A 2010 BREN GROUP PROJECT

BREN SCHOOL OF ENVIRONMENTAL SCIENCE & MANAGEMENT
UNIVERSITY OF CALIFORNIA, SANTA BARBARA

GreenLA

Evaluating the Impacts of Small-Scale Urban Greenspace: A Case Study of Harlem Place in Downtown Los Angeles

Project Members
Theresa Morgan
Kathryn Riley
Rebecca Tannebring
Leanne Veldhuis

Project Advisor
Christina Tague

Client
The Sustainability Committee for the Downtown Los Angeles Neighborhood Council

On the web at http://fiesta.bren.ucsb.edu/~greenla/

PROBLEM
There is a lack of information on the potential impacts of small-scale greenspace on ecosystem services and uncertainty in how different designs can be used to maximize local and regional benefits.

SIGNIFICANCE
Urban environments rely on natural systems outside their boundaries to provide resources and mitigate pollution. Diminishing undeveloped land increases the need to integrate ecological services into existing infrastructure to enhance environmental and social health.

Project Background and Significance

As of 2007, more people live in cities than rural areas and this urbanization trend is accelerating. With increasing human-dominated landscapes, there is less undeveloped land available to provide natural amenities and environmental services. Urban greenspace was historically planned as large parks in distinct settings within city boundaries to provide respite for residents. With less available space, however, there is a need to integrate smaller parcels of greenspace into the existing fabric of the urban built environment.

In addition to providing aesthetic appeal, urban greenspaces can provide ecosystem services which mitigate common environmental and human health problems. While much research has been conducted to quantify the impacts of large-scale greenspace, there is a lack of information on the effects of redeveloping smaller, interstitial areas. No comprehensive model exists to provide guidance on how to best approach small-scale greenspace projects and assess the ecosystem services provided by small parcels of urban greenspace.

Los Angeles is a city with an overall lack of open space and degraded ecological functioning. Our project works to fill this need and assist our client, the Sustainability Committee for the Downtown Los Angeles Neighborhood Council (DLANC), in creating a long-term greening strategy for Downtown LA. The DLANC works with local stakeholders to understand and articulate the needs of the community, but lacks information on the potential value of small-scale greenspace. This information is crucial to convey the importance of urban greenspace and mobilize support. We chose to use Harlem Place, an alley in Downtown LA, as a case study to demonstrate how to quantify site-specific impacts of greenspace on relevant ecosystem services.

DLANC Downtown Los Angeles Neighborhood Council
Sustainability Committee

KEY QUESTIONS
How can a conceptual framework guide the design and evaluation of greenspace redevelopment projects?

What are the tangible and intangible impacts of small-scale greenspace on ecosystem services?

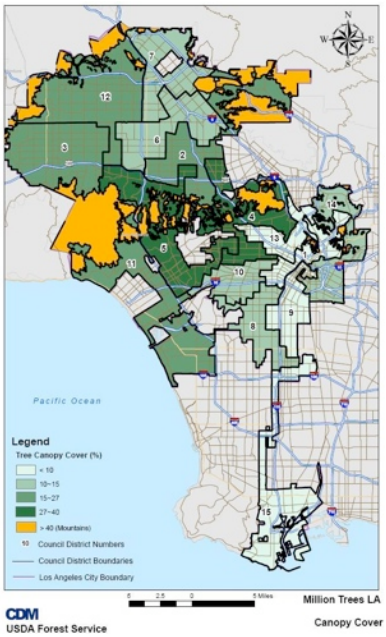
To what extent can ecological functioning be restored in urban environments, and what is the value?

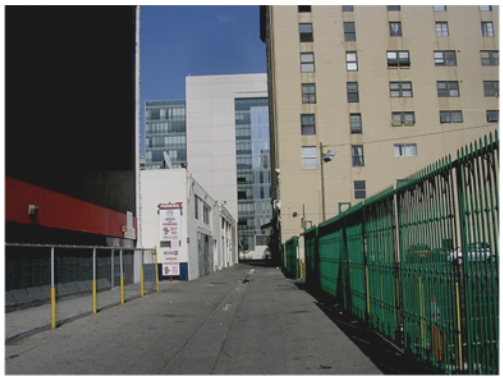
Project Goals

- Develop conceptual models for five urban environmental issues to communicate key design considerations, constraints, and tradeoffs for providing ecosystem services on local and regional scales
- Create six different greenspace design scenarios for Harlem Place to illustrate the application of conceptual models and evaluate the impacts of interstitial greenspace on ecosystem services

Downtown LA Overview

Downtown Los Angeles is an area with many environmental and livability issues. Downtown residents do not have much access to traditional greenspace; only 30% of LA residents live within walking distance of a park. Downtown LA has ten times as many workers as residents, resulting in a high proportion of commuters. This creates problems of increased commuter miles, vehicular air pollution, and little sense of community ownership. Since 2007, however, there has been a 20% increase in the residential population Downtown. This influx of new residents creates demand for more open spaces and natural amenities in the Downtown.





