Green Zones: A Strategy to Transform Environmental Justice Communities

A Guide

Greater Grove Hall Main Streets

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Updated August 17, 2023

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A game plan for bridging the coming energy divide

Without serious intervention, those most in the need of help will fall further behind

Ed Gaskin

(Originally published to *Commonwealth Magazine* on July 22, 2023)

WHENEVER THERE IS a major transition, there is often a divide between the haves and the have-nots. Consider the digital divide. To this day, some communities still don't have broadband internet access. We are about to see a similar divide with respect to energy and the environment. According to a report published by McKinsey & Company, it will take $265 trillion in capital to decarbonize buildings, transportation, power generation, and agriculture. These investments and the disruptive efforts they fund will have a huge impact, not only by reducing greenhouse gases and forestalling the effects of climate change, but by creating wealth for some (mostly White) people and destroying it for other (mostly Black and Brown) people. Like the internet revolution, the effects will likely be vastly different for some communities than for others.

Without significant intervention, affluent communities will run on clean, green energy and benefit from environmental improvements, while poorer neighborhoods will be left behind in the legacy brown economy, which is based on fossil fuel systems. These areas already have worse indoor and outdoor air quality and suffer more from the effects of residual pollutants such as lead and asbestos. Plagued by brownfields, methane gas leaks, and inadequate storm water management, these environmental justice communities also tend to be heat islands, with significantly less green space and tree cover than wealthier areas.

We already know that those living in environmental justice communities tend to have fewer economic resources, poorer health, and relatively less public safety. Ironically, these communities also often have a higher energy burden (energy cost as a percentage of disposable income) because of the way utility rates are set. Rates are based on the utility company's cost plus a markup. As fewer people rely on old infrastructure, the shared cost of maintaining that infrastructure rises per person. Thus, those who can least afford it end up paying higher energy rates despite being historically underserved by the energy system.

Communities with the means to transition to the green economy will benefit from lower energy costs, with their residents enjoying tax breaks for making the transition as they buy everything from new appliances to electric vehicles to solar and geothermal systems. Not only is it less expensive to drive an electric vehicle than a gas-powered one, but EVs are emissions-free, thus minimizing pollution in their owners' neighborhoods. Areas without green infrastructure — known as brown zones — will become less desirable, depressing housing prices, reducing community wealth, and exacerbating the wealth gap.

It's no coincidence brown zones are also home to the highest concentrations of Black and Brown people. They are largely the same neighborhoods as those previously designated as Empowerment or Enterprise Zones. Those Black and Brown neighborhoods have endured decades of spatial injustice, intentionally chosen as the sites for transfer stations, junkyards, scrap metal recycling, waste management facilities, water