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THE POLICY ISSUE

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- FINDING THE SILVER LINING IN THE PANDEMIC
- BEST PRACTICES IN GREEN ROOF POLICY MAKING
- SHOULD THERE BE A POLICY OF ONLY SPECIFYING NATIVE PLANTS?
- SETTING GREEN ROOF MARKET PENETRATION GOALS
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- GREEN WALLS AND THE WELL STANDARD
- A TECHNICAL MASTERPIECE - THE REACH

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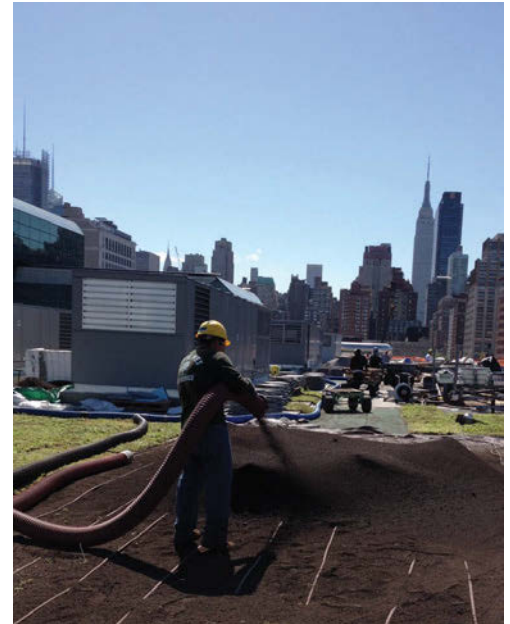
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Green Roofs for Healthy Cities' mission is to develop and protect the market by increasing the awareness of the economic, social and environmental benefits of green roofs, green walls, and other forms of living architecture through education, advocacy, professional development and celebrations of excellence.

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FINDING THE SILVER LINING AMIDST THE PANDEMIC CHAOS

Summer is officially here, but it doesn't feel like it. That's because the whole landscape has changed. In today's COVID-19 world, even loved ones are potential threats to our health. Millions remain unemployed. Misinformation about the pandemic spreads faster than the virus – exploiting our fears and divisions. The economy lurches back to life, albeit unevenly. But because my dad brought me up as an optimist and as an entrepreneur, I wonder: Is there a silver lining in all of this? Can we emerge stronger? Here are my top five suggestions.

1. The science is clear: accessible, safe green space is critically important for the maintenance of our mental health and physical well being. More and more people realize this because for many, the pandemic has meant no access to greenery. Millions of people have come to realize that having a nearby park, a rooftop garden or a lush green wall, can make a big difference in their daily lives. People are hungry for green space now more than ever. We need the rapid adoption of policies that grow quality green space in, on and around our buildings. Jeff Joslin points the way for policy makers on pages 23-25.

2. Images of empty shelves in grocery stores, closed processing plants, restricted international borders and the shortage of farm workers provides a much-needed wake up call about the fragility of our food systems. Policies that enable the protection of regional farming, and the expansion of urban agriculture improve our food resiliency. And a great place to make this happen is on roofs. Investment in greater food resiliency today will save billions in potential damage from inevitable disruptions in the future.

3. The destruction of the world's forests and resulting closer contact between wild animals and humans have been blamed for the development of new viruses. This provides another reason to protect forests. We can also protect and enhance urban biodiversity, with policies and programs that reduce the negative impact of buildings on birds, instead designing them to support native flora and fauna. For greater context on this, see Brad Rowe's article (pages 8-9) on native vs. non-native plants.

4. Viruses don't distinguish between the rich and poor victims. In that sense we are all in this together. However, because far too many people are living on the edge financially, the coronavirus has been particularly tragic for these members of our society. The ongoing systematic killing of black people, and institutional racism faced by all people of color makes the pandemic even harder to bear. Moreover, many of these individuals are on the front line, providing important essential services. Given unprecedented levels of unemployment, there is a growing awareness of the importance and benefits of establishing living wage policies, and a basic level of income security for everyone. These policies would not only strengthen the economy, but would also go a long way to improving social equity. GRHC is committed to improving the lives of people of color and has established a scholarship program to support green infrastructure training for youth. An initial \$10,000 has been set aside to facilitate their access to our many training programs and virtual events.

5. Generating employment for the post-COVID recovery should be every policy

makers priority. Instead of megaprojects built faraway, we need to embrace green infrastructure development in our neighborhoods. JennCourt's overview of the economic impact study of the green infrastructure sector in Ontario (page 26) shows that the industry is already large and ready. Rohan Lilauwala's report (pages 12-18) about the results of six green infrastructure charettes provides a sense of the huge opportunities that await us.

Let's grab this time and set some aspirational goals and work plans. Let's aim to green 10 per cent of all of our rooftops and walls, regenerate wetlands, build tens of thousands of bioswales, and have 40 per cent of city land covered in leafy green urban trees by 2050. Investments in these measures will stimulate local economies now, and also pay out dividends for generations to come. The pandemic has shone a bright light on our weaknesses, and on the racism that continues to threaten people of color and prevent them from achieving their dreams. Together, they have shone a bright revealing light on how fragile the things we rely upon truly are.

Let us work together to ensure that this new awareness lights the path to a better future.

Sincerely yours,



Steven W. Peck,
GRP, Honorary ASLA
Founder and President

EMERGE STRONGER

Emerge Stronger – is GRHC's campaign to provide affordable professional training during the pandemic by offering a 30 per cent reduction on all of its courses and the GRP accreditation bundle, as well as free resources until July 15, 2020. In May 2020, GRHC launched two new courses: *Rooftop Urban Agriculture* which reviews best practices for rooftop farming design and management, and *Why Buy a Green Wall*, which reviews the pros and cons of different green wall technologies and provides a review of their many public and private benefits.

See livingarchitectureacademy.com

GRHC has launched the monthly Green Infrastructure Virtual Symposia Series, featuring best practices in design, installation and maintenance. Attendees can learn easily and affordably about policies, design, and economics of green roofs, urban forests, green walls and more and earn CEUs from AIA, ASLA, GRHC, and APLD.

Chicago Symposia is July 9 and Urban and Rooftop Agriculture is July 23, 2020. See greenroofs.org/virtualevents to register.

For sponsorship information contact Manpreet Sahota, msahota@greenroofs.org

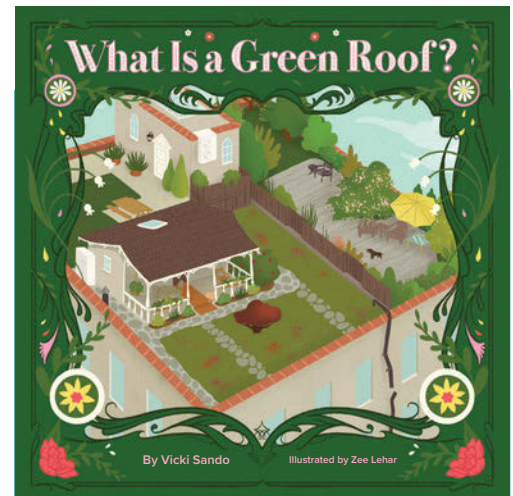
The Green Infrastructure Foundation has released a detailed report on the findings from six green infrastructure charrettes and how green infrastructure can help us adapt to climate change. Highlights of the report can be found on pages 12 to 18 of this Living Architecture Monitor.

For more information on the economic benefits as well as transformative designs please visit greeninfrastructurefoundation.org to download the free report.

The World Green Infrastructure Network (WGIN) and the German Green Roof Association (BuGG) have moved their annual Congress in Berlin, Germany to September 28-30, 2021. WGIN has established a European Chapter whose members are lobbying for more EU green roof and green infrastructure support.

Visit worldgreeninfrastructurenetwork.org.

GRHC announces \$10,000 scholarship program for people of color to help generate opportunities to work in the green infrastructure sector. See greenroofs.org



The next generation. A beautiful book on green roofs for young children has been created by Vicki Sando and Zee Lahar, which is now available at nausicaavalleypress.org

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Photo courtesy Edwin Hooper (Unsplash)

ON THE ROOF WITH...

GREEN ROOF LEADERS DISCUSS THE IMPACTS OF THE CORONAVIRUS AND THEIR RESPONSES

INTERVIEW BY DANIEL MARTIN, CHAIR, CORPORATE MEMBERS COMMITTEE, PERMALOC CORPORATION

As part of our Emerge Stronger Campaign, GRHC assembled the following industry leaders to take part in a webinar to share their responses to the Pandemic with other industry professionals.

This special edition of On The Roof With contains highlights from the webinar. Facilitated by Daniel Martin, Director of Marketing, Permaloc Corporation, Holland, Michigan, participants included Molly Meyers, President, Omni-Ecosystems, Chicago; Ed Jarger, National Sales Manager, American Hydrotech, Chicago; Mark Morrison, MKM Landscaping Construction and Design, New York; Christian Mahlstedt, President, Ginkgo Sustainability, Toronto; Dave MacKenzie, President, LiveRoof/LiveWall; Spring Lake, Michigan.

Daniel: *How has your business been impacted by the pandemic?*

Mark: We design and construct a wide range of green infrastructure projects. So very little has changed. We typically work remotely and our design work has continued apace. We have lots of different types of projects – ranging from design through to construction. Each morning we have a quick call to coordinate among senior managers.

Ed: We provide roofing and waterproofing nationwide and American Hydrotech has been working in the green roof industry



Mark Morrison



Daniel Martin



Dave MacKenzie



Molly Meyers



Ed Jarger



Christian Mahlstedt

since 1996. Most of our employees are able to work remotely, however we have limited office staff working to get product out the door. We've experienced some disruption in interacting with customers but we've been using Microsoft Teams, and other platforms to continue to interact with and communicate with our architectural clients.

Molly: Construction and sales activity are still moving forward and some construction times have accelerated. Design is slowing down due to future uncertainty. Maintenance is ongoing and we are practicing safe maintenance by using masks, gloves, disinfecting surfaces, and allowing staff to avoid often busy service elevators, and using stairs instead. Few clients have stopped maintenance. We are also providing remote technical support – particularly focused on irrigation systems.

Dave: LiveRoof and LiveWall, LLC's are under the umbrella of Hortech, Inc., which is a nursery, and therefore we're considered "essential" in Michigan. So, it is business as usual, except for our office staff, two thirds of whom are working from home. We grow modular green roofs and wall systems here in Michigan, and throughout North America, through our network of affiliated nurseries. We sanitize the office and nursery regularly, and our customers can pick up orders for product outside of the office, rather than coming in. I prepared a backgrounder on the coronavirus and what staff could do to protect themselves to help alleviate fears and the negative impact of incorrect information.

Christian: We've been designing, building and maintaining green roofs and walls for more than ten years in Ontario. Our maintenance business has been disrupted, particularly in long term care facilities and

some residential so there is a back log. Design and project estimation have remained strong. Some workers are concerned about travelling on public transit to projects.

Daniel: *How has your business been impacted by the pandemic?*

Christian: Don't get sidetracked too easily or bogged down. Focus on effective communication to ensure continuity. Customers need to know we can safely maintain their projects.

