Look Up to Make Room for a Greener NYC

Photo © Michael Treglia/TNC

Nature plays a crucial role in the life of New York City. Green roofs atop the city's buildings offer environmental, economic, and public health benefits to our communities. Yet today, roofs are a largely untapped resource; there are approximately 1 million buildings in New York City, but, as of 2016, there are only 736 green roofs (installed on less than 0.1% of the city's rooftops). There is ample opportunity for increased public resources and incentives for green roof installations on public and private properties.

GREEN ROOFS PROVIDE DIVERSE BENEFITS IN AN URBAN LANDSCAPE

A green roof, or living roof, is a roof that is partially or completely covered with vegetation, a growing medium such as soil, waterproofing, and a drainage system. They play a critical role in helping cities adapt to a world with more extreme weather, including more frequent and intense heat waves and storms. Green roofs provide multiple benefits including improved air quality, increased insulation, and greater energy efficiency that helps reduce greenhouse gas emissions.

Reducing the amount of dark rooftop surfaces (e.g. from exposed asphalt or tar-and-gravel rooftops) helps to reduce urban heat island effect, a significant threat to human health, on hot days[i]. Green roofs also absorb stormwater, helping to reduce street-level flooding and combined sewer overflow events. In the coming decades, the benefits of green roofs will become even more significant for the city's climate resiliency and New Yorkers' health and wellbeing, as the frequency of heat waves is expected to triple, and we expect nearly 1.5 times as many extreme precipitation events by 2080.[ii]

Cities across the United States and the world, including Paris, Denver, Chicago, Washington D.C. and Philadelphia, have been installing, promoting, incentivizing and mandating this multi-benefit technology. Over the past decade in New York City, green roofs have received increasing attention from government agencies, developers, building owners, and residents.

The results are clear: rooftops are an underutilized asset that could be working much harder for New Yorkers.

To support public and private sector initiatives seeking to realize the diverse benefits that green roofs provide, The Nature Conservancy undertook a comprehensive mapping project to characterize the number, location, size, and distribution of green roofs on both public and private property in New York City, which was previously unknown.

KEY FINDINGS: ROOM TO GROW

The 736 green roofs on public and private buildings cover only about 60 acres (or 0.15% of all rooftop surface area). Because so much of New York's landscape is covered by buildings, there is enormous potential for increasing the sustainability and resilience of the city, and quality of life for residents, by increasing the number of green roofs.

Nearly 90% of green roofs are located on private property, with most of those (254) installed on residential buildings. However, the largest footprint of green roofs comes from private, institutional facilities—namely from two installations at the Jacob Javits Convention Center in midtown Manhattan and Barclays Center in downtown Brooklyn. Due in part to their large building sizes, they make up approximately 9.31 acres (or nearly 15% of the total area of installed green roofs in the city). Owners of private buildings appear to be installing green roofs to capture associated environmental and economic benefits.

Most green roofs are small. We estimate the median area of a green roof in New York City is about 1200 square feet—just under 1.5 times the size of an average Manhattan apartment (866 square feet). Though large, flat-roofed buildings can be significant areas of opportunity, installations on many small buildings that can accommodate green roofs may yield significant benefits in the aggregate. This provides an opportunity for further research as well as for policy. As the City Council considers options to accelerate the expansion of green roofs, providing different types of incentives and rules may facilitate faster uptake.

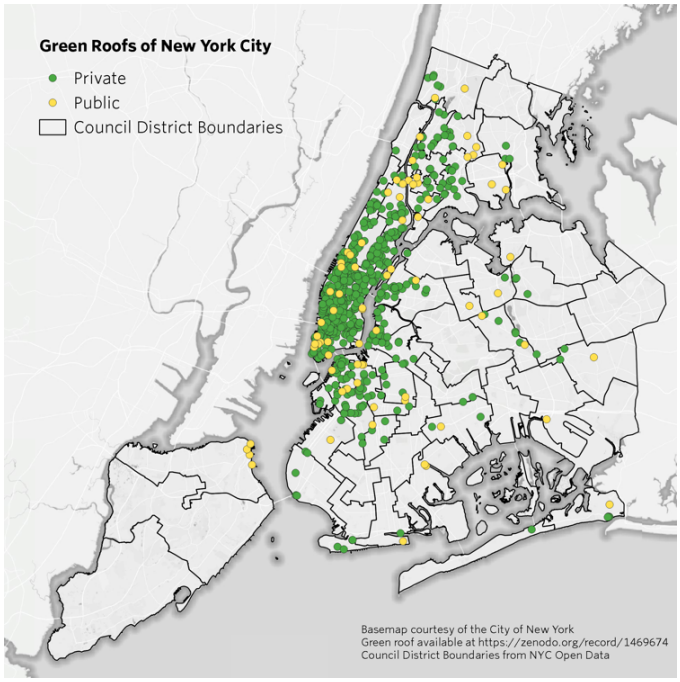

Figure 1. Distribution of NYC Green Roofs

Table 1. Green Roof Distribution by Ownership and Building Type[iii]

