

Reference Cities—The Science Behind STRATUM

When you import a project into STRATUM you are asked to choose your climate zone (STRATUM Climate Zones Map). The STRATUM program uses data specific to each zone to model the costs and benefits of trees. In order to calculate tree-related benefits for your city, STRATUM must know what species are most likely to be found in your region, how big the trees are expected to grow, how quickly they will reach mature size and what leaf area they will have. These factors vary by location due to differences in growing conditions, management practices, climate, and soils. Nineteen regional tree-growth zones, based on aggregation of climate zones from Sunset's *National Garden Book* (Eyre 1997), have been identified for the nation. Cities within a zone are assumed to have similar species of trees with similar growth and size traits. The Center for Urban Forest Research (CUFR) has completed eight regions and work is underway in three additional regions.

The regional tree data are based on measurements from a Reference City (STRATUM Climate Zones Map). Approximately 800 trees are randomly sampled—40 trees of each of the 20 most common species. For each species, five to ten trees from each diameter at breast height (dbh) size class are measured for dbh, tree height, crown diameter, crown shape, and tree condition. Planting dates are determined from city records and other local sources. Crown volume and leaf area are estimated from computer processing of tree-crown images taken with a digital camera. This method has shown greater accuracy for open-grown trees than other techniques ($\pm 20\%$ of actual leaf area)¹. Regression analyses are used to determine regionally specific growth curves, so that the tree-related benefits can be estimated for each year of a tree's life.

STRATUM's economic analyses use regional energy prices, property values, water prices and stormwater costs. Regional energy prices, typical energy use, and water prices are collected from the utility companies in the Reference City. Property values and land-use distribution (single-family residence, multi-family residence, commercial, etc.) are determined from local data. Air-pollutant emissions are calculated based on the regional mix of fuels used to produce electricity, natural gas consumption, and hourly weather data. Stormwater costs are estimated with the help of local stormwater officials. Prices for trees and tree maintenance are determined from surveys of municipal foresters and local arborists. All this information is incorporated into STRATUM as regional default values. However, default values such as benefit prices can be adjusted to better reflect local conditions.

Each Reference City is the basis for the regionally specific modeling capabilities of STRATUM and also serves as the basis for CUFR's *Tree Guidelines* series. For more information on the methodology behind STRATUM and other data that are part of the modeling process, please see the *Tree Guidelines* volume for your region, available on our website: <http://cufr.ucdavis.edu/>.

¹ Peper, P.J. and E.G. McPherson. 2003. Evaluation of four methods for estimating leaf area of isolated trees. *Urban Forestry and Urban Greening* 2:19–30. Available at <http://cufr.ucdavis.edu>.