Dave: You need to adapt and be flexible to this changing situation, in part by accepting what you can and cannot control. The potential long term impact of the pandemic is concerning.

Molly: I think our industry is going to emerge stronger from this pandemic. People are recognizing more and more that nature is a refuge. The fundamentals of our industry are strong.

Ed: We need to remain patient, control what can be controlled and take a deep breath. This will pass. We will continue to invest in innovative ways to manage stormwater which is likely to become more of a challenge due to climate change.

Mark: I think our team will emerge stronger because of this. We are optimistic about the industry, particularly residential green roof projects which provide amenity spaces.

For More Information

Location of Maintenance Tips- <https://livingarchitecturemonitor.com/news/2020/5/5/top-ten-tips-for-ensuring-the-maintenance-of-your-green-roof-and-wall-projects-during-the-covid-19-pandemic>

Covid-19 Backgrounder <https://livingarchitecturemonitor.com/news/2020/5/6/how-to-reduce-the-anxiety-you-may-be-feeling-about-covid-19>

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SETTING TARGETS FOR GREEN ROOF MARKET PENETRATION AND POLICY EVALUATION: A SCENARIO FOR NYC

BY STEVEN PECK, GRP AND ROHAN LILAUWALA, GRP

Paul Hawken's *Drawdown* provides a comprehensive model of the 80 top solutions we can take to avert the climate crisis by eliminating greenhouse gases by 2050. All of the scenarios are considered economically and technically feasible and have considerable benefits, independent of their greenhouse gas emission reductions. At #73, green roofs are listed as a solution that should be deployed at a large scale around the world.

Hawken and his team outline two scenarios based upon 9 per cent and 13 per cent adoption of green roofs on all feasible roofs by 2050. These targets place green roof market development in a broader context that can be used to evaluate the effectiveness of public policy in different jurisdictions.

We applied these targets to New York City to provide a basis for public policy, and the context for researching the positive impacts of widespread implementation - for example, measuring the reduction in the urban heat island. This also provides important context for understanding the costs and benefits resulting from public and private green roof investment.

There are approximately 1.74 billion sq. ft. of roofs in NYC (40,000 acres), with approximately 2.6 million sq. ft. (60 acres) of existing green roof area as of 2016. For NYC to achieve the targets outlined in *Drawdown* by 2050, we have created the following scenarios:

NYC MARKET PENETRATION SCENARIO SUMMARY

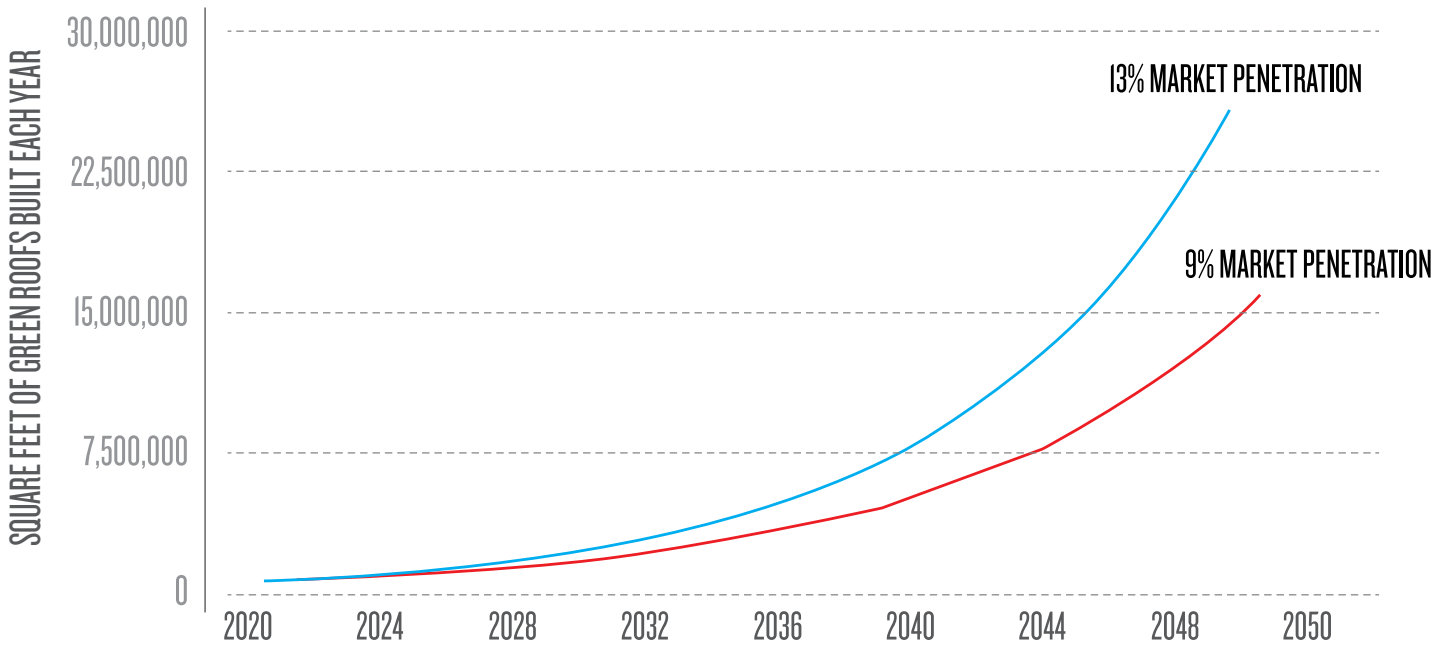
9 PER CENT MARKET PENETRATION

- In 2020, 700,000 sq. ft. of green roofs are installed
- This grows at an 11 per cent rate annually, leading to 16 million sq. ft. installed annually by 2050
- The cumulative total by 2050 is approximately 157 million sq. ft. (3600 acres)

13 PER CENT MARKET PENETRATION

- In 2020, 700,000 sq. ft. of green roof installed
- This grows at a 12.8 per cent rate annually, leading to 26 million sq. ft. of green roof installed annually by 2050
- The cumulative total by 2050 is approximately 226 million sq. ft. (5200 acres)

TWO GREEN ROOF MARKET PENETRATION SCENARIOS FOR NYC



These scenarios represent realistic and achievable goals for building green roofs on a scale where they can be a meaningful part of an urban climate change mitigation strategy. GRHC’s corporate members alone have installed between 650,000 and 1.6 million sq. ft. every year for the previous five years in the leading metro area each year. The NYC metro has not led for any of those years – the list is dominated by cities like Washington, DC and Toronto, which have more robust green roof policies.

Existing green roof policy in NYC is largely limited to two programs: The first is the Department of Environmental Protection’s Green Infrastructure Grant Program, which has seen low uptake, funding only 278,000 sq. ft. of green roof area since 2011, just over 30,000 sq. ft. annually.

The second program is the Property Tax Abatement, which began at \$4.50/sq. ft., was increased to \$5.23/sq. ft., and is proposed to increase to \$15/sq. ft. for certain areas of the city (see page 28). This increase is welcome, but the program spending is currently capped at \$1 million a year over four years, supporting only about 66,667 sq. ft. of green roof area annually.

Trends show that NYC’s existing policies are inadequate to meet the

targets necessary to address the climate crisis. The Green Infrastructure Grant and Property Tax Abatement Programs together are likely to incent less than 100,000 sq. ft. of green roof annually. This represents only 13.8 per cent of realistic 2020 targets, and only 0.6 per cent and 0.37 per cent of the 2050 targets for the two different scenarios.

The Green Infrastructure Grant Program has recently been updated and a third party has been contracted to help deliver the program, which should help with its uptake. For the Property Tax Abatement to be an effective contributor to the targets established, the annual program cap will need to be increased.

Despite their current limitations, improvements in these policies, along with mandatory green roof requirements passed in 2019, suggest that the area and number of green roofs in NYC will increase. However, the market impact of these policies remains to be seen, and more aggressive action may be needed for green roofs to meaningfully contribute to NYC’s climate mitigation efforts.

More Information

Drawdown (<https://drawdown.org/solutions/green-and-cool-roofs/technical-summary>)

SHOULD THERE BE POLICY SPECIFYING ONLY NATIVE PLANTS ON GREEN ROOFS?

DR. BRADLEY ROWE, MICHIGAN STATE UNIVERSITY, (MSU) EAST LANSING

Do native plants on a green roof provide greater environmental services than non-natives? In some situations, yes, while in others it is difficult to make such a claim. The assumption that they are better adapted to local climatic conditions stems from the comparison at ground level. However, green roofs do not represent native environments as engineered shallow growing media and more extreme environmental conditions are the norm.

First, if native plants are going to be mandated for green roofs, then who decides the definition of a native plant? The meaning of the word varies widely depending on who you talk to. For example, the Sustainable Sites Initiative and the EPA Green Landscaping Program have different definitions. There are definitions based on geographic regions, state boundaries, time, ecosystems and other factors. It is quite possible to have multiple ecosystems within the same geographic region. Throughout Michigan for example, glacial deposits have resulted in multiple soil types in close proximity to each other. On my own property, one corner is sandy while the rest is clay. Plants that would thrive on these two types of soil and thus be 'native' are very different.

Much has been written about the drought tolerance mechanism of sedum. Even so, not all sedums are really suitable for green roofs. *Sedum ternatum* is native to the sand dunes along Lake Michigan, but has performed poorly in our plant evaluations. Because of a climate that normally includes ample rainfall most native plants in Michigan are not going to exhibit enough drought tolerance to survive on a shallow green roof. In contrast, many plants native to parts of California or the arid western states are very drought tolerant or they wouldn't be able to survive at ground level in those locations. In regions where plants have evolved under drought condition then the use of natives makes sense.

Whether native or not, within a given location, depth of the growing substrate determines what types of plants can be grown

unless irrigation is provided. Generally, as substrate depth increases, moisture retention, plant survivability, and the number of potential suitable plants also increases. For example, in 2011, a portion of the roof on the Molecular Plant Sciences Building at MSU was planted with 17 species of native perennials and grasses. After eight years, although the 20 cm deep roof still maintains 100 per cent coverage, the roof consists of mainly *Allium cernuum* (a Michigan native) and several species of sedum that moved into the bare spots. Most of the original native herbaceous perennials and grasses have slowly disappeared, but may have survived in a deeper substrate. Although these were all native species, the same scenario would have occurred with similar non-native species.

I think that the strongest

argument for use of native plants is that they are usually superior from an ecological perspective. Plant community influences a roof's ability to provide wildlife habitat for microorganisms, insects, birds, and other animals. A good example is the monarch butterfly (*Danaus plexippus*). Monarchs have co-evolved with milkweed (*Asclepias* spp.) and their caterpillars rely on milkweed as their sole source of food. The eastern US population of monarchs has declined 80 per cent since 1990, due in part to the removal of native habitat. Planting milkweed on green roofs is at least a step in the right direction. Even so, non-natives may provide a food source for other species at times when natives are not flowering. The major factor that determines biodiversity and wildlife habitat is the



Plant species diversity at MSU Molecular Plant Sciences Bldg, in June 2013

Photo courtesy Mert Eski

structure of the vegetation. Varying substrate depths will provide favorable micro-environments for a greater number of plant species with variations in season of flowering, plant height, and spread. This structural diversity in plant species will then provide the microhabitats for various flora and fauna to live which increases the overall diversity. Both native and non-native plants can increase diversity.