Ownership	Building Type	Number of Green Roofs	Acreage
Public	Residential	3	0.15
	Mixed-Use (Commercial and Residential)	5	0.87
	Institutional	59	7.47
	Commercial	8	2.81
	Sub-Total	*75*	*11.30*
Private	Residential	254	9.68
	Mixed-Use (Commercial and Residential)	216	11.55
	Institutional	68	17.54
	Commercial	123	10.77
	Sub-Total	*661*	*49.54*
	Grand Total	**736**	**60.84**

There is an unequal distribution of green roofs across the city, with most concentrated in midtown and downtown Manhattan. Of the 51 City Council districts, 30 have five or fewer green roofs, and eight districts (in the Bronx, Queens, Brooklyn, and Staten Island) have no green roofs at all. There are fewer green roofs in

areas that need them most—like those identified as heat vulnerable or as priority areas for stormwater capture. The Heat Vulnerability Index[iv], which was developed by the New York City Department of Health and Mental Hygiene and Columbia University, identifies communities most susceptible to heat-related morbidity and mortality, based on based on a suite of local environmental and socio-demographic variables (higher HVI rank indicates greater risk). When comparing the distribution of green roofs (Figure 2) to areas of the city ranked by Heat Vulnerability Index (Figure 3), we see large areas, such as in central Brooklyn, southern Bronx, and northern Manhattan, where there are highly heat-vulnerable communities and relatively few green roofs. Green roofs can provide a particular benefit for these communities by reducing ambient temperatures and providing an additional layer of insulation on buildings to increase cooling efficiency. Areas that would potentially benefit the most from green roofs are currently underrepresented.

