Understanding the Effects of Low Impact Development on the Energy Balance Within A Microclimate

Rachel Burnett
Internship for Science-Practice Integration

Monica Rabb, City of Glendale Mentor

Paul Westerhoff, DCDC Faculty Mentor

Can Utilizing Low Impact Development Stormwater Management Practices in Landscape Design Work to Ameliorate Urban Heat Island Effects?

- The City of Glendale is assessing the efficiency of implementing **Low Impact Development (LID)** as a form of stormwater management in urban retrofits and future landscape design in order to meet stormwater retention requirements.
- LID is a strategy that aims to create **functional landscapes** to manage stormwater, controlling flooding and contaminant levels typical of impervious surfaces in urban landscapes. LID offers the opportunity to maintain or replicate the benefits of existing riparian ecologies, including soil stabilization and water quality improvement, with practices focused on **basic maintenance** and **efficient design**.
- LID resources list Urban Heat Island (UHI) mitigation as a benefit. As the city hopes to promote compact urban development that is supported by a sustainable built environment, the evaluation of this benefit is essential for the advancement of LID in city design.

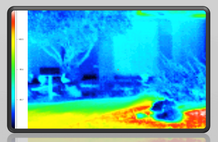
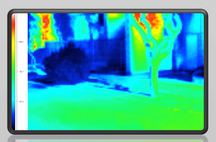
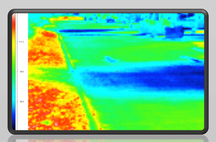
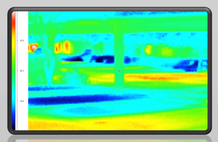
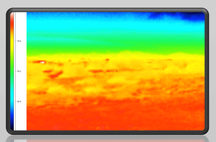
Glendale Public Library	Foothills Public Library	Glendale Park-n-Ride	Power Road Park-n-Ride	Prospective Park-n-Ride





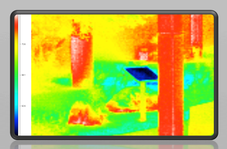
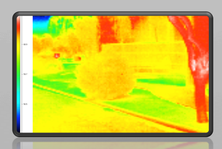
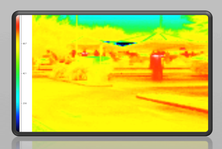
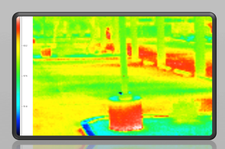
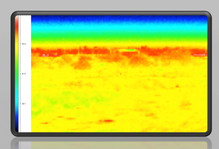
Daytime Temperatures (°F)

Min.	72.3	71.4	72.7	72.8	77.6
Max.	118.2	116.3	119.9	104.0	94.9
Avg.	95.3	93.9	96.3	88.6	86.3

Nighttime Temperatures (°F)

Min.	58.7	53.9	59.1	51.0	47.6
Max.	79.2	75.4	79.6	69.3	67.9
Avg.	69.0	64.7	69.4	60.2	57.8

Spatial Configuration, Variation of Surface Cover, and Adjacent Land-Use Are Determining Factors of Thermal Storage Within the City of Glendale's Case Study Sites.

- LID promotes the minimization of impervious surfaces by narrowing roads, creating green spaces interspersed within urban areas, and encourages tree growth; **all of which have been shown to alleviate urban warming.**
- **LID may not directly mitigate thermal storage of urban surfaces.** but does encourage the consideration of site orientation, local land-use, efficient design layout, and landscaping to make optimum use of microclimatic conditions
- By approaching site design from an LID perspective, city management can encourage best management practices that benefit local urban landscapes, on a site-by-site basis, creating efficient, sustainable development.

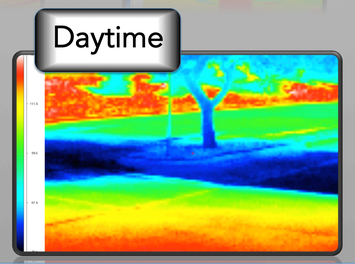
The Urban Heat Island Effect describes the warming of daytime and nighttime temperatures of urbanized areas that are composed of surface materials that increase heat storage, in comparison with non urban sites.

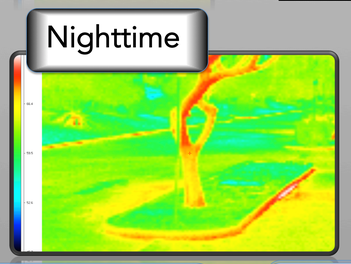
UHI can be measured by analyzing temperatures at night when solar radiation stored in urban surfaces during the day is released into the atmosphere.

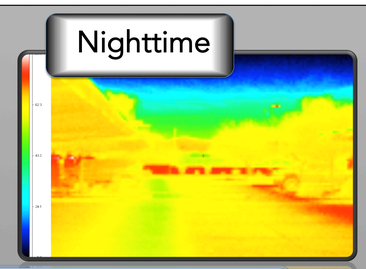
Thermal Imaging and a handheld ifrared thermometer were used to examine LID concepts in place at Glendale Case Study Sites and were contrasted with corresponding sites that exhibit typical landscape design of the arid southwest. The prospective Park-n-Ride site was also assessed for thermal storage of pre-development land surface.

Minimum and maximum temperatures for each image, and those collected by the handheld infrared thermometer were averaged to compare daytime thermal storage with nighttime release of energy across all sites

Glendale Park-n-Ride
Key LID Practice:
Permeable Concrete



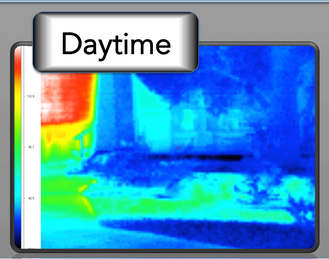


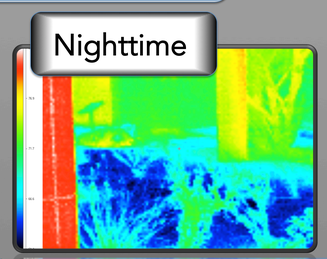


Permeable Concrete (the lower, right portion of the shown surface) exhibited higher temperatures than the concrete concourse in direct sun but had the lowest temps under the canopy of trees and shaded structures in each lot row, showing greater variability.

At night, temperatures across the permeable pavement still show higher thermal storage and greater variability in temperature range.

Glendale Public Library
Key LID Practice: Rain Garden





Cooling is provided by the orientation of the building, the depressed vegetated swale, and concentrated evaporative transpiration and shade supplied by the vegetation.

The semi-enclosed spacial orientation of the walls and shading structure behave as a barrier to thermal release at night.

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