For other green roof services the benefits of native plants is not so clear. Numerous studies have shown that vegetation type influences stormwater retention. Plant photosynthetic metabolism has a major effect on transpiration and plants with larger shoot and root biomass will intercept rainwater which may evaporate before reaching the substrate surface. Regarding energy, intuition would also

tell us that deeper green roofs planted with herbaceous perennials and grasses would be better insulators than shallow sedum roofs. Likewise, the same could be argued for mitigation of the urban heat island, air pollution, and membrane lifespans. These services are also a function of substrate depth which in turn favors larger plants. However, there isn't any difference in these services between native and non-native perennial plants of similar size and structure.

Furthermore, what about green roof farms that are producing locally grown nutritious food? Crops often grown on rooftops such as beans, carrots, cucumbers, lettuce, peppers, spinach, and tomatoes? You guessed it. All non-native. For that matter, none of our major food crops are native to North America. Corn originated in Central America, wheat in the

Middle East, the potato is from South America, and rice and soybeans are native to Asia. Likewise, apples, peaches, pears, and cherries were all introduced to America. The only food crops eaten with any frequency that are native to North America are blueberries, cranberries, grapes (excluding vinifera wine grapes), pumpkins, strawberries, and sunflowers. Guess we could all enjoy our meals of wild game, berries, and sunflower seeds. Do we really want to outlaw rooftop farms?

So should there be policy specifying only native plants on green roofs? No. Native plants should definitely be considered for green roofs if the structural integrity of the roof allows for the substrate depth needed. Are we going to outlaw sedum roofs and thus limit the number of green roof installations and in the process eliminate all the stormwater retention, energy savings, and other benefits that the roof would have provided? I would much rather see a sedum roof than no green roof at all. Sedum are probably growing on more green roofs and have had more to do with driving the economic engine of green roofs than any other species. Decisions should be made on a project basis, not by mandated public policy.

Brad Rowe has been conducting green roof research at MSU since 2000. Research topics include plant selection, growing substrates, carbon sequestration, stormwater runoff, energy conservation, and roof vegetable production. He was the founding co-chair of the GRHC Research Committee and received the GRHC Research Award of Excellence in 2008. Brad also teaches a course on green roofs and walls at MSU.

GRHC LAUNCHES SCHOLARSHIP PROGRAM IN SUPPORT OF BLACK LIVES MATTER

DR. EMMA TAMLIN, GRHC

On behalf of the staff and board of Green Roofs for Healthy Cities (GRHC), we stand in solidarity with Black Lives Matter. Every person has a right to expect and receive fair and equal treatment under the law and from law enforcement professionals. No violation of this right is ever acceptable. Such a violation is particularly reprehensible when carried out against Black, Indigenous and racialized communities, particularly given both the historical atrocities committed by colonial settlers and the continued oppression through systemic racism that is pervasive throughout North America.

On June 6, GRHC issued this statement in support of Black Lives Matter and launched a new scholarship program. GRHC will be offering \$10,000 worth of scholarships throughout 2020 by partnering with Black-led environmental organizations. Through these partnerships, GRHC will offer free online training and passes to our virtual events. The program is a tangible way for GRHC to create opportunities and to help break down the barriers of entry for Black Youth into the green infrastructure industry. Moving forward, GRHC is going to center the discussion of social justice and environmental racism in green infrastructure conversations.

As individuals, company owners and employees, it is clear that not being racist is insufficient in light of the ongoing violence and persecution against marginalized communities. In the words of famous American political activist, Angela Y. Davis, “In a racist society, it is not enough to be non-racist, we must be antiracist.”

In addition, GRHC encourages its members to donate to local organizations working towards racial and social justice. If you work with an environmental organization that supports Black, Indigenous and racialized communities, please contact the program coordinator for more information, Emma Tamlin at etamlin@greenroofs.org.

GRHC Virtual Symposium Series

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Technologies in Water Management Symposium | 8/27
Green Wall Design and Health Benefits Symposium | 9/23

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greenroofs.org/virtualevents



Photo courtesy Paul Hanaoka (Unsplash)

HOW GREEN WALLS RELATE TO THE WELL BUILDING STANDARD

BY MEILSSA CAGGIANO, PLANT CONNECTION, INC

The WELL Building Standard is a building performance rating and certification system compatible with and similar to LEED, but focuses on the physical and mental health of humans. It maximizes the happiness and wellness of employees within the built environment, rather than the effect of buildings on the environment.

The WELL Building Standard was developed through seven years of consultation with leading doctors, scientists, architects, and other wellness professionals. It is grounded in solid science and medical research that demonstrates the connection between buildings, where people spend more than 90 per cent of their time, and the health and wellness impacts on occupants. The WELL Building Standard sets performance requirements in 7 categories of architecture and design conditions: air, water, nourishment, light, fitness, comfort, and mind. The installation of green walls or the addition of potted plants helps to earn credits and satisfy 3 of the 7 categories. Green walls can help create a more sustainable workplace by boosting employee happiness and productivity, reducing absenteeism, and improving well-being. Here are the areas within WELL where green walls apply.

AIR - Air Quality Standards: Plants naturally remove carbon dioxide and convert it into oxygen through photosynthesis. This process can also effectively “scrub” the air of VOCs (volatile organic compounds) and other harmful toxins like benzene and formaldehyde that are generated indoors from textiles, paints, wood finishes, and electronic devices. VOCs can be detrimental to human health if there are too many particles present in the air. The addition of a living wall within an interior space has been shown to reduce VOCs in the air.

COMFORT - Sound Reducing Surfaces: Green walls have been proven to provide sound absorption, reducing the amount of ambient noise within a room, when fully installed on vertical surfaces. This means living walls can effectively be used as acoustic panels to create a more comfortable noise environment. While they cannot

insulate sounds from coming in or out of a room, they can significantly decrease the amount of echo and sound movement within the room in which they are installed.

THERMAL COMFORT - The presence of plants directly affects the temperature and humidity within a room. Living green walls can help maintain the optimal balance of cool air, warm air, and humidity, thus increasing the overall comfort within a space (as opposed to a space with fewer or no plants).

MIND - Biophilia I - Qualitative: WELL’s Biophilia requirements were modeled after the Living Building Challenge, and seek to address humanity’s psychological need to be around life and nature. Living walls directly fulfill the requirements of incorporating nature within the building or space by providing an environmental element,

incorporating patterns from nature, and allowing human-nature interaction.

BIOPHILIA II - Quantitative: The quantitative element of biophilia includes wall or potted plants being incorporated into the design of the interior space, which of course can be accomplished easily with a living green wall installation. WELL requires “a plant wall per floor, covering a wall area equal or greater than 2 per cent of the floor area, or covering the largest of the available walls, whichever is greater”.

More Information

Melissa Caggiano, CNLP is the Vice President of Plant Connection and Chair of the Green Walls Committee which just completed an online course and resource manual on the benefits of green walls. Please visit www.livingarchitectureacademy.com to learn more and register for the training.

WHY GREEN INFRASTRUCTURE IS IDEAL FOR CLIMATE ADAPTATION

BY ROHAN LILAUWALA, GRP, GREEN INFRASTRUCTURE FOUNDATION

As extreme weather events like floods, wildfires, heat waves, and droughts become more severe with the impacts of climate change, communities are starting to understand that this is the ‘new normal’.

While mitigating the impacts of climate change by reducing carbon emissions (and using nature-based solutions like forests and wetlands to capture and sequester carbon) is still paramount, more and more community leaders are now looking for ways to adapt their communities to minimize the inevitable impacts of climate change.

According to a 2020 report by the Insurance Bureau of Canada and the Federation of Canadian Municipalities, every \$1 invested in climate adaptation has a potential return of \$6 in future avoided losses. Green infrastructure’s characteristics make it an ideal choice for these investments, providing a broad array of benefits while increasing community resilience. The COVID-19 pandemic has, if anything further intensified the awareness of our need to have accessible, healthy, and safe green spaces in every community.

We identified several best practices communities can focus on when incorporating green infrastructure into future plans, policies and infrastructure investments. They are:

- **Improve and Expand Existing Green Spaces:** Existing underused and neglected parks and other green spaces can be improved and expanded to function as high-performing urban ecosystems.
- **Turn Streets into ‘Green Streets’:** Many streets have more paved area than necessary – de-paving and adding public and green space can improve aesthetics while providing many other benefits. These can be incorporated from the beginning in new developments, as a targeted program, or as part of routine reconstruction.
- **Green Transportation and Utility Corridors:** Highways, rail lines, power lines, and other corridors often feature poor

JUST AS WE VALUE ROADS, BUILDINGS, AND PIPES AS ASSETS, WE ALSO NEED TO VALUE TREES, WETLANDS, GREEN ROOFS, AND RAIN GARDENS AS ASSETS.

GREEN INFRASTRUCTURE'S CHARACTERISTICS ARE IDEAL FOR CLIMATE ADAPTATION

FLEXIBLE AND ADAPTABLE: Can be tailored to meet local conditions and requirements

HIGH EMPLOYMENT TO CAPITAL RATIO: More money spent on labor and less on materials than conventional infrastructure, creating more jobs per dollar of investment

DECENTRALIZED: More resilient to external shocks with few critical points of failure

SHORTER IMPLEMENTATION PERIOD: Smaller and less complex projects that can be aggregated

FUNCTION IMPROVES OVER TIME: As vegetation matures, performance improves

LOW-OR-NO ENERGY INPUT: Not dependent on large amounts of external energy

CLIMATE CHANGE MITIGATION BENEFITS: Plants and soils sequester carbon, while emissions can be reduced through direct and indirect energy use reductions

MORE LIVABLE COMMUNITIES: Improved aesthetics and new recreational opportunities build public support and make people healthier and happier

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air quality and impermeable surfaces. Introducing green infrastructure can minimize negative impacts like noise and poor air quality, while helping create corridors that connect fragmented habitats.

- **Create Multi-Functional Spaces:** Spaces like sports fields, parking lots, and golf courses can be designed for multiple functions using green infrastructure – even designed to flood temporarily during extreme rain events.
- **Support Urban Agriculture:** Community-based and commercial urban agriculture projects increase food security and resilience, improve community cohesion, and put underused space to productive use.
- **Use Hardy, Climate-Adapted Vegetation:** Horticultural experts should identify appropriate plants for each community, while accounting for the shifting of climate zones due to climate change.
- **Design for Biodiversity and Resilience:** Diversity in nature is essential for resilience against threats like disease, pests, and extreme weather. Increased biodiversity creates resilient ecosystems that minimize the impacts of these threats.

