City of Tampa Urban Ecological Analysis and Management Plan 2010-2012

Scope of Work

INTRODUCTION

The City of Tampa (City), University of South Florida (USF), University of Florida (UF) and the UF-IFAS/ Hillsborough Extension Service completed an ecological analysis of the City's urban forest in 2006-2007[1]. Nearly five years old, the 2006 project examined the temporal change in canopy coverage from 1975-2006 and concluded that average citywide tree cover of 29% had returned to 1970s levels, that tree cover change was not positive in all areas of the City, but that the potential existed to substantially increase tree cover on most land uses within the City. The project also established two-hundred permanent sampling plots to conduct a robust scientific analysis of the vegetative structure, functions, and values provided by Tampa's urban forest. The estimated 7.8 million trees in Tampa provided ecosystem services with an annual economic value in the tens of millions of dollars and a replacement value of $1.4 billion, but that the health of trees on privately maintained land uses was much lower than those on publicly maintained lands. Using the results of the 2006-2007 study and grant monies from the State of Florida, the project team developed a report describing existing and possible urban tree canopy[2] and helped the City initiate the process to develop a long-term urban forest management plan. A major outcome of this effort was a vision (with goals) for urban forest sustainability developed by the Mayor's Steering Committee on Urban Forest Sustainability. More recently, the project team assisted the Department of Parks and Recreation to develop a survey of community preferences regarding urban forests. This project will re-examine the City's urban forest as required by the Tampa tree ordinance (Ord. No. 2006-74, § 9, 3-23-06) and develop Tampa's first long-term urban forest management plan.

The project team will leverage the results of recent efforts to benefit the City. As part of the Tampa Bay Watershed Forest Working Group, project team members have

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[1] Andreu, MG, Friedman, MH, Landry, SM, & Northrop, RJ. (2008). *City of Tampa Urban Ecological Analysis 2006-2007*: City of Tampa Parks and Recreation Department. Available as Florida Cooperative Extension Service EDIS document FOR203, http://edis.ifas.ufl.edu/fr265.

[2] Landry, SM, Andreu, MG, Friedman, MH, & Northrop, RJ. (2009). *A report on the City of Tampa's existing and possible urban tree canopy. Final report to the City of Tampa, February 19, 2009.* : City of Tampa, Florida, http://www.fccdr.usf.edu/upload/documents/Tampa-FOS-Document-lo-res.pdf.

conducted several scientific and applied research projects to better understand the social, physical, ecological and economic dimensions associated with urban forest management in the Tampa Bay area. Research funding from sources other than the City have contributed to knowledge that will be shared with and used by the stakeholders who will participate in the development of the City of Tampa Urban Forest Management Plan.

The purpose of this project will be three-fold:
1. To re-inventory Tampa's urban forest in order to complete a 5-year update to the Tampa Urban Ecological Analysis (UEA);
2. To utilize both new and previously collected field and remote sampling information to conduct a detailed analysis of structural and spatial change to Tampa's urban forest since 2006; and
3. To develop a science-based, publicly-supported, fiscally responsible Urban Forest Management Plan based on the vision and goals developed by the Mayor's Steering Committee on Urban Forest Sustainability.

The project will be lead by members of the unique research team representing the City, USF, UF, IFAS and nationally recognized urban researchers from the USDA Forest Service and the Spatial Analysis Laboratory of the University of Vermont.

PROJECT GOALS & OBJECTIVES
The primary goals of this project are to guide the City in the development of a comprehensive Urban Forest Management Plan, including specific recommendations on policies, procedures and practices, and to provide the information required by policy makers, planners, utilities, environmental managers, businesses and citizen volunteers to optimize the benefits and values of the urban forest while minimizing management costs. This project will demonstrate Tampa's commitment to becoming a sustainable city by both building upon the latest scientific knowledge and by using innovative approaches that will serve as a model for other US cities. Although the efforts outlined in this project are designed to be interrelated and complementary, this scope of work is organized according to two major tasks: task one is the development of the Urban Forest Management Plan; and task two is the re-inventory and update to the *City of Tampa Urban Ecological Analysis 2006-2007* and the *Report on the City of Tampa's existing and possible urban tree canopy* as well as the detailed change analysis that will allow the City to understand the dynamics of their urban forest. These tasks are outlined below.