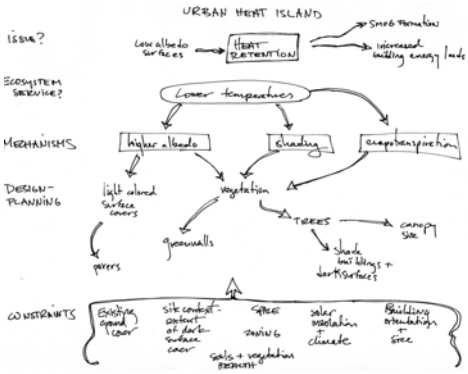
Harlem Place Today

Our study site, Harlem Place, is a seven-block service alleyway that runs between S. Spring St. and S. Main St., from W. 2nd to W. 7th St. through the historic core of Downtown LA. We used Harlem Place as a demonstration project to provide the Downtown community with a visualization of what greening an underutilized space, such as an alley could look like, in addition to what services it could provide to the community.

Rethink what Harlem Place could be...

Methods and Models

We created five conceptual models to understand the links between greenspace and ecosystem services by identifying the issues, mechanisms, design options and constraints.



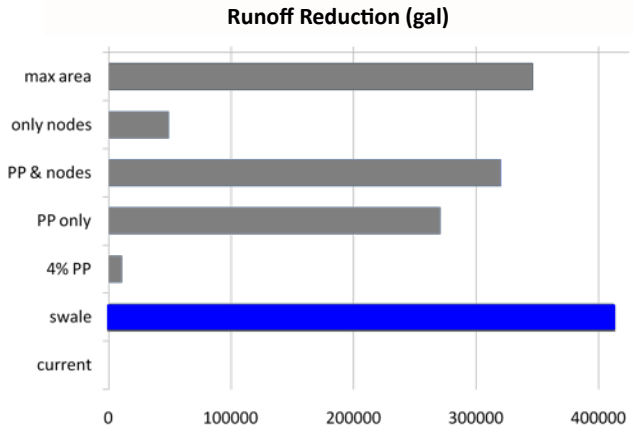
Based on these conceptual models we created six greenspace design scenarios for Harlem Place and measured their impacts on five urban issues:

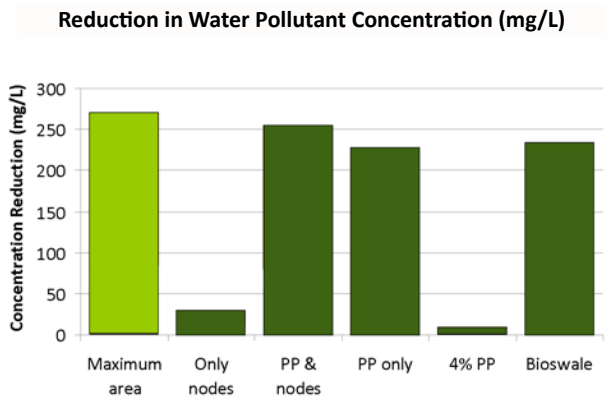
1. **air quality**
2. **stormwater runoff & quality**
3. **urban heat island mitigation**
4. **carbon dioxide mitigation**
5. **livability**

We used a combination of models, coupled with our own calculations and a literature review, to fill knowledge gaps. To quantify air particulate capture and carbon sequestration, we used the iTree Streets model developed by the US Forest Service. To quantify stormwater runoff, we used L-THIA, a long-term hydrologic impact assessment model, created by Purdue University and the US EPA. We used literature review and a community survey to assess impacts on livability, urban heat island, carbon mitigation, and stormwater quality, and to cross-reference our findings. Our design scenarios varied type and extent of permeable pavers and vegetation to quantify effects on each issue.

Results

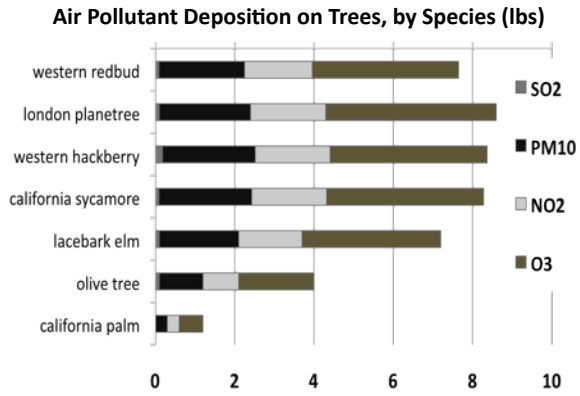
Varying the type and amount of different design features changes ecosystem service impacts. Comparing our six scenarios in Harlem Place revealed that permeable pavers and bioswales had a greater effect on reducing stormwater runoff and increasing pollutant removal than did trees and shrubs. From our physical site surveys, we found that the greatest opportunity was for paved surfaces, but also identified existing node space that could be planted with vegetation.