- **Shift Paradigms:** Development practices used over the past several decades that encouraged human dominance over nature must be changed. An approach that works within natural ecology and hydrology must be the new paradigm.
- **Value Green Infrastructure as Assets:** Just as we value roads, buildings, and pipes as assets, we also need to value trees, wetlands, green roofs, and rain gardens as assets. Incorporating green infrastructure into asset management and accounting frameworks can codify and monetize the value of their benefits and improve decision making.
- **Engage the Public:** Educating and building awareness is essential to greater public support. Using school curriculums, special events, and communications to articulate the benefits and importance of green infrastructure is key to successful implementation.
- **Leverage Private Sector Investment:** Developing policies like stormwater fees, green factors, or credit trading programs can turn public benefits into private revenue streams, encouraging private investment. Green bonds and other financial instruments can also be used to further leverage



Photo courtesy Marco Sala CC BY-SA 4.0

private sector investment.

- **Achieve Environmental Justice Goals:** Low-income and communities of color often suffer from hazards like poor air quality, lower tree canopy, and a greater urban heat island. Green infrastructure investments should aim to right these historical injustices, while being part of a strategy that also minimizes displacement through gentrification.
- **Incorporate Job Training and Workforce Development:** Plans should encompass workforce development programs to not only create the necessary skilled workforce, but to also help achieve a just transition to a low-carbon economy for workers.

WORKING WITH COMMUNITIES

Many communities across North America face the same issues: aging water infrastructure, vulnerability to flooding, increasing urban heat islands, and a lack of capacity to use green infrastructure to address these and other challenges. As part of a Climate Adaptation Partners Grant Project funded

by the Government of Canada through the Federation of Canadian Municipalities, the Green Infrastructure Foundation and the Ontario Parks Association partnered with six Ontario communities to build green infrastructure capacity through training and green infrastructure charrettes. This work resulted in the recent release of the Green Infrastructure for Climate Adaptation report. (See greeninfrastructurefoundation.org)

Staff from Barrie, Brampton, Guelph, London, Toronto, and Waterloo gathered for a day with private and non-profit experts to re-imagine actual sites in each of their communities. These sites, which are going through the planning and redevelopment process, were subjected to a green infrastructure design charrette. A menu of green infrastructure types was applied to these sites, with the goals of leveraging green infrastructure's many benefits and creating more climate resilient communities. We conducted aggregate cost-benefit analysis of these redesigns, with the goal of combining visuals and economic analysis to showcase the green infrastructure alternatives. Here are some highlights.



GREEN INFRASTRUCTURE INSTALLATION AND MAINTENANCE COULD PROVIDE THE MEANINGFUL AND LOW-CARBON JOBS OF THE 21ST CENTURY.

2017 GRHC AWARD WINNER:
ROOFTOP WHEAT PRAIRIE, OMNI ECOSYSTEMS

Photo courtesy OMNI ECOSYSTEMS

BARRIE

Barrie Conceptual Plan, Option A

Participants looked at a site in the west end of Downtown Barrie, along Dunlop Street. The area is poised for change, with a redeveloped Fisher Auditorium and Event Centre, a new YMCA, and 600 proposed apartment units. There are opportunities for green infrastructure in the new developments, rebuilt streetscapes, city-owned land in the vicinity, as well as in the rehabilitation of adjacent Kidd's Creek.

The charrette participants proposed elements like daylighting Kidd's Creek, tree-lined streets and paths, an outdoor education space, and a reconfigured street network with green infrastructure elements in the right-of-way. (See graphic below)

COST-BENEFIT ANALYSIS

CONSTRUCTION COST: \$1.38 million

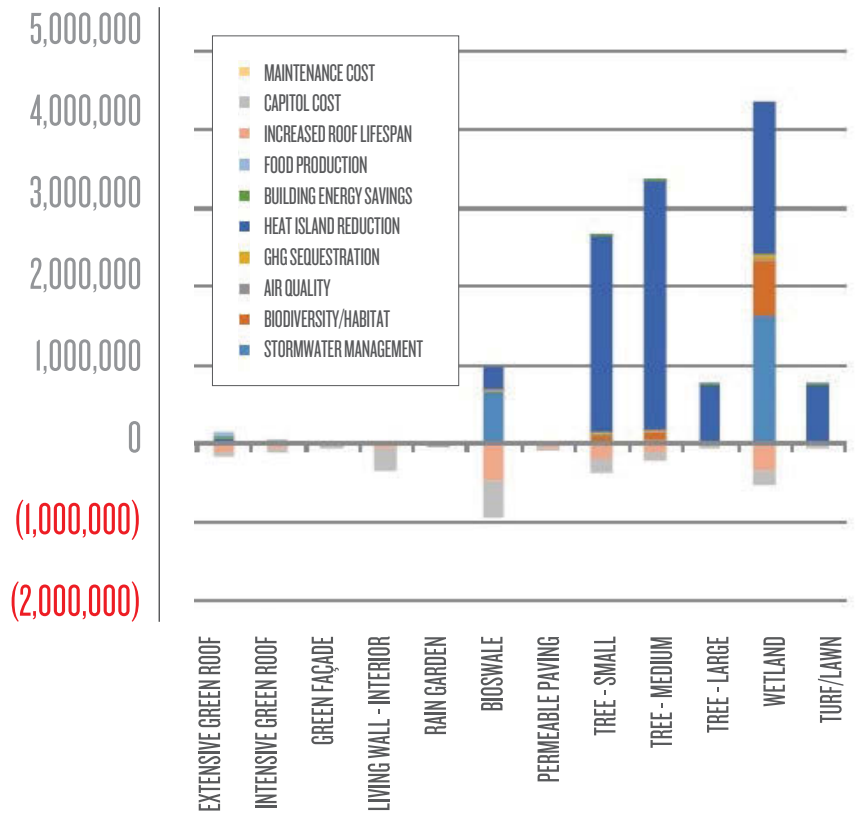
ANNUAL MAINTENANCE COST: \$40,365

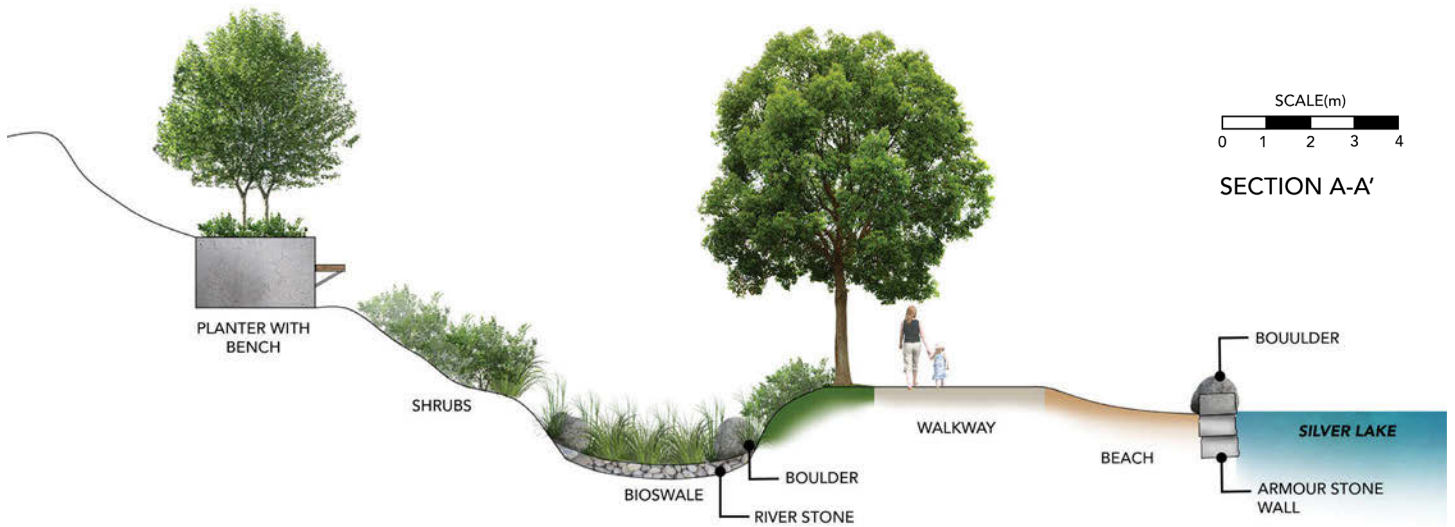
JOB-YEARS IN CONSTRUCTION AND MAINTENANCE OVER 50 YEARS: 59.3 FTE

NET PRESENT VALUE OVER 50 YEARS: \$10.51 million

SIMPLE PAYBACK PERIOD: 3.7 years

BREAKDOWN OF COSTS AND BENEFITS OVER 50 YEARS





WATERLOO

Waterloo Conceptual Plan, Option A

Participants from Waterloo studied Waterloo Park, a much-loved park close to uptown Waterloo that is planned for rehabilitation, including dredging of the lake, enhancement of upstream Laurel Creek, and reconstruction of recreational areas. All these interventions create opportunities to take a green infrastructure approach. (See graphic above)

They proposed creating a green corridor along the Light Rail Transit line, bioswales to slow and cleanse runoff into the lake, wetlands to address drainage and flooding issues, boulders and tall grasses to suppress geese, and an optimized central area including a lookout point and amphitheatre.

