change across a metropolitan region.

The Metropolitan Mayors Caucus will assist your project through disseminating information to its members and engaging its members to support data collection.

Sincerely,

David Pope
Oak Park Village President and

233 South Wacker Drive, Suite 800, Chicago, Illinois 60606
Tel: 312.201.4505 Fax: 312.258.1851
www.mayorscaucus.org

Northern Illinois University

Department of Geography

Mike Konen, Ph.D., CPSS, CPSC
Associate Professor
Graduate Program Coordinator
Northern Illinois University
Department of Geography
212 Davis Hall
DeKalb, IL 60115

Voice 815-753-6849
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http://www.niu.edu/geog/

11-28-11

This letter is written to confirm my participation in and to strongly support the pre-proposal titled "Carbon Sequestration and Resiliency of the Urban Forest" submitted by Dr. Bryant Scharenbroch and Dr. Robert Fahey of the Morton Arboretum. I have been collaborating with Dr. Scharenbroch on soil carbon and soil quality projects since his arrival at the Morton Arboretum and have had undergraduate and graduate students internship at Morton Arboretum. The potential for future undergraduate and graduate student mentorship and training would be greatly enhanced by this proposed research project.

My research focus is on human impacts on soils and landscapes. I have been actively investigating soil carbon dynamics in native, agricultural, and restored ecosystems in the glaciated Midwest. There is paucity of data available on soil carbon dynamics in urban systems. This proposal would significantly strengthen this data set and contribute immensely to our understanding and modeling of carbon dynamics.

Mike Konen Ph.D.

November 28, 2011

I am writing in support of the proposed funding request for research in the area of carbon sequestration and the resiliency of the urban forest. Over the last few years we have seen a sharp increase in our clients' and stakeholders' desire to understand the ecological benefits of trees especially in urban areas. People, including governmental officials and policymakers, are beginning to understand and appreciate the values of trees that go far beyond what they can see. Much of this has been driven by aggressive climate action plans, ordinances to reduce heat islands and storm water runoff mitigation desires. I also work with a number of not-for-profit groups involved in planting and caring for trees in urban areas. Research of this nature would greatly benefit many groups that are working to make our cities more livable though the planting and care of trees in our toughest areas. The many groups that work to make our cities more livable need good research on why trees make a difference in climate change issues and how their efforts contribute to a local and global benefit.

The Bartlett organization itself is committed to research as it benefits our employees and the clients they serve. We may assist in this project in a number of ways as we are currently partnering with the Morton Arboretum in looking at the potential use of biochar to help urban trees. We know biochar has intriguing properties in carbon sequestration yet our current research is not looking at this aspect. Our role may include access to research plots in urban areas, the Bartlett research grounds and/or the use of trees under our care for the study. Our scientists and laboratory facilities may also be used in this partnership.

There is a strong need for good science in this area and we believe the researchers proposing to lead this research are some of the best in the world in this area.

Sincerely,

Scott Jamieson
Vice President
847 770-0141
sjamieson@bartlett.com

The Morton Arboretum
4100 Illinois Route 53
Lisle, IL 60532-1293

Megan Dunning
Manager of Community Education & Outreach
The Morton Arboretum
4100 Illinois Route 53
Lisle IL 60532-1293

Bryant Scharenbroch
Soil Scientist
The Morton Arboretum
4100 Illinois Route 53
Lisle IL 60532-1293

November 28, 2011

Dear Bryant,

The 2013 symposium on the effects and value of the urban forest that we discussed as a product of your USDA Forest Service Urban and Community Forestry grant proposal is an excellent fit to the goals of our adult education programs. The education team will be happy to work with you in coordinating your proposed symposium.

Your proposal will be an excellent fit for the education program's symposium series on the biology, management, and conservation of urban forests and woody plants. Our past symposia on topics related to urban trees and forests were highly successful, and highlighting the value of these forests is directly aligned with the Arboretum's mission. We have the experience needed to ensure excellent publicity and hosting for the event. I'm excited to be able to include the proposed symposium in our education planning for 2013. Thank you for providing this opportunity for our audiences, and I look forward to collaborating with you on this event.

Sincerely,

Megan Dunning

630-968-0074
Fax 630-719-2433
trees@mortonarb.org

The Morton Arboretum
4100 Illinois Route 53
Lisle, IL 60532-1293

March 27, 2012

Dear Committee:

The Morton Arboretum Community Trees Program is an enthusiastic partner with The Morton Arboretum Department of Research on the grant proposal for "Carbon Sequestration and Resiliency of the Urban Forest." This project is designed to fill important knowledge gaps by studying carbon storage in urban soils, urban tree growth resilience, and developing and validating an urban tree site index.

We agree that a stronger understanding of urban forest responses and mitigation potential related to projected climatic change is needed to support work in urban and community forestry into the future. We look forward to participating in collaborative efforts with arboretum research scientists to reach the broadest range of audiences with the information collected. These audience groups include: municipal leaders, municipal and commercial arborists, tree planting groups and environmental organizations, community associations, and the general public.

As a partner, The Community Trees Program will assist in project activities, such as the development and dissemination non-technical, user friendly, handouts. This will include supporting outreach through the Sustainable Landscape Resources for Community Associations (SLRCA) initiative and other tree planting and environmental organizations in the Chicagoland region.

We believe that this research will develop a more comprehensive understanding of carbon storage and tree resilience in urban ecosystems. This information is critical in supporting regional and national scale data bases for carbon sequestration by urban trees. By building on existing urban forest data sets to fill existing knowledge gaps this study will benefit the region by providing a more complete understanding of the potential for urban ecosystems to sequester and store carbon and the potential effects of climate change on our urban trees. This information will help us more accurately determine and promote the benefits of urban trees.

Sincerely,

Beth Corrigan
Community Trees Program
Project Coordinator