PROJECT TASKS

Task 1: Development of an Urban Forest Management Plan
In cooperation with the Office of the Mayor and the City Council, the project team will develop a comprehensive Urban Forest Management Plan (Management Plan). The Management Plan will use the 5-year urban forest inventory cycle set by City Council to monitor progress and update the plan's goals and objectives. We will accomplish this through an open, inclusive and collaborative stakeholder driven process that builds upon the results of existing and proposed analysis of the urban forest. Work efforts to

support the development of the Management Plan are outlined below in chronological order. Based on revised ideas to better achieve project goals, and with agreement with City staff, the specific order of tasks and exact specification of work efforts may differ slightly from this original project plan. The following is an outline and brief description of specific efforts.

Subtask 1.1 Community Preferences Survey and Analysis

The project team will conduct a survey of City of Tampa neighborhood association members to identify the perceptions of community members regarding the urban forest. Survey results will be analyzed within the context of the Urban Ecological Analyses, mission and goals statement the Mayor's Steering Committee on Urban Forest Sustainability, and Forest Opportunity Spectrum. To encourage a continuing dialogue with residents and inform the future development of the Management Plan the results of the survey will be presented in a public and advertised meeting of the Tampa Homeowner's Association of Neighborhoods.

Subtask 1.2 Organization of a Technical Advisory Committee

In cooperation with the Office of the Mayor and the City Council, the project team will organize a Technical Advisory Committee (TAC) whose members will represent the various City departments that use, manage or otherwise impact the ability of the City to sustain its urban forest resources. The anticipated role of the TAC will be to support the development of the Management Plan through the provision of needed technical information, practical advice, and periodic review of the Urban Forest Management Plan at various stages of development.

Subtask 1.3 Verification of Goals and Generation of Alternatives for Action

The project team will organize a series of facilitated and structured meetings with the TAC and stakeholders identified by the City of Tampa to verify and prioritize the initial set of goals identified by the Mayor's Steering Committee on Urban Forest Sustainability; generate alternatives for action; select the preferred action alternative; and evaluate the preferred alternative relative to existing public policies, fiscal constraints and the City's internal organizational structure.

Subtask 1.4 Generate Urban Forest Master Plan

The development an Urban Forest Master Plan will be guided by information generated by the 2007 Urban Ecological Analysis, 2010 Social Survey and outcomes from the goal verification and action strategy sessions (subtask 1.2). The final plan will contain measureable objectives and monitoring criteria addressing such issues as the development of a comprehensive green infrastructure system including a citywide streetscape plan; regeneration, maintenance and development of a mature canopy; integration of the Urban Forest Master Plan into land use planning and zoning activities; and recommendations to focus volunteer initiatives and educational efforts. The final 'draft' plan will be reviewed for comments by both the TAC and stakeholders identified by the City of Tampa. Comments will be used by the project team to further refine the final Urban Forest Management Plan. The 'proposed' Urban Forest Management Plan will be presented to the Mayor's Executive Committee, City Council, the TAC and stakeholders identified by the City of Tampa.