COST-BENEFIT ANALYSIS

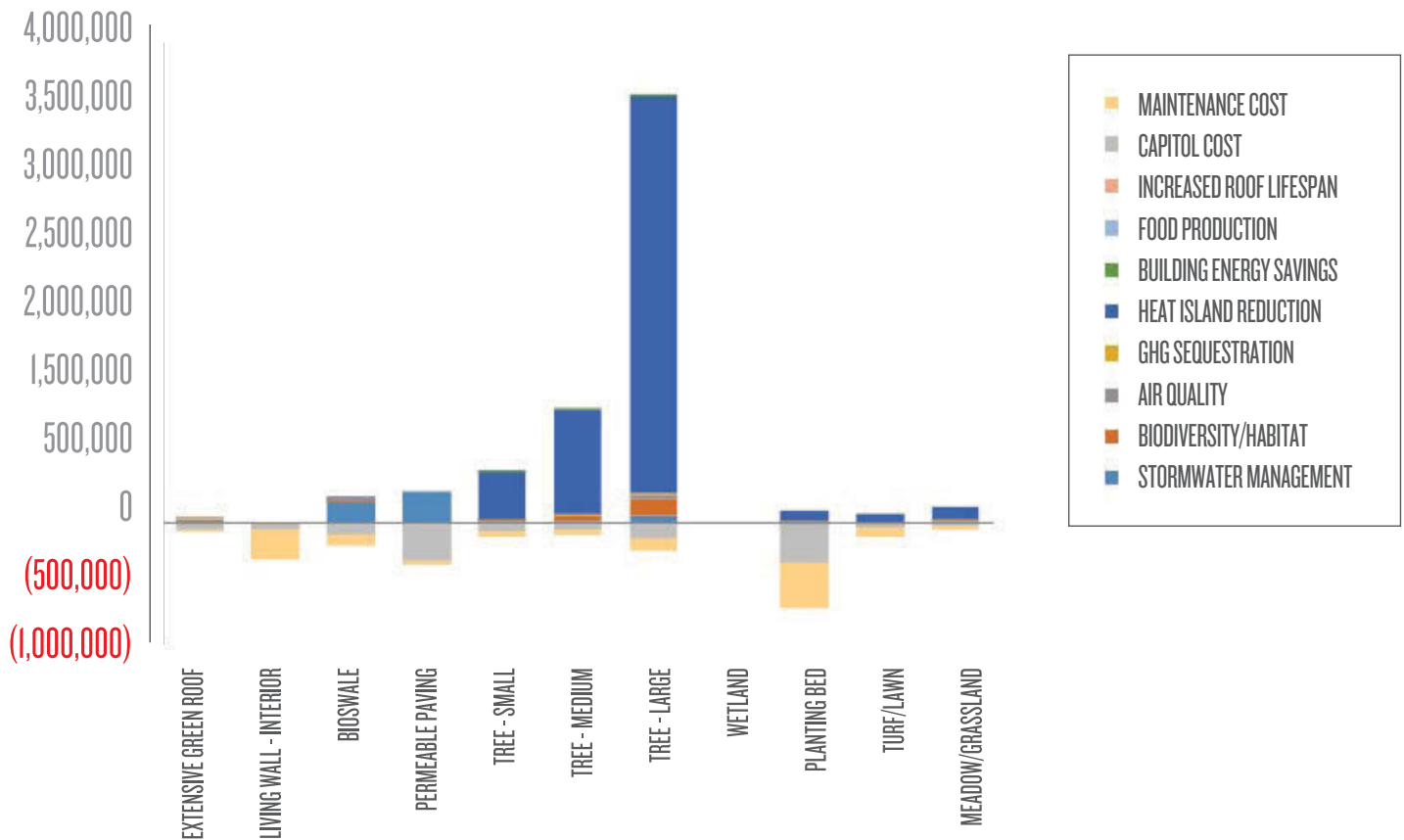
CONSTRUCTION COST: \$880,000

ANNUAL MAINTENANCE COST: \$22,400

JOB-YEARS IN CONSTRUCTION AND MAINTENANCE OVER 50 YEARS: 35.5 FTE

NET PRESENT VALUE OVER 50 YEARS: \$3.72 million

SIMPLE PAYBACK PERIOD: 9.9 years



COVID-19 RECOVERY PLANS SHOULD INCLUDE GREEN INFRASTRUCTURE INVESTMENTS TO HELP US ADDRESS OUR NEXT GREAT CRISIS – CLIMATE CHANGE.

LESSON LEARNED - CHANGING POLICY

To build truly resilient and climate-adapted communities using green infrastructure, local government staff need to be able to create a supportive policy environment for green infrastructure. Getting there means many different things: making sure staff have a thorough understanding of green infrastructure types, applications, costs, and benefits; providing best practices, policy success stories, case studies, and project examples; and most importantly, convening the wide array of multidisciplinary professionals (from engineering and environment to parks and planning) whose practice green infrastructure cuts across.

“The design charrette was particularly useful in providing a real-life case study to work through - bringing together professionals from a variety of backgrounds with the developer and consultant team - to identify green solutions for a particular site”, said Kristina Hausmanis, Project Manager, Green Streets, at the City of Toronto. “Any time we have the ability to bring together a diversity of professions and expertise problems are solved faster and there is more natural collaboration that takes place.”

Green infrastructure, as the charrettes in six communities demonstrate, holds tremendous potential to help communities adapt to climate change, improve public health and well-being, all while helping us transition to the new low-carbon economy. Post COVID-19 recovery plans should include green infrastructure investments to help us address our next great crisis – climate change.

Roban Lilauwala, GRP, is the Program Manager at the Green Infrastructure Foundation. For more information, read the report at bit.ly/2XxbWFZ, visit greeninfrastructurefoundation.org/charrette, or email Roban at rlilauwala@greenroofs.org



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INNOVATIVE GREEN ROOF PROJECT 'THE REACH' IN WASHINGTON DC IS A TECHNICAL MASTERPIECE

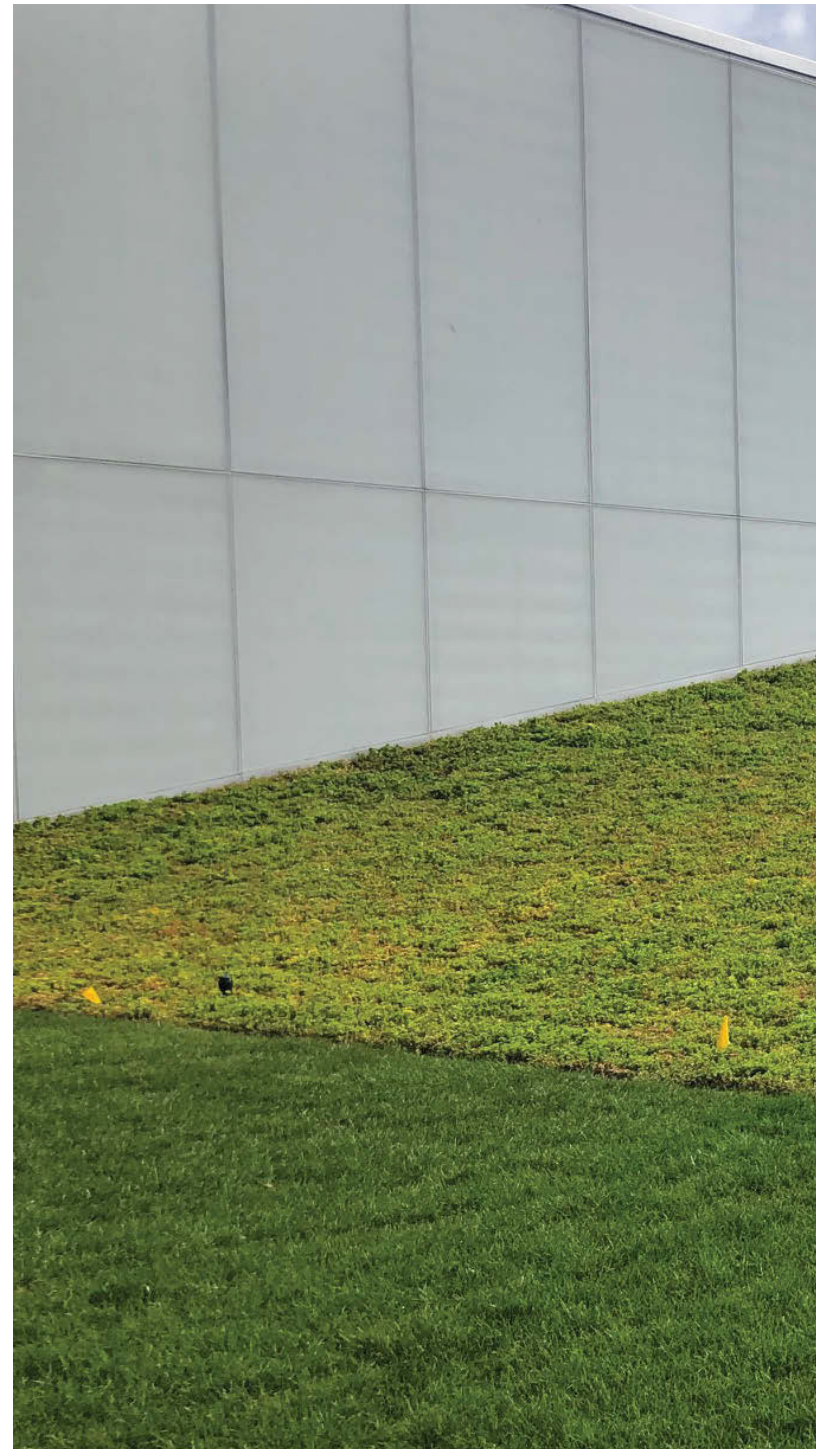
BY RIANNE SLOOTWEG, SEMPERGREEN

The John F. Kennedy Center for the Performing Arts is a historic venue, standing on the bank of the Potomac River in Washington D.C. The facility recently underwent a \$250 million expansion called The REACH expansion, which is a true state of the art project.

The project incorporates an expansive landscape over structure containing a technical masterpiece: a three-dimensional cork-screw green roof for the public area of the project as never seen before. It was the result of a unique collaboration between designers, contractors and material suppliers. The Steven Holl Architects-designed project opened in October 2019 and has already achieved LEED Gold certification.

SPECTACULAR FUSION OF BUILDING, LANDSCAPE AND RIVER

As the living memorial that bears his name, the John F. Kennedy Center for the Performing Arts fulfills the vital mission of John F. Kennedy to set the artist free. Free to reach beyond hallowed



halls and sacred walls into creative open spaces where audiences can reach back and connect with art and the artist who created it. As the institution enters its fifth decade, the expansion project The REACH is now a living theater where the community can engage and interact with artists and their creative output in inspired and meaningful ways. It was Steven Holl Architects' vision for the expansion of the building to fuse it with the landscape and river. The varied greenspaces provide opportunities for casual performances and events. Remarkably, nearly the entire facility is capped with a green roof. The buildings have a footprint of 72,000 sq. ft., and 69,000 sq. ft of that is covered by green roof. The slope of the vegetation varies from virtually flat to nearly vertical.



**"THIS IS ONE OF THE MOST COMPLEX
PROJECTS WE HAVE EVER WORKED ON."**

- RICHARD HAYDEN - AMERICAN HYDROTECH
AND OSCAR WARMERDAM - SEMPERGREEN

GREENING THE IMPOSSIBLE: THREE-DIMENSIONAL CORK-SCREW GREEN ROOF/ GREEN WALL

The open and engaging landscape provides small and intimate spaces to gather and visit at all times of the day. For this visually attractive landscape Steven Holl Architects created a three-dimensional green roof/wall design. It starts as a flat green roof, and then rotates into a green wall. Geoffrey Valentino - Landscape Architect from Edmund D. Hollander Designs - proposed the project to the collaborative team of American Hydrotech and Sempergreen USA to take on the task of 'greening the impossible'. The subsequent collaboration between Hydrotech and Sempergreen needed to address many of the issues with

creating a 3-dimensional, corkscrew shaped green roof and accommodating all of the other adjacent architectural elements. This collaboration required frequent communications with the design and construction teams. Richard Hayden, National Garden Roof Department Manager at American Hydrotech and Oscar Warmerdam, president of Sempergreen USA remarked: "This is one of the most complex projects we have ever worked on. It required a deep collaboration between our two companies and the design team."

THREE DIFFERENT PLANT PALETTES AND MERGING SOIL MIXTURES

American Hydrotech took on the responsibility of water proof-



PROJECT DETAILS

PROJECT: THE REACH - rehearsal space, classroom space, event and pre-function space, 150-seat multipurpose space, board room, landscape gardens, River Pavilion café and performance space.