Design scenarios that incorporated greater amounts and distribution of permeable pavements and bioswales could capture close to all stormwater runoff in Harlem Place. The urban heat island effect was difficult to model and quantify, due to its complexity and the lack of transferability of modeling tools. Microclimate improvements are primarily local; tree shade and evapotranspiration provide pedestrians walking through the alleyway cooler, more pleasant temperatures. A pedestrian walking under the immediate shade canopy of a tree can experience a 4˚C to a 20˚C decrease in temperature during prime daylight hours. Greenwalls can potentially add an additional 2˚C cooling effect to the proximate area.

Airborne pollutant capture by specific tree species is quantifiable, but in relation to the degraded air quality of LA, the impacts were relatively small. A design that maximizes vegetation (45 trees) did not bring the site into EPA compliance for ozone, but could capture approximately 40 lbs of common air pollutants - SO_2, NO_2, and PM_{10}.



Air pollution and microclimate improved most in designs that included various tree species, due to increased shading and evapotranspiration.

Constraints

Spatial and regulatory constraints determine which designs are feasible for a greenspace redevelopment project, and small-scale projects, like Harlem Place, require creative design to maximize impacts. Regulations in LA required our project to maintain vehicle access to Harlem Place, which significantly reduced available space for vegetation. Our physical site surveys and in-depth research on regulatory constraints were critical to identifying underused opportunities, such as node spaces, that could be transformed into functional greenspace.

Issues of Scale

Ecosystem services can be biophysical or social in nature, and impacts will differ between local and regional scales. At a regional scale, many impacts of greening a single alley is negligible. However, the aggregate effects of interstitial greenspace can be significant. In Los Angeles, stormwater management and air quality are issues of regional concern. By increasing permeability, small-scale greenspace projects can address urban runoff affecting the Santa Monica Bay and by creating spaces for vegetation, improve air quality especially if many redevelopments occur throughout the city.

Community Relevance

Issues Downtown Residents Ranked as High Level of Concern

Shade, Stormwater, Lack of Vegetation, Air Quality, Access to Parks


4%

11%


16%


19%


20%

The DLANC conducted a community survey to determine that Harlem Place residents are primarily concerned with livability in their immediate neighborhood. However, when asked to rate their level of concern for issues Downtown, more residents rated air quality (73%) and access to recreational park space (77%) as a high concern. This demonstrates that residents are concerned with ecological functioning (e.g., air quality) on a regional scale, but value aesthetics and increased community interaction specific to Harlem Place. Livability is difficult to quantify, but affording people the opportunity to relax and walk within an aesthetically appealing space increases use, thereby increasing safety and community interaction. This feedback effect works to build support for more projects, which can cumulatively achieve significant biophysical results on a larger, regional scale.

The type of design stakeholders want is dictated largely by education and perceived value of greenspace. Small-scale greenspace can improve specific ecosystem services, but there may be a disconnect between the stakeholder priorities and what design features are most feasible or will yield the greatest impact. Greenspace design must to be tailored to the constraints of the site as well as the needs of the stakeholders. Importantly, greenspace designs can also serve as education tools about what benefits they can provide. Generally, we found that stormwater and air quality were the most easily quantifiable ecosystem services in Harlem Place, but residents expressed more concern about air quality than stormwater. This demonstrates that the ecosystem services that are most easily quantifiable are not always the most important to the local stakeholders.

Conclusions

As urbanization continues to increase, small-scale greenspace will play a pivotal role in providing healthy, livable urban environments.

Harlem Place serves as a tangible prototype to demonstrate the potential impacts of small-scale greenspace redevelopment, and our conceptual models provide a design framework to guide future greenspace projects. While many of the impacts we modeled were local, interstitial greenspace can provide substantial regional improvements if implemented throughout an entire region. Quantification of these potential impacts helps build political and community support to create and maintain urban greenspace projects. Project design, however, needs to consider both local and regional perspectives and include community, policy, and professional stakeholders. Our project reveals the need to rethink what urban greenspace can be and how it can be effectively integrated back into the urban built environment.

KEY FINDINGS

1. Greenspace impacts must be quantified on a relevant scale
2. Changes in microclimate most affect human comfort within the alley
3. Redesign has the potential to capture close to all stormwater falling on the alley and from roof drainage
4. Changes in air quality from pollutant deposition on trees are quantifiable, but redesign did not bring Harlem Place into EPA compliance for ozone
5. While vegetation sequesters carbon, there are embedded carbon costs to site construction and maintenance that need to be accounted for - time scales are relevant
6. It is critical to communicate the intangible improvements on livability as well as the quantifiable biophysical impacts to generate support for future greenspace

***Acknowledgments**: Christina Tague, Ashley Zarella-Hand, Gunnar Hand, Joe McFadden, Dave Nowak, Stephanie Pincetl, Jennifer Wolch, Josh Segal and the AECOM Design + Planning Team, Arturo Keller, Jason Wickert, Lauren Takeda, Stewart Patterson, and the Downtown Community*