<u>Task 1 Deliverables:</u>

1. The project team will plan and facilitate ten (10) meetings: two (2) meetings with the Mayor's Steering Committee on Urban Forest Sustainability, four (4) TAC meetings, four(4) open forums for city residents, and meetings as required with the Office of the Mayor and/or City Council
2. Urban Forest Master Plan in PDF format
3. Five-hundred color copies of the executive summary report
4. Web pages hosted as part of the Tampa Bay Forest Working Group website to provide public access to meeting minutes, interim reports and final Management Plan
5. Presentation of project results to The Mayor's Executive Team,City Council, Parks and Recreation Department, and two additional presentations to be determined by the City
6. Citizen and neighborhood volunteer efforts will use the Community Forest Steward Program (University of Florida/Hillsborough County Extension)

Task 2: Re-inventory Tampa's Urban Forest

The primary goal of this task will be to re-inventory Tampa's urban forest, producing comparable deliverables as the 2006 Tampa UEA (City of Tampa Parks and Recreation Dept. PO#POPR07100305). The research approach for task one will include detailed mapping of the urban forest utilizing remote sensing technologies, field sampling techniques to quantify the structure of the urban forest, and scientifically proven modeling techniques to evaluate the economic benefits and ecosystem services provided by Tampa's urban forest. Research objectives for this task includes the following major components:

- Map the extent of tree cover within the City and quantify tree cover with respect to several important factors, including, but not limited to: land-use; neighborhood; sociodemographic properties; parcel attributes; land values; and right-of-way characteristics.
- Revisit the 200 permanent field plots, located to represent all land uses within the City, to measure tree and forest structural and ecological characteristics, and to model forest health, diversity, age, condition and the associated economic benefits and ecosystem services.
- Take advantage of the availability of five-year detailed monitoring information and by one of the first US cities to conduct a change analysis designed to understand the sustainability, future outlook, and management needs of the urban forest.

In addition to updating the information provided within the 2006-2007 Tampa UEA, the deliverable for this task will include updated maps describing the distribution of existing and potential tree canopy, and geographic information systems and other data products for use by City of Tampa staff. The subtasks below provide a brief description and outline of the project team's approach to completing this task.

<u>Subtask 2.1: Project Planning</u>
A primary goal of this first subtask will be to determine the detailed work efforts, schedule, and products to be delivered by task two. As with the previous (ie 2006) UEA,

the raw data collected during the field sampling and remote sensing efforts will fuel much additional analysis beyond the scope of this one project. It is thus prudent to review and discuss the methods to be employed, planned analysis to be performed, and the products and formats to be delivered. The project team will host a planning meeting with City staff to discuss these details, and if necessary and within the constraints of the budget, make minor adjustments to the scope of the project.

Subtask 2.2: Urban Forest Analysis using Remote Sensing Techniques
The purpose of this task will be to utilize remote sensing techniques with recent satellite imagery in order to analyze the citywide urban forest. Using the latest high-resolution satellite imagery, on the ground image calibration procedures, and advanced image analysis techniques, the project team will characterize the tree canopy and other vegetation cover at the scale of the property parcel within the City of Tampa. Unlike the 2006 UEA, this project will benefit greatly by the ability to plan and schedule the collection of satellite imagery. Image collection will be planned for late spring 2011 in order to remain comparable to the April timeframe used during 2006 and earlier efforts[3]. Concurrent with the scheduled dates of image collection, the project team will conduct on-the-ground sampling in order to determine the spectral signature of select tree species and calibrate the satellite imagery to at-ground reflectance. The result of this effort will produce a very high resolution imagery dataset of the City of Tampa suitable for additional future analyses by the City or external researchers (e.g. reduction in stormwater runoff by the tree canopy). In other words, the City will benefit from the knowledge provided by the unfunded work efforts of researchers who study Tampa using the 2011 imagery dataset collected for this project (e.g. including academic publications[4]). The project team will employ object-based techniques to develop a 2011 tree canopy classification dataset suitable for the analysis of individual trees and tree patches (e.g., estimated number and size of trees located within the public right-of-way) and comparison with 2006 tree canopy.