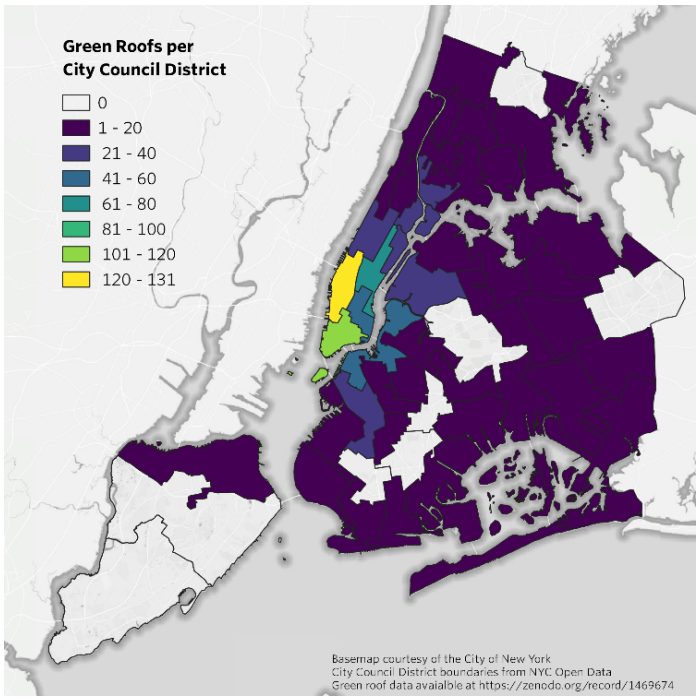

Figure 2. Number of Green Roofs per City Council District

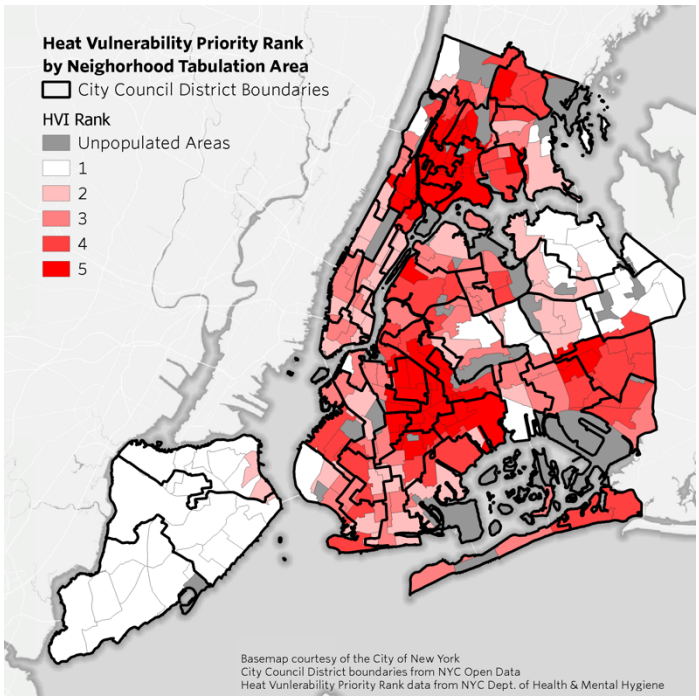

Figure 3. Heat Vulnerability Priority Rank by Neighborhood Tabulation Area

[i] Gaffin, S., C. Rosenzweig, J. Eichenbaum-Pikser, R. Khanbilvardi, and T. Susca. 2010. A temperature and seasonal energy analysis of green, white, and black roofs. Center for Climate Systems Research, Columbia University, New York, Technical Report.

[ii] Horton, R., D. Bader, Y. Kushnir, C. Little, R. Blake, and C. Rosenzweig. 2015. New York City Panel on Climate Change 2015 Report. Chapter 1: Climate Observations and Projections. Annals of the New York Academy of Sciences 1336:18–35.

[iii] For Figures 1 and 2: Ownership Type: Ownership Type is generalized based on 'OwnerType' field of MapPLUTO, version 18v1. Based on our inspection of the data, for this work we considered types C, M, and O as 'Public' and P, X, and blank entries as 'Private.' Land Use: Land Use is generalized based on MapPLUTO, version 18v1. "Residential" includes all land use classes that were exclusively residential (Land Use Codes (LUC) 01, 02, and 03); "Mixed" includes all properties denoted as mixed commercial and residential (LUC 04); "Institutional" includes all properties denoted as public facilities and institutions, transportation and utility, and outdoor space and outdoor recreation (including NYC Parks Recreation Centers; LUC 07, 08, and 09); Commercial includes all properties denoted as commercial and office buildings, industrial and manufacturing, and parking facilities (LUC 05, 06, and 10). Two green roofs on property denoted as vacant (LUC 11) were actually on NYC DEP buildings and allocated to Institutional; two other properties had no Land Use indicated, but were allocated to Commercial and Residential based on ancillary information.

[iv] Madrigano, J., K. Ito, S. Johnson, P. L. Kinney, and T. Matte. 2015. A case-only study of vulnerability to heat wave–related mortality in New York City (2000–2011). Environmental health perspectives 123:672–678.

Photo © Timon McPhearson

RECOMMENDATIONS

Through our study of green roofs, we have identified some important dynamics that can be addressed to accelerate the greening of New York's rooftops and realize their associated benefits.

1. New York City's rooftops are a **high-potential and highly underutilized asset**. The city has an important opportunity to put this asset to work.

2. The realistic opportunity for adding green roofs, factoring in considerations such as, but not limited to rooftop suitability and affordability, has not yet been estimated. This is an important step to **understand the true potential** for their expansion.

3. Green roofs are not the only kind of rooftop treatment that can benefit New Yorkers. **Rooftops with renewable energy installations, stormwater capture (i.e. "blue roofs"), and white-painted rooftops (i.e. "cool roofs") also offer meaningful benefits** and can be further expanded, both in combination with green roofs and where green roofs may be more challenging to install.

4. Different kinds of properties may benefit from **different types of rules and incentives**. A suite of actions is required to put our rooftops to work for New Yorkers.

5. To achieve environmental, social and equity goals, **tiered incentives** may be necessary.

6. All **impacts of rooftop treatments on communities should be considered**, and safeguards should be developed to ensure that rooftop improvements don't have the unintended consequence of displacing New Yorkers.

7. Action may be required by **both the City of New York and the State of New York to address the suite of opportunities** in front of us, as well as to ensure those opportunities are **distributed equitably or to the areas of highest potential need.**

8. Institutionalized **tracking of rooftop uses** would allow an understanding through time of where various benefits of rooftop installations are being provisioned.

APPENDIX

Methodology

We conducted the analysis with support from the J.M. Kaplan Fund, and in collaboration with Timon McPhearson of The New School, Eric Sanderson of the Wildlife Conservation Society, and Greg Yetman at Columbia University. We used remote sensing and geographic information system (GIS) analyses that leveraged building footprints and high-resolution aerial imagery from 2016 from NYC Open Data, as well as locations of previously documented green roofs from the New York City Departments of Environmental Protection (DEP) and Parks and Recreation (DPR), and the websites Greenroofs.com and greenhomenyc.org.

Our final dataset, representing an estimate of the footprints of green roofs in New York City as of 2016 (the most recent imagery available at the time of this analysis), is available as "Green Roofs Footprints for New York City, Assembled from Available Data and Remote Sensing" at Zenodo[v], an open scientific data platform.