CLIENT: John F. Kennedy Center for the Performing Arts

ARCHITECT: Steven Holl Architects

GENERAL CONTRACTOR: Whiting-Turner

LANDSCAPE ARCHITECT: Edmund D. Hollander Designs

ROOFING: James Myers Roofing

ROOFING AND WATERPROOFING MATERIALS (ALL SLOPED

AND FLAT GREENSPACE AREAS): American Hydrotech

GARDNET SLOPED GARDEN ROOF ASSEMBLY: American Hydrotech

GARDEN ROOF MEDIA: American Hydrotech (with Urbanscape)

SLOPED GARDEN ROOF PLANT MATERIALS AND INSTALLATION: Sempergreen

IRRIGATION SYSTEM: Sempergreen

SIZE: 113,906 sq ft

OPENING: October 2019

ing and designing a soil stabilization system that can move in a fluid-like motion from flat to vertical while rotating like a corkscrew. Sempergreen USA and Hollander Designs created sedum blankets into 3 different plant palettes. For the most vertical sections of the roof where it becomes a wall another partnership of Sempergreen USA and Knauf Urbanscape designed a growing media blend mix that starts with Lite-Top growing media from American Hydrotech and merges slowly into a Lite-Top/Urbanscape mineral wool mixture which in turn merges slowly into the vertical section that has 100 per cent green wall mineral wool from Urbanscape inside the Hydrotech sloped Garden Roof Assembly.

EXPERIMENTAL MOCK UP 'THE RAMP'

James Myers Roofing is the roofer that had to put all the pieces together into a finished project for general contractor Whiting-Turner. It was a monumental task. Nothing was straight, just mapping and calculating surfaces was extremely difficult to do on two-dimensional drawings that needed to represent three-dimensional shapes. To properly prepare, Myers, Hydrotech and Sempergreen built a JFK mock up called 'The Ramp'. Monthly visits from the Landscape Architect, the General Contractor and

Myers to the sedum slope gave everyone confidence that it could be done. The Ramp is an actual replication of all the possible angles of the design and has been growing successfully at the Sempergreen farm in Culpeper. It allowed the team to work out any bugs and discover any practical problems before the installation.

SEMPERGREENWALL IRRIGATION SYSTEM HAS PROVEN ITSELF

To irrigate the vertical parts of the sedum based roof/wall, the Irrigation Management System for outdoor SemperGreenwalls was selected. The irrigation has an advanced web-based system with the ability to confirm water flow, water pressure, water temperature, and the ability to self-empty prior to frost, and refill right after temperatures warm up. This ability allow the irrigation system to effectively run 24/7, 365 days a year. Sixteen groups of irrigation with attached drip lines and sprinklers supply water year-round to the REACH. Now that the project is finished and the final piece of green art is into place, the system has proven itself because all of the plants are healthy and alive.

Rianne Slootweg is the Marketing Manager at Sempergreen and Dennis Yanez - National Marketing Manager at American Hydrotech, Inc

OBSERVATIONS FROM THE GREEN ROOF POLICY FRONT

JEFF JOSLIN, DIRECTOR OF CURRENT PLANNING, CITY AND COUNTY OF SAN FRANCISCO

Green roofs have been with us for centuries. But it's this past decade that's brought North America the most significant advancement in, and proliferation of, green roof policies.

Numerous cities and towns have successfully made the case for the environmental and economic efficacy of green roofs across a range of political and climatological settings. While each has done their own homework and advocacy, so too have evolved various principles and practices useful to those looking to further existing policies, or implement new ones.

To capture these advancements, and to provide a baseline tool for municipalities considering developing policies specific to their unique environment, Green Roofs for Healthy Cities recently published a new guide: *Green Roof Policy in North America*. This document not only serves as a compendium of established regulatory and incentive approaches and policies, but also provides an overview of lessons-learned and strategic considerations when attempting to develop and advance such policies and regulations. Following are some observations that have resulted from this rapidly evolving collective knowledge set.

POLICY IS FINE, BUT ONE MUST ESTABLISH A CLEAR PATH TO ACTUAL IMPLEMENTATION.

Policy advocacy and placement can contribute to awareness of green roofs as a climate-change strategy, and promote education about green roofs. For entities just entering the climate change arena, identifying green roofs as an essential and practical response may be a useful and necessary initial step. However, policies without implementation goals and tools push the critical work farther into the future. The time to implement meaningful tools is now, and any policy should establish defined and aggressive goals and timelines.

Likelihood of success is dramatically improved if defensible

financial analyses is at the forefront of the effort.

Any effort to establish a policy or regulation should include anticipatory financial analysis to address concerns about the first-cost of green roof installation and maintenance. Economic concern is inevitable: it's the one aspect that all policy makers and the constituencies most affected will raise early. Demonstrated benefits at various building scales, and at the community-wide scale have proven to win over a wide variety of constituencies for the policies in cities like New York, San Francisco and Toronto.

The analytical tools exist and are accessible. Executing a cost-benefit analysis that is transparent and defensible is essential to best understand and describe the implications and benefits of prospective policy initiatives.

Assumptions within such analyses need to be based in local bioclimatic conditions, zoning and the specific development environment. The more ready and complete the analysis, the greater the likelihood of advancement. Once an analysis is established for a particular geography, it's a modest effort to apply it to various building typologies as appropriate for the locality. This information will address concerns of stakeholders, and can also contribute to the crafting of a more effective policy.

FINANCIAL ANALYSIS AND GREEN INFRASTRUCTURE ARE NOT JUST FOR THE RITZY PROJECTS.

Cities around the world are currently facing an affordable housing challenge. In the absence of analysis and advocacy, policy makers and others will raise the issue of "unnecessary" first costs, claiming such cost would put affordability further out of reach. In fact,



GREEN ROOFS TAKE ROOT AROUND THE WORLD

The eco-friendly design just got a big lift in San Francisco, and it is spreading globally.



In San Francisco, even bus shelters support green roofs.

more vulnerable projects will benefit most meaningfully: full cost recovery within six+ years on average and the economic benefits then accruing to those projects and occupants through energy savings and deferred maintenance for remaining decades to come. Affordable projects will be all the more challenged in the future. Green roofs guarantee a more stable and accessible future for such projects and their residents, thus directly addressing environmental equity imperatives.

Identify stakeholders, both supporters and others, early in order to best-define an effective regulatory approach and accompanying advocacy strategy.

It is recommended to seek input from other municipalities who have generated policies and regulations in order to employ that intelligence to achieve early support from stakeholders. Denver is a good recent example of a case where such early input was not achievable, with mixed results as a consequence.

In 2017, Denver passed the Green Roof Ordinance, following a citizen-led effort in reaction to local government's climate change inaction. The stringent ordinance mandated green roofs on both new and existing buildings. Following passage, a technical committee was convened to adjust the mandated requirements. That process determined that green roofs were not structurally feasible for most existing buildings. This opened the initiative to a fundamental reworking, which was amended to mandate a less stringent and impactful set of compliance options.

The Denver effort provides two principle lessons. First: in the absence of policy leadership and best public participation practices, fundamental stakeholder issues may not be adequately vetted and incorporated, and ultimate results may be compromised. Second, if efforts are not appropriately led by policymakers; citizens can, and will, act.

MANDATORY APPROACHES ARE IDEAL, BUT SOME FLEXIBILITY IS ESSENTIAL.

Mandatory policies provide the most immediate path to green roof deployment. However, flexibility is necessary in terms of



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public support and performance.

In the case of San Francisco, the option to employ solar, living roofs, or a combination was key to its ready path to approval and implementation.

As described above, Denver was able to achieve consensus once stakeholders arrived at a menu of compliance options.

When considering parallel paths, consideration needs to be given to creating a level playing field: each path or technology should be assessed in terms of cost-recovery and environmental benefit, and calibrated accordingly.

Properly scaled incentives can facilitate policy acceptance, and encourage emergent supportive providers to enter the marketplace.

Complementing compliance options for mandatory policies with incentive policies may make choosing a green roof option more appealing. However, incentive policies with low tax abatements, minimal rebates, or strict restrictive covenants will not be adequate to encourage markets to emerge. The benefits of incentive programs should outweigh or meet the cost of installing a green roof to have a meaningful effect.

PERFORMANCE IS THE PURPOSE.

Performance-based measures, such as minimum retention rates for stormwater, coupled with prescribing systems and components, is fundamental to establishing best practices. Performance requirements allow for market flexibility, as well as maintaining space for innovation. Municipalities do not need to invent such framework (unless they really want to): The Living Architecture Performance Tool (LAPT) is available to calibrate the performance of green roofs and walls. It provides a scientifically based framework of performance measures and minimum prerequisites for the design, installation, and maintenance of these technologies. You can download the LAPT at www.greeninfrastructurefoundation.org

"THE LIVING ARCHITECTURE PERFORMANCE TOOL (LAPT) IS AVAILABLE TO CALIBRATE THE PERFORMANCE OF GREEN ROOFS AND WALLS. IT PROVIDES A SCIENTIFICALLY BASED FRAMEWORK OF PERFORMANCE MEASURES AND MINIMUM PREREQUISITES FOR THE DESIGN, INSTALLATION, AND MAINTENANCE OF THESE TECHNOLOGIES."

- JEFF JOSLIN

BEST PRACTITIONERS PROVIDE A CERTAIN PATH TO BEST PRACTICES.

Green Roof Professional (GRP) certification is designed to provide those who earn the accreditation with knowledge of best practices in design, installation, and maintenance. Should concern be raised about the availability of professional capacity or expertise, such certification can be referenced, and even incented by providing expedited review for certified professionals.

EVERY LOCALE IS A "SPECIAL FLOWER", BUT NOT.

The *Green Roof Policy In North America* document provides a comprehensive list of policies and regulations currently in place, and resources and contacts to dive deeper when looking for best-comparables as new initiatives are considered or getting underway. This information is already being well-exploited. It's highly recommended that each next effort steal and borrow freely, adopting and customizing these existing wheels rather than inventing new ones. Relying on pre-existent models advance the case that green roof requirements are not exotic and uncertain, but are – in fact – fully vetted and effective at the building, community, regional, and – ultimately – planetary scales.

As in so many things, green roof policy perfection can be the enemy of the good.

Local appetite for new regulation is variable, particularly when considering "new" technologies in an unevolved market. There's wisdom in manifesting politically expedient "starter" requirements if necessary, allowing the market and the trades to mature, in anticipation of additional requirements down the road as changing political landscapes and other policy efforts present new opportunities to expand or otherwise augment approaches already in-place.

THE CONCLUSION: THERE'S ONLY ONE BEST TIME TO DEPLOY GREEN ROOF POLICIES AND REGULATION.

Not surprisingly, that time is: now, which is why region-by-region and city-by-city, increasingly aggressive green roof policies are being established each year. And this period of sheltering and distancing further underscores the environmental, outdoor space, and aesthetic benefits of green roofs, which will be all-the-more appreciable – if not essential - to our calm and health in this rapidly emerging era of post COVID 19 recovery ahead.

Green roofs and walls provide proven approaches to meeting multiple policy objectives at all scales and in all North American economies and climates. And they do so in a manner that is cost-effective, address multiple climate change objectives simultaneously, and contribute directly and immediately to making projects - and our communities - more resilient and sustainable.

