The University of Arizona Campus Arboretum Tree Benefits Assessment

The landscaped grounds of the University of Arizona, Tucson, are rooted in the research and educational missions of the land grant institution. As a cultural connection to Arizona's history and as a living laboratory, the more than 7000 trees on the UA campus from arid regions of every continent, provide a resource for outreach and service both to the state and to other arid, regions globally. The value of the campus is appreciated for its role in defining a unique sense of place, for its beauty and rich connection to the State and University history. However, trees serve as part of the University's green infrastructure providing unaccounted services that improve air quality, reduce atmospheric pollutants and greenhouse gas emissions, mitigate urban heat islands, conserve energy, filter water, reduce municipal costs for flood control and contribute to offsetting climate changes. In essence, trees serve as a source of natural capital that is the currency fundamental to the ecosystem processes sustaining the health of all life on earth. As a land grant institution, the University of Arizona has an important responsibility to apply its research expertise so as to model natural resource stewardship by judicious planning and efficient management. Our natural capital is foundational to all other endeavors and can and it should be accounted for and managed just as we would our financial or human capital.

To promote environmental and economic sustainability and provide decision support for campus administrative units responsible for campus planning and management, the UA Campus Arboretum collected quantitative data using the latest models and urban forestry research to define in numerical and monetary terms the value of the campus trees. This benefits assessment quantified the structure of the university's urban forest and calculated the environmental services that trees provide. This baseline data can be used to demonstrate value and guide priorities for more effective decision-making and ultimately, to link campus activities with environmental quality and community livability.

Forest structure: An inventory of **6070** trees on main campus revealed **44%** of the collection is represented by **10** species. **39%** are broadleaf evergreen, **33%** deciduous, **20%** palms and **9%** conifers. Relative age distribution, as estimated by trunk diameter, revealed **13%-37%** of trees are newly planted compared with **63%-77%** of trees that have reached maturity. (Possible conclusions: fewer new trees planted, smaller trees planted or less trees are reaching maturity). Tree canopies cover **12.9%** of campus. To maximize ecosystem services provided by urban forests in the southwest, **25-30%** canopy cover is required.

Total value of ecosystem services: The total value of these ecosystem services provided by the campus forest is **$272,997** each year with an average of **$44.95** in benefits/tree. Collectively, a conservative estimate of the total replacement value of all campus trees is **$28, 217,339**, without consideration for additional value resulting from positive impacts on university recruiting/retention or state historical and cultural significance.

Energy savings: By consuming solar energy in the process of evapotranspiration and blocking winter winds, campus trees help reduce energy use by **433MWh**, valued at approximately **$55,065**. Through direct shade, the trees provide even greater energy conservation benefits.

CO2 sequestration and avoidance: Trees reduce the amount of carbon dioxide (CO_2) generated by energy production. As they grow, they also store CO_2 from the atmosphere. Together, these

processes reduce CO_2 per year, valued at **$29,180** from permanently storing **3,890,698lbs** of CO_2 and sequestering and avoiding **708,010lbs** of additional CO_2 annually. This is equivalent to the reduction in CO_2 emissions that would result from decommissioning almost 300 automobiles now and an additional removal of 30 vehicles for each year of the trees' life.

5lbs = .0025metric tons (1 metric ton = 2200 lbs)

1 car produces 5 metric tons CO2 / year. (5 metric tons x 2200 = 11000lbs co2/car annually)

Stormwater: Stormwater management reduces runoff and protects municipal water quality. Trees not only reduce runoff and protect water quality but also intercept rainfall and reduce soil erosion. The existing campus forest traps and filters nearly **2,867,671 gallons** of stormwater each year, with an associated savings of **$13,766**.

Air quality: Trees intercept and absorb atmospheric pollutants. The campus trees remove **1,474 lbs** of air pollutants, with an estimated value of **$13,675**. After accounting for negative contributions to air quality, the net contribution of campus trees to air quality is estimated to be **$12,450** with a net **632lb** reduction in air pollutants. Trees also impact air quality indirectly through energy conservation and reduced power plant emissions.

Additional metrics: The campus forest offers many other environmental benefits that are less easily quantified including reduced evaporative emissions from parking surfaces that contribute significantly to poor air quality. It is estimated that increasing parking lot shade to 50% reduces evaporative emissions by several tons a day. Tree shade also helps protect pavement by reducing wear and tear on asphalt. A California study, estimated that unshaded streets required more than twice as many repavings over a 30-year period than shaded streets. Finally, trees are primary producers, supporting a diverse ecosystem and sustaining biodiversity, central to environmental resilience. Relative performance and contributions of known species should be considered along with additional and deliberate trees selection to maximize biological diversity.

Campus Arboretum Future Work

There are a number of other ways that the forest can contribute to UA sustainability goals in the future. Tree benefits data will be added to the Campus Arboretum database, along with the life histories of all campus trees to support future strategic planning and plantings that not only enhance generation of natural capital but also guide management practices which increase the return on investment from the landscape.

The ecosystem services and environmental benefits as well as the cultural and aesthetic value of the existing campus forest are likely significant, but are currently undocumented. The social, cultural and human health benefits of green spaces on worker productivity, opportunities for recreation, impacts on recruiting, retention, illness and recovery time could all be documented to aid in improved landscape planning and performance.

Institutional processes could be modified to align known tree benefits with