TREES

Help Cities Meet Clean Water Regulations

Tree cover in urban areas can provide cities with reduced costs for stormwater management and improvement in water quality. American Forests has developed a computer software package to measure the effects of urban tree cover and impervious surfaces on stormwater that will help city managers meet ever tightening water quality regulations. Scientific research and time-tested engineering practices provide the basis for the software calculations.

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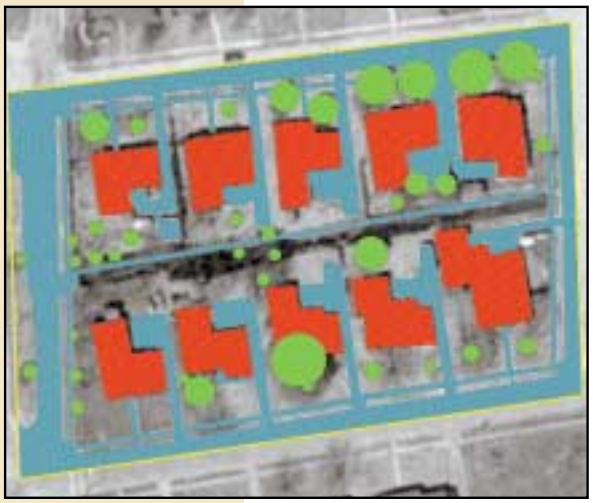
TREES
Tackle Clean Water Regs

CITYgreen computer software is helping cities heighten water quality through increased canopy cover.

In the late 1960s and early 1970s the quality of the nation s waterways was so bad that by 1972 Congress passed the Clean Water Act and launched an effort to remove pollution from the nation s waterways, bring back the fish, and make safe swimming possible.

Since the passage of the Clean Water Act, water quality has improved substantially, but the work is far from finished. In 1990 the Environmental Protection Agency (EPA) reported to Congress that one-third of U.S. waterways were impaired by stormwater runoff which directly affects water quality.



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In the images above and to the right, green circles represent trees (here, actual tree cover); red blocks, buildings; and blue, impervious surfaces such as streets and sidewalks.

Today the EPA s regulatory efforts continue and are directed at more and different sources of pollution. Continuing the cleanup will engage a wider audience and require more innovative approaches. Locally, cities can employ new strategies such as using trees to help clean water naturally and tying urban greening to property cost-saving incentives. AMERICAN FORESTS CITYgreen software has been designed as a tool to help people understand how trees affect stormwater and to help them make better planning decisions.

As communities grow, urban infrastructure expands and water quality regulations tighten, and stormwater managers are faced with a difficult challenge. How can they reduce the volume and improve the quality of the water that drains from impervious (impenetrable) surfaces as it makes its way into surrounding waterways? In most cities today, almost all stormwater runs rapidly off roads, sidewalks, parking lots, rooftops, and other impervious surfaces.

The traditional engineering goal has been to move stormwater out of the community as efficiently as possible through a series of gutters, sewers, and drainage ditches. However, experience has shown that moving water quickly from one place to another creates more problems than it solves, including a drop in water quality.

A more modern approach is to move water slowly through cities, allow for infiltration on site, minimizing flooding and maintaining water quality. This shift away from built infrastructure is taking hold; EPA now recognizes nonstructural methods, such as increasing tree canopy cover for slowing stormwater runoff, as a best management practice (BMP).

AMERICAN FORESTS has studied the effects of trees on the urban environment for 20 years, utilizing the scientific research and engineering resources of federal agencies and academic institutions. From this research it is apparent that urban forests are indicators of the environmental quality of a community and that they provide measurable benefits, in particular: reducing stormwater flow and improving water quality. These valuable services can be calculated and translated into dollars.

Trees help manage stormwater flow by intercepting rainfall and slowing the rate at which it runs over the surface of the land and seeps into the ground. When trees are present, the flow of water is spread over a greater amount of time (time of concentration), and the impact of a storm on the facilities built to handle it at any one time is smaller.

Reducing the volume of stormwater and its peak flow reduces the size and cost of stormwater structures. By incorporating trees into a city s infrastructure, managers can build a smaller, less expensive stormwater management system.

Trees are also natural pollution filters. Their canopies, trunks, roots, and associated soil and other natural elements of the landscape filter polluted particulate matter out of the flow toward the storm sewers. Reducing the flow of stormwater reduces the amount of pollution that is washed into a drainage area. Trees use nutrients like nitrogen, phosphorus, and potassium byproducts of urban living which can pollute streams.

As stormwater management issues have become more complex, communities across the country have found an innovative solution and a way to fulfill regulatory requirements to improve water quality. In Garland, Texas, for example, the city established a stormwater utility in 1991 to fund stormwater management projects for improved flood control, water quality treatment, groundwater recharge, and ecological preservation projects.