More Information

Jeff Joslin is the Director Current Planning, City of San Francisco and the Chair of GRHC's Policy Committee.

Green Roof Policy in North America is a free resource: greenroofs.org/policy-resources

The Living Architecture Performance Tool is a free resource: greeninfrastructurefoundation.org/lapt

GREEN INFRASTRUCTURE READY RECOVERY

BY JENNIFER COURT, EXECUTIVE DIRECTOR, GREEN INFRASTRUCTURE ONTARIO COALITION

The full scope and impact of Ontario's vibrant green infrastructure sector has never been quantified—until now.

The new “Economic Impact Assessment of the Green Infrastructure Sector in Ontario” is a first-ever assessment of the full scope of the green infrastructure sector, commissioned by the Green Infrastructure Ontario Coalition (GIO) and funded by the Greenbelt Foundation, with additional financial support from Landscape Ontario. This report highlights to what degree green infrastructure is an important contributor to Ontario's economy and a creator of jobs. It demonstrates that the sector has the capacity for significant, regional wide growth in a Post-COVID 19 recovery.

According to the 2020 report, green infrastructure generates CDN\$8.6 billion in gross output (revenues), \$4.64 billion in direct gross domestic product (GDP), and directly employs approximately 84,400 people in 2018. Factoring in the indirect and induced impacts, Ontario's green infrastructure sector was responsible for more than 120,000 jobs and nearly \$8.33 billion in GDP in 2018.

The green infrastructure sector is divided into six key sub-sectors: landscape horticulture and open spaces, natural heritage, parks, urban forests, green stormwater management, and green roofs and walls, as well as the cross sectoral support services that play essential roles across these sub-sectors.

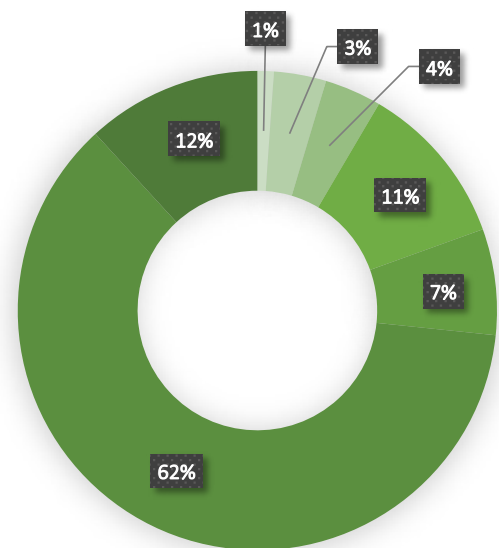
Ontario's Green Roof and Walls sub-sector was responsible for an estimated 840 direct jobs in 2018, with a gross output of \$93 million and a direct contribution to provincial GDP of \$51.2 million. This growing sector has a direct, indirect, and induced GDP contribution of over \$88 million. The growth potential of this subsector is particularly impressive; under a business-as-usual scenario, the Green Roofs and Walls sub-sector is projected to see the highest relative growth rate of all sub-sectors based on current trends, equal to 108% growth by 2030. Under a stretch scenario, which includes more aggressive policies and regulations and more significant investment, the growth potential is even more significant at up to a 270 per cent increase between 2018 and 2030.

Support for green infrastructure projects has value chain ripple effects wherein the economic, environmental, and social benefits largely remain inside Ontario. Current trends show significant growth potential for the sector as public awareness and attitudes towards the sector evolve. In short, this report recognizes the meaningful role that this sector plays in today's economy, as well as the vital role we can play in the economic recovery of tomorrow.

For more information

You can download this report from www.greeninfrastructureontario.org

CONTRIBUTIONS OF GREEN INFRASTRUCTURE TO \$4.6B IN GROSS DOMESTIC PRODUCT IN ONTARIO



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- Green Stormwater Management
- Urban Forests
- Parks
- Natural Heritage
- Landscape Horticulture and Open Spaces
- Cross-sector Support Services

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The Journal of Living Architecture (JLIV) is the peer-reviewed journal of the Green Infrastructure Foundation. The magazine publishes the abstracts of each published JLIV manuscript, with the full paper available online.

Volume 7 Number 1 Pages 1-26

CARRYING THE BALL: A PORTRAIT OF LEADERSHIP IN URBAN ROOFTOP AGRICULTURE

Michael Sánchez I*, David Wang²

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Rooftop agriculture has seen a surge in development, especially over the latter half of this decade. By involving committed leadership, urban rooftop agriculture can advance awareness of food production and food security while creating a new kind of social engagement. This paper reports on common traits of ten North American activists (a.k.a. ball-carriers) who make urban rooftop agriculture initiatives their primary work. We provide a trait analysis and describe the recurring features of leadership through three heuristically-developed models. This research helps clarify the profile of individuals who are currently pioneering the movement and provides information to aid efforts for urban rooftop agriculture as a mainstream practice.

The Journal of Living Architecture (JLIV) is the official, peer-reviewed journal of the Green Infrastructure Foundation. The magazine publishes the abstracts of each published JLIV manuscript, with a link to the full paper online.

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IDENTIFYING OPPORTUNITIES TO INCREASE GREEN ROOFS IN NYC (WHERE THEY ARE MOST NEEDED)

MICHAEL L. TREGLIA AND ALAINA VAN SLOOTEN, THE NATURE CONSERVANCY, NEW YORK STATE CITIES PROGRAM

The Nature Conservancy and partners estimate that as of 2016 only about 736 of more than one million buildings in New York City (NYC) had green roofs, based on the first analysis of their distribution.

The Nature Conservancy and partners estimate that as of 2016 only about 736 of more than one million buildings in New York City (NYC) had green roofs, based on the first analysis of their distribution. Though not all buildings are suitable for green roofs, significant untapped potential remains. Furthermore, green roofs are not equitably distributed across the city – some areas with limited greenspace, higher exposure to the urban heat island effect, air pollution and stormwater challenges that do not have many green roofs can potentially benefit the most from local expansion of green roofs.

Recently, several new policies have been developed to increase the number and area of green roofs across NYC. Generally, these policies do not explicitly prioritize green roofs in areas of higher opportunity or need. To generate dialogue, The Nature Conservancy, with support from the mapping company, Azavea, and their Summer of Maps Fellowship Program, examined how green roofs could be prioritized across NYC, based on various types of need and at multiple spatial scales. This work can inform the development of relevant policies and programs.

POLICY BACKGROUND

The new policies and programs designed to help increase green roofs across NYC include mandates, tax incentives, and grants. For example, Local Laws 92 and 94 of 2019 require green roofs, solar, or a combination of the two on nearly all newly constructed buildings, building expansions, and full roof replacements. Though there are multiple incentive programs for solar panels, there are only two for green roofs. The NYC Department of Environmental Protection has a Green Infrastructure Grant

Program, providing financial support for construction of green roofs above a certain size. There is also a tax abatement which was renewed and amended in 2019 for property owners who install green roofs on their buildings.

A key amendment to the tax abatement was an attempt to help address inequity in green roof distribution by providing a higher abatement rate (\$15/sf) in “priority Community Districts,” with a lower rate offered in non-priority areas (\$5.23/sf). According to the legislation, priority areas would be determined based on “potential to minimize net stormwater runoff and increase green space.” These criteria are a great start, but they are not comprehensive. Green roofs indeed can help manage stormwater – greatly needed in cities like New York where outdated Combined Sewer Overflow (CSO) systems discharge raw sewage directly into local waterways when overwhelmed by rainfall. Green roofs also function as wildlife habitat, and sometimes as places of respite, recreation, and education for local residents. However, they provide other benefits that address critical urban environmental issues that can also be considered in spatial prioritization, including mitigating urban heat and absorbing air pollution.

DATA AND METHODOLOGY

We explored four factors in potential prioritization of green roofs, based on relevance to NYC and data availability. We considered greenspace and need to manage stormwater, in part because these were specified in the tax abatement. For greenspace need, we calculated the percentage of land that was not covered in vegetation, based on recent land cover data for NYC (Figure 1 Map b). For

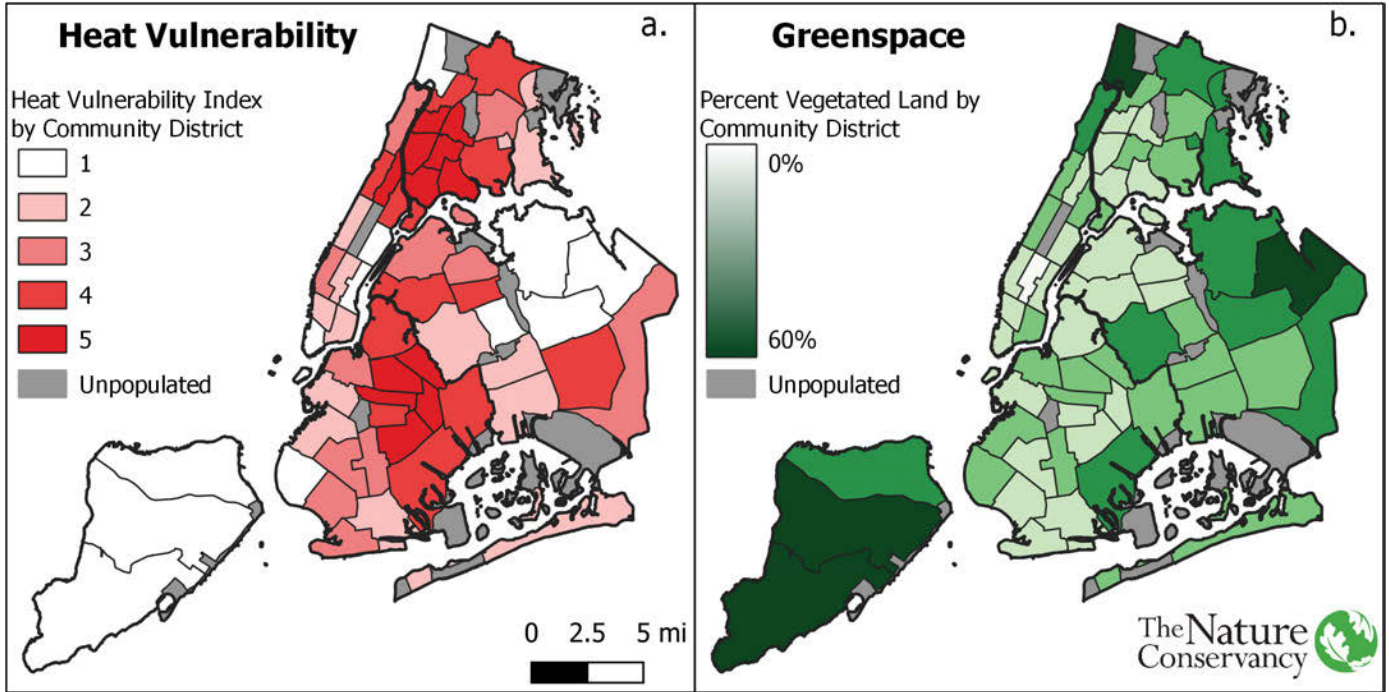


Figure 1. Maps showing the Heat Vulnerability Index (panel a) and percentage of vegetated land cover as a metric of greenspace (panel b). Heat Vulnerability Index data are available from the NYC Dept. of Health and Mental Hygiene, and the greenspace data are derived from Land Cover data available on the NYC Open Data Portal.