Summary Table: Green Roofs by Council District, Property Ownership, and Heat Vulnerability Index

Borough	Council District	Green Roofs on Privately Owned Buildings	Green Roofs on Publicly Owned Buildings	Total Number of Green Roofs	Total Green Roof Area (Acres)	Highest HVI Rank by NTA
Manhattan	1	98	8	106	5.451	3
Manhattan	2	43	1	44	2.790	3
Manhattan	3	125	6	131	14.956	3
Manhattan	4	77	3	80	4.013	4
Manhattan	5	23	2	25	0.885	4
Manhattan	6	25	3	28	2.100	3
Manhattan	7	20	0	20	2.096	5
Manhattan/ Bronx	8	21	6	27	2.476	5
Manhattan	9	11	4	15	2.198	5
Manhattan	10	1	0	1	0.050	4
Bronx	11	6	2	8	1.384	5
Bronx	12	0	0	0	0.000	5
Bronx	13	3	0	3	0.249	5
Bronx	14	9	0	9	0.259	5
Bronx	15	7	4	11	0.570	5
Bronx	16	17	2	19	0.836	5
Bronx	17	16	1	17	1.282	5
Bronx	18	0	3	3	0.596	5
Queens	19	0	1	1	0.205	2
Queens	20	3	0	3	1.025	2
Queens	21	1	1	2	0.359	4

Borough	Council District	Green Roofs on Privately Owned Buildings	Green Roofs on Publicly Owned Buildings	Total Number of Green Roofs	Total Green Roof Area (Acres)	Highest HVI Rank by NTA
Queens	22	1	0	1	0.031	4
Queens	23	0	0	0	0.000	5
Queens	24	1	0	1	0.049	5
Queens	25	0	1	1	0.007	3
Queens	26	23	1	24	2.621	5
Queens	27	2	1	3	0.101	5
Queens	28	0	1	1	0.059	5
Queens	29	5	2	7	0.787	3
Queens	30	0	0	0	0.000	4
Queens	31	4	1	5	0.240	4
Brooklyn	32	1	0	1	0.305	4
Brooklyn	33	48	6	54	4.175	5
Brooklyn	34	10	0	10	0.278	5
Brooklyn	35	13	2	15	3.786	5
Brooklyn	36	3	2	5	0.109	5
Brooklyn	37	1	0	1	0.004	5
Brooklyn	38	6	1	7	2.067	4
Brooklyn	39	22	2	24	1.008	4
Brooklyn	40	3	0	3	0.104	5
Brooklyn	41	0	0	0	0.000	5
Brooklyn	42	4	1	5	0.099	5
Brooklyn	43	3	0	3	0.277	4
Brooklyn	44	0	0	0	0.000	5
Brooklyn	45	0	0	0	0.000	4
Brooklyn	46	0	2	2	0.148	4
Brooklyn	47	4	0	4	0.146	4
Brooklyn	48	1	1	2	0.205	3
Staten Island	49	0	4	4	0.451	2
Staten Island	50	0	0	0	0.000	2
Staten Island	51	0	0	0	0.000	1
TOTAL		**661**	**75**	**736**	**60.837**	

[v] Treglia, M. L., T. McPhearson, E. W. Sanderson, G. Yetman, and E. N. Maxwell. 2018. Green roofs footprints for New York City, assembled from available data and remote sensing (Version 1.0.0) [Data set]. Zenodo. Available at https://zenodo.org/record/1469674

Photo © Charles Gleberman

WHO WE ARE

The Nature Conservancy is the world's largest conservation organization, working in all 50 states and over 70 countries. Our mission is to conserve the lands and waters on which all life depends. Across New York State, The Nature Conservancy has 90,000 members, 35,000 of whom reside in New York City. Established in 2013, our New York City Program builds strategies and initiatives to create a healthy, resilient and sustainable city environment. Building on the Conservancy's science-based, collaborative, results-oriented approach and record of contributing creative and effective solutions to conservation challenges, we promote nature and environmental solutions to enhance the quality of life of all New Yorkers. Statewide, we work with government and non-government partners to tackle climate change, protect land and water, sustainably provide food and water, and build healthy cities. We have offices on Long Island, in Western New York, in the Hudson Valley, the Adirondacks, in New York City and in Albany, including a policy team that works with our State Legislature and Congressional delegation to further our mission.

For more information:

Emily Nobel Maxwell
Program Director
Email: emaxwell@tnc.org
Phone: 212-381-2185

Michael L. Treglia
Urban Spatial Planner
Email: michael.treglia@tnc.org
Phone: 646-647-2045

The Nature Conservancy

Our World Depends on Us.
NEW YORK CITY