The city has mapped all of its impervious surfaces so

it can accurately assess the amount of stormwater flowing over a parcel. Instead of linking the stormwater fee to real estate value or charging everyone a flat fee, the property owner s fee is linked to the amount of impervious surface on his or her property and to the volume of stormwater that property generates. The more you have, the more you pay.

Garland, Texas, is expanding its stormwater formula to include information provided by AMERICAN FORESTS CITYgreen. A recent CITYgreen analysis conducted by AMERICAN FORESTS and The Davey Tree Expert Company showed the value of the city s existing urban forest canopy in terms of stormwater costs and modeled the effects of trees in slowing stormwater given various urban development options.

Findings suggest that if Garland s existing tree canopy cover was removed, the city would have to contend with 19 million additional cubic feet of stormwater. The cost to build retention facilities to handle this additional stormwater would be $38 million. (This would be about $2.8 million annually, based on a conservative, $2 per cubic foot cost of constructing retention ponds. These construction costs are based on the assumption that such facilities are rebuilt or that significant maintenance work is performed every 30 years. Annual benefits are essentially treated as avoided annual payments on a 6 percent interest loan over 30 years, which would otherwise be necessary to construct the additional facilities.)

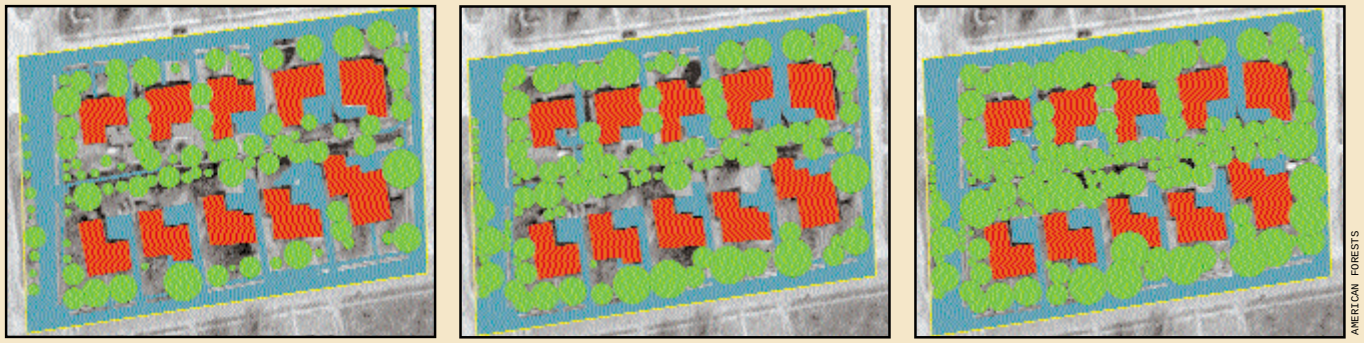
The analysis is based on the Natural Resource Conservation Service s methodology for assessing stormwater flow in small urban watersheds. Known as Technical Release 55, the model is the most widely used for this application in the United States.

The city of Garland has now put all the pieces of the puzzle together toward meeting EPA s clean water program. The city can offer property owners a direct incentive for reducing the amount of stormwater that flows off their property.

By reducing the amount of impervious surface and increasing the number of trees and other vegetation, citizens can reduce their stormwater utility fee. City managers can now show citizens the dollars saved in doing so, using AMERICAN FORESTS CITYgreen. With these incentives, the city of Garland will be greener and its waterways cleaner.

Communities across the country must contend with the same stormwater and water quality issues and regulations as Garland, Texas. The city s innovative approach to managing stormwater can be considered a model for others. A comprehensive approach to stormwater management includes nonstructural BMPs increasing urban tree cover to slow stormwater runoff and improve water quality. Cities can now link a reduction in impervious surfaces to a reduction in stormwater fees. With CITYgreen they can show people the direct relationship between increased tree canopy and reduced stormwater runoff. As the nation works toward improving water quality, every city can employ these strategies so that the goals set by the Clean Water Act a quarter-century ago can become a reality in our lifetime. AF

A CITYGREEN ANALYSIS SHOWED THE VALUE OF GARLAND S URBAN FOREST CANOPY IN TERMS OF STORMWATER COSTS.