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stormwater, we estimated the amount of sewage discharge attributable to distinct areas based on data from Open Sewer Atlas NYC.

We also incorporated the Heat Vulnerability Index (Figure 1), developed by the NYC Department of Health and Mental Hygiene, which represents how vulnerable communities are to health consequences of heat waves based on demographic and environmental factors. Lastly, we used the Social Vulnerability Index, developed by the Center for Disease Control and Prevention, which generally reflects resilience of communities to external stresses.

We scored each factor in a standardized way, and combined them with equal weight into a single metric. Weights of different variables could be adjusted based on various considerations; we even explored omitting the Heat and Social Vulnerability Indices.

While combining these different factors, we considered how geographic scale influences the results. The tax abatement

names Community Districts (CDs) - local administrative areas represented by boards of citizens - as the unit for prioritization. As a smaller alternative, we examined Neighborhood Tabulation Areas (NTAs), which are aggregations of census tracts that encompass 15,000 people in each. These were developed for planning purposes, but also serve as a practical scale for analyses such as this.

RESULTS AND TAKEAWAYS

We present a selection of maps to illustrate what prioritization could look like according to specific combinations of variables at both CD and NTA scales (Figure 2). Adding heat and social vulnerability as metrics shifts the areas of greatest need to include more of southern Bronx, northern Manhattan, and eastern Brooklyn. These areas are generally recognized as including

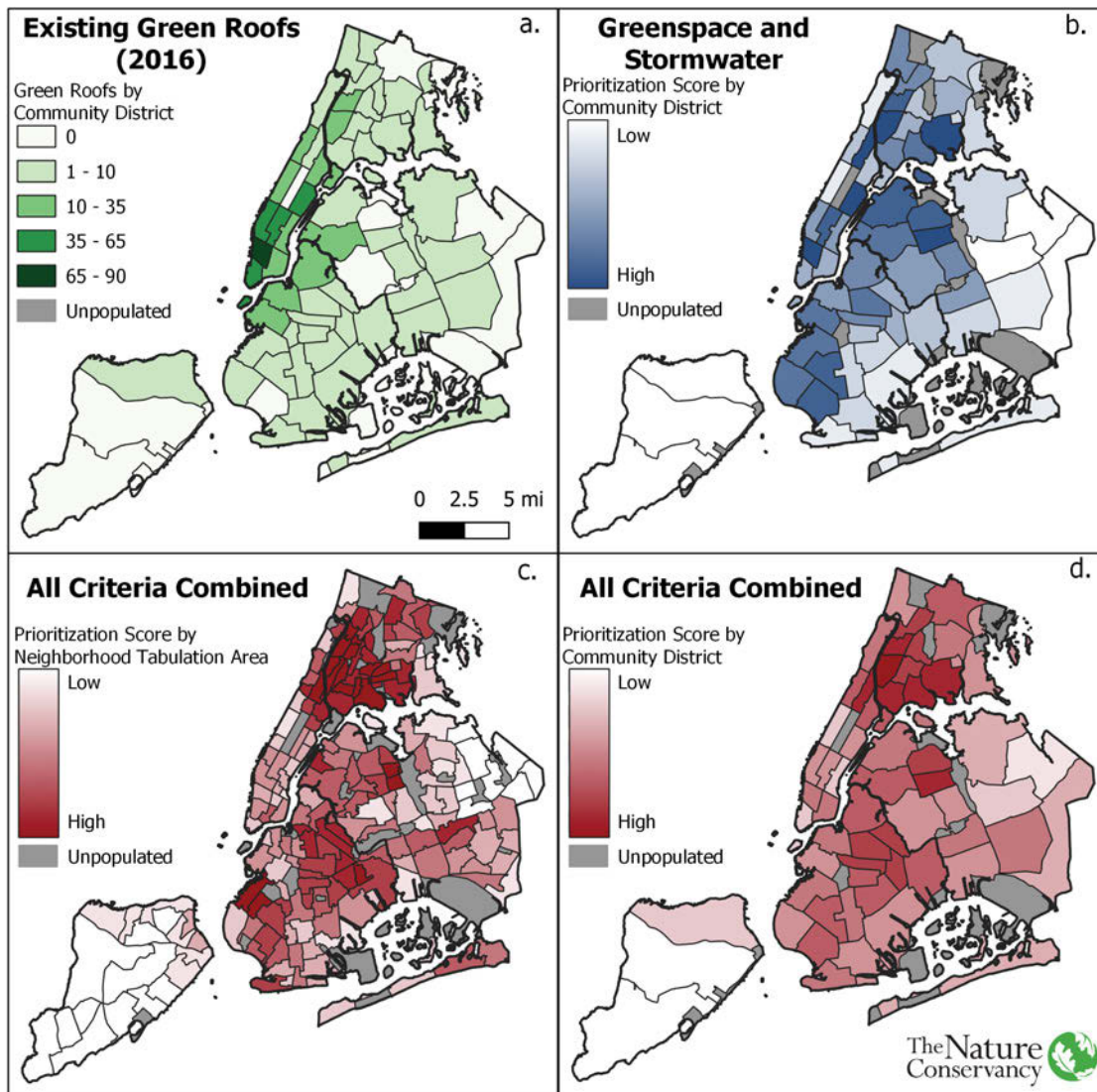


Figure 2. Maps showing distribution of existing green roofs in NYC (panel a), and potential prioritization schemes for green roofs (panels b, c, and d). Panel b depicts a prioritization at the scale of community districts based on lack of greenspace and an estimate of combined sewer system challenges; panel d adds metrics of Heat and Social Vulnerability; and panel c represents a prioritization with all four of these metrics at a smaller geographic unit, Neighborhood Tabulation Areas. See text for more details on methods.

environmental justice neighborhoods, where disproportionate environmental burdens have impacted communities of people of color and lower income households. Simply focusing on stormwater and greenspace could potentially further the disparity in green roof distribution based on the metrics we used, as greater need was identified for these variables in some areas that already have more green roofs, such as downtown and midtown Manhattan. Spatial scale of analysis also has a clear influence. With the smaller NTAs, prioritization can be conducted in a more targeted way, helping ensure that communities in areas of the city with the greatest need for green roof benefits can see them locally. Notably, CDs vary in population and area, and large ones in particular can have substantial environmental and demographic variation. Thus, policies enacted at this scale could be implemented in ways that don't benefit those whom they were designed to help.

Overall, the work described helps us explore some, but not all, of the options for prioritizing green roofs in NYC. This builds on previous examples of green infrastructure prioritization in both applied and academic settings. Other factors can be incorporated, and the factors we did include can be calculated in different ways to more holistically represent potential green roof benefits. Such work should leverage partnerships with local experts, including community-based organizations, relevant agencies, and academic researchers, to make the best

use of available data and incorporate local perspectives. Furthermore, given that not all buildings can support a green roof, similar analyses will benefit from a rigorous understanding of feasibility of buildings to support green roofs. For NYC and other cities around the world, this is still a significant data gap.

As prioritization efforts are applied, it is also critical to consider how relevant policies may affect local residents. For example, if green roofs are incentivized, and seen as an amenity in needed areas, what approaches can be used to avoid potential green gentrification? And how can new green roofs be made accessible and usable for communities?

Green roofs are not a panacea for environmental and social problems, but they are part of the equation for making cities more livable and enjoyable in a climate-changing world. It is critical both that we increase them in number and area, and that their benefits be equitably distributed. We believe work like this can inform policy and incentive programs to make that happen.

Michael Treglia, Lead Scientist, NYS Cities, michael.treglia@tnc.org. More information about The Nature Conservancy's work on green roofs in NYC is available at https://www.nature.org/content/dam/tnc/nature/en/documents/NYC_GreenRoofs_Summary.pdf. Learn more about NYC's Sustainable Roof Laws at https://www.nature.org/content/dam/tnc/nature/en/documents/SustainableRoofLaws_12.12.pdf.



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POST COVID-19 POLICIES FOR BIODIVERSITY ARE NEEDED

BY DAN SLONE

Earlier this year, before everything turned upside down, I spoke to a new Biophilic City regarding the trends in biodiversity being integrated into city plans and ordinances. My theme was that our historic approach to public landscape was like our approach to junk food. It's inexpensive, convenient, filling, somewhat tasty but lacking in nutrition. I encouraged them to adopt four policies to guide their planning for more nutritious physical spaces and the ordinances that might relate to them.

As humans were absent from the parks, waterfronts and streets of their cities and towns during the lockdown, wildlife asserted itself, manifesting its resilience and displaying its willingness to share human habitat. If the number of tweets and postings is any measure, humans are increasingly realizing they would like to share space with wildlife. I believe that these policies will become even more central to the decisions of cities to create "high nutrition" urban landscapes.

The first is to think in clusters (everything is connected). It is not sufficient to create a park, without also creating corridors such as landscaped boulevards, green infrastructure or connected living buildings, connecting it to other parks or habitats. Those connections will be insufficient if there are not protected road crossings and regulations for lighting and sound along the corridor.

The second is to layer purposes (no dollar does one job). City budgets will be strained as cities deal with debt and reduced taxes after the pandemic. Some leaders will be tempted to cut back on landscape expenditures. Given the significant physical, psychological, and fiscal returns on biophilic investments, the opposite should occur. But investment in grass should not be in turf grass requiring mowing, fertilizing, pesticides, and irrigation, but in seasonal grasses that provide food and habitat and have minimal maintenance costs. Investment in trees and shrubs

should not be solely for aesthetics but for food for pollinators and birds, for wildlife habitat or even food for people.

The third policy is to anticipate consequences (do no harm). Working with experienced professionals, cities should anticipate the things that can go wrong in inviting living creatures into human habitat. This policy would require cities to mandate bird friendly buildings along the corridors that have been protected or preserved for bird movement, and to prohibit the application of herbicides and pesticides at least along wildlife routes. Other practical regulations on food waste disposal help prevent the creation of "problem wildlife."

The final policy is to create experience (think like Singapore). Humans will protect what they love, so there needs to be many ways for residents to experience the wildlife around them, both directly and virtually. They need to have access to training so that they can understand the creatures and their behaviors, can overcome any fears, and so they can avoid creating behaviors that are bad for the wildlife.

A gift from the virus has been a glimpse of the rich landscape that could fill our cities if we would consciously facilitate it.

For More Information

Through his law firm Vertical Vision, Dan Slone helps cities craft code and planned communities design governance documents for sustainable and resilient placemaking. He coaches developers in using community storytelling to embed their values and helping green business and non-profit start-ups such as the Congress for the New Urbanism, the US Green Building Counsel, the World Green Building Counsel, EcoDistricts, and Green Roofs for Healthy Cities. dan@verticalvision.legal. biophilicities.org

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