Subtask 2.3 Inventory Field Work and UFORE Analysis
The purpose of this subtask will be to monitor the permanent field plots located within and near the City of Tampa randomly located as part of the 2006 study. During the spring and summer of 2011, the project team will conduct field sampling of these 200 plots following the methodology outlined by the U.S. Forest Service UFORE (urban forest effects model) and modified during the 2006 study. Although the project team was able to gain access during the 2006-7 sampling period to all field plots located on private lands, re-visits to some plots may not be feasible due to property owner restrictions. Data to be collected will include, for example: plot tree cover, tree species, DBH, height, crown width, health, ground cover, distance and direction to buildings, and other parameters. Analysis of the field results will provide information related to the

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[3] Campbell, KN, & Landry, SM. (1999). *City of Tampa urban ecological analysis*. Tampa, Florida: University of South Florida, Florida Center for Community Design and Research.

[4] Pu, R. (2010). Mapping urban forest tree species using IKONOS imagery: Preliminary results. *Environ. Monit. Assess.*; Pu, R, Landry, SM, & Yu, Q. (Accepted). Object-based urban detailed land cover classification with high spatial resolution IKONOS imagery. *Int. J. Remote Sens.*; Landry, SM, & Pu, R. (2010). The impact of land development regulation on residential tree cover: An empirical evaluation using high-resolution IKONOS imagery. *Landscape Urban Plann., 94*(2), 94-104.

physical structure and health of the urban forest as well as the economical benefits and ecosystem services trees provide in the urban environment. The UFORE model application maintained by the US Forest Services will be used to estimate ecosystem services, while other statistical techniques will be used to provide descriptive structural and diversity characteristics.

<u>Subtask 2.4 Report Preparation & Data Analysis</u>
The project team will produce a single final report with all of the same components as the *City of Tampa Urban Ecological Analysis 2006-2007* and the *Report on the City of Tampa's existing and possible urban tree canopy*. In addition to fifty (50) color printed and bound copies, the final report will be provided in PDF format that includes an active (ie clickable) table of contents. GIS data layers created during the project, including the satellite imagery and classified tree cover, will be provided with appropriate metadata in an ArcGIS compatible format for distribution by the City. Finally, the project team will develop up to ten web pages for use on the TampaGov.net website to highlight the results of tasks one and two, and provide access to the PDF version of the full report.

Analyses to be performed and provided in the final report, at a minimum, are as follows:
- Citywide tree canopy temporal change from 2006-2011;
- Tree cover summarized by neighborhood; land use; socio-demographic properties; parcel attributes; land values; and right-of-way characteristics;
- Maps and summarized describing the distribution of existing and potential tree canopy for different land use categories, including right-of-way;
- Tree species diversity summarized by land use;
- Citywide and land use specific tree species abundance;
- Density of trees by land use category;
- Tree species size distribution;
- Tree, shrub and ground cover estimates by land use category;
- Leaf area by tree species;
- Relative health of trees by species and land use;
- Relationships between tree age and health in right-of-ways and public land uses;
- Residential heating/cooling energy savings and CO_2 emissions avoided
- Estimated air pollution removal by trees, including carbon monoxide (CO), nitrogen dioxide (NO2), ground-level ozone (O3), particulate matter (PM10), and sulfur dioxide (SO2);
- Carbon dioxide (CO2) storage and annual sequestration amounts by tree species, size class and land use; and,
- Estimated compensatory (ie replacement) value of trees in Tampa by land use;

<u>Subtask 2.5: Analysis of Urban Forest Change in since 2006 in Tampa</u>
This project will be one of the only studies nationwide to conduct a re-inventory of field plots and second UFORE analysis, combined with an updated detailed urban tree canopy cover classification. The data provided by these efforts will be an invaluable information resource to understand the sustainability, future outlook, and management needs of Tampa's urban forest. The purpose of this task will be to select and conduct specific analyses of 2006-2011 urban forest change, out of the many possible analyses

supported by the data collection efforts. The research approach to be taken as part of this task will involve significant collaboration between the project team and City of Tampa staff. As a follow up to subtask 2.1, the project team will work with the City during planning meetings to refine the specific change analyses to be performed. City staff from multiple departments, including those responsible for utility management and growth management, will be consulted in order to identify analysis priorities. Specific change analysis to be performed in conjunction with this project will be contingent upon the approval by designated project manager representing the City. Analysis results will be provided as a separate section within the same final report specified for Subtask 2.4. In addition, a separate executive summary will be developed as a stand-alone document to highlight the change analysis results.