MODELING THE CITY S FUTURE

Through modeling various tree canopy cover percentages, a CITYgreen analysis shows how increasing canopy can save stormwater construction costs. A CITYgreen analysis of a 3.86-acre residential site in Garland, Texas, shows that an 8 percent tree canopy cover (page 18) reduces by 34 cubic feet per acre the amount of stormwater that would otherwise require management. When canopy cover is increased to 25 percent, 35 percent, and 45 percent (above, from left), stormwater is reduced by 4,223, 5,941, and 7,635 cubic feet per acre, respectively. At $2 per cubic foot stormwater retention construction cost, this translates to an avoided cost of $2,630,

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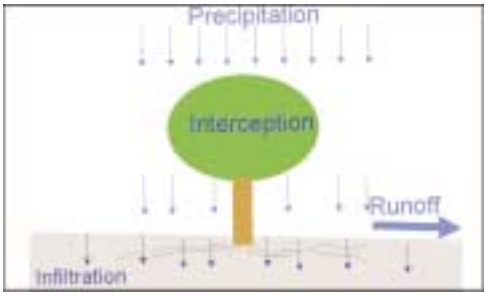
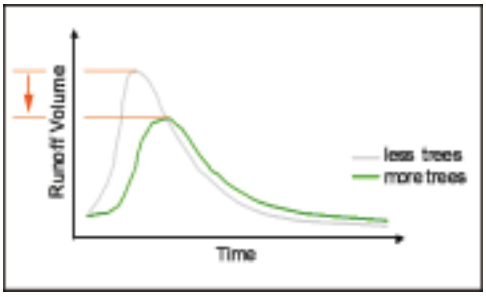
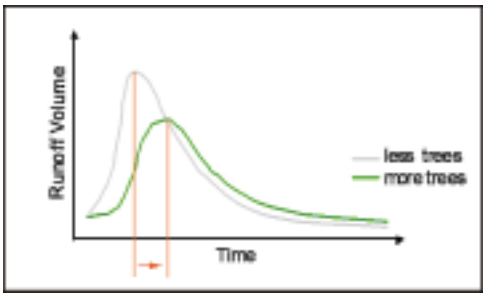
Jeff Beattie, Cheryl Kollin, and Gary Moll are part of AMERICAN FORESTS Urban Forest Center, Beattie as natural resources analyst, Kollin as director, and Moll as vice president.

Tree Effects on the Hydrologic Cycle

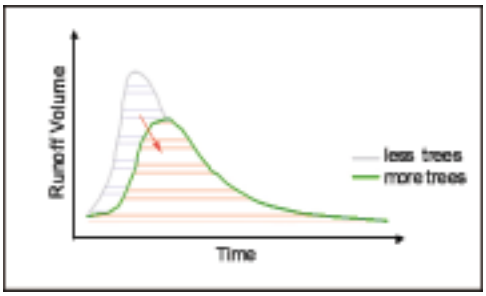




Trees Reduce Peak Flow



Trees Increase Time to Peak Flow



Trees Decrease Total Runoff Volume

These hydrographs show how trees intercept and slow stormwater runoff including reducing volume, increasing the time of concentration, and reducing peak flow.

How Trees Slow Storm water Runoff

Trees slow storm flow, reducing the volume of water that must be managed in urban areas and decreasing the amount of runoff that containment facilities must store. Trees and soil work together in this stormwater reduction effort. Trees lessen stormwater flow by intercepting rainwater on leaves, branches and trunks, slowing its movement into channelized drainage areas. Stormwater volume is also diminished when some intercepted water evaporates into the atmosphere or soaks into the soil. This net reduction in total volume and peak flow lessens the potential for flooding, a critical concern during heavy rains. Structural stormwater management control costs are reduced as well.

During light rains, trees provide their greatest benefit by promoting soil permeability to facilitate goundwater recharge. Reducing impervious surfaces and increasing tree cover promotes the movement of water into the water table.

Technical Release-55 and CITYgreen

The stormwater runoff calculations in CITYgreen incorporate engineering formulas from the Urban Hydrology of Small Watersheds model, (TR-55), developed by the U.S. Natural Resources Conservation Service (NRCS). This method is widely used for stormwater planning as well as in urban engineering analyses. Don Woodward, P.E., a hydrologic engineer with NRCS, customized the formulas in CITYgreen to determine the benefits of trees and other urban vegetation with respect to stormwater management.

The TR-55 model uses a "runoff curve number" based on land cover and soil characteristics to estimate resulting stormwater runoff. The curve numbers in TR-55, primarily used for agricultural conditions, were modified for various urban conditions such as trees, grass, ground cover, shrub and impervious surfaces in CITYgreen.

CITYgreen calculates stormwater runoff volume, peak flow and time of concentration and can model the percent change between two land cover scenarios. To estimate the dollar benefits of stormwater reduction provided by trees, the total volume of avoided storage runoffis multiplied by the construction costs for building retention facilities. For example, in Garland, Texas, the city's trees provide 19 million cubic feet in avoided storage (for an average maximum two-year, 24 hour storm event). When multiplied by a conservative $2 per cubic foot construction cost, tree cover would contribute about $38 million. Annually, this would be $2.8 million, calculating the cost of construction financing over the 30 year life of a facility.

American Forests' CITYgreen software provides individuals, organizations, and agencies with a powerful tool to evaluate development and restoration strategies and impacts on urban ecosystems. American Forests offers training workshops and technical support for CITYgreen and is a certified ESRI developer and reseller of ArcView products. For further information contact:

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