Specific 2006-2011 urban forest change analyses are expected to include:
- Change to tree canopy cover by neighborhood, watershed, City Council District, planning area or other defined geographic areas of the City;
- Parcel-based changes to the extent of tree canopy cover, summarized by land use, property value, building age, and other parcel characteristics;
- Change to the extent of tree canopy cover with respect to estimates of socio-demographic change
- Land-use specific change in forest health, species diversity, and abundance;
- Changes to tree species and size class distributions on right-of-way and other public land use categories
- Citywide changes in forest composition; and,
- Citywide and land-use specific changes to estimated ecosystem services and economic benefits provided by Tampa's urban forest.

Task 2 Deliverables:
1. Final report in PDF format
2. Change analysis executive summary report in PDF format
3. Fifty (50) color printed and bound copies of the final report
4. Five-hundred color copies of the Change analysis executive summary report
5. Up to 10 web pages hosted as part of the Tampa Bay Forest Working Group website to provide public access to all project results
6. GIS data layers compatible for use by City staff using existing software and information technology infrastructure
7. Development of a 20-40 minute PowerPoint presentation summarizing project results
8. Presentation of project results to The Mayor's Executive Team, City Council, Parks and Recreation Department, and two additional presentations to be determined by the City

PROJECT TEAM
The project team will leverage existing expert knowledge, data resources, equipment and facilities to complete this project at no cost to the City. The project team will provide conventional forestry field equipment required of Task 2, including: GPS (sub-meter

resolution), laser hypsometers, clinometers, and diameter tapes. Transportation to field plots will be provided by an existing UF vehicle currently under the management of Dr. Michael Andreu. As a direct result of managing previous urban forest field data collection to support UFORE modeling, project personnel are familiar with anticipated equipment needs, possess the required equipment, and will make the necessary equipment available for use with the proposed project. The geospatial analytical software applications ESRI ArcGIS and eCognition, high-powered 64-bit workstations designed for GIS and remote sensing data processing are available at the USF research center directed by Shawn Landry. Salaries for Michael Andreu and Robert Northrop are not being requested. Select project team members are listed below:

Name	Organization
Shawn Landry, USF Project Manager	University of South Florida (USF)
Robert Northrop, UF-IFAS Project Manager	UF-IFAS & Hillsborough Extension Service (IFAS)
Michael Andreu, UF Project Manager	University of Florida (UF)
Melissa Friedman	University of Florida (UF)
Ruiliang Pu	University of South Florida (USF)
Jarlath P.M. O'Neil-Dunne	Spatial Analysis Lab, University of Vermont
B. Terry Johnson	University of South Florida (USF)
J. Morgan Grove	Northern Research Station, USDA Forest Service
Wayne C. Zipperer	Southern Research Station, USDA Forest Service

CITY ASSISTANCE
1. The City will provide the Consultant lawful right of entry to City property for a mutually agreeable time period.
2. The City will assist the project team with the notification of residents and City employees, such as park employees and public safety officials, as to the nature of this project and the Consultant's presence in the neighborhoods.
3. The City will dedicate staff time to participate in project and planning meetings
4. The City will send announcements to property owners within the city boundaries requesting access to property for the purposes of re-sampling permanent plots
5. The City will provide information on public policy, regulations and departmental procedures that influence the management, health and distribution of the urban forest

TIMEFRAME
The duration of this project will begin Summer 2010 and end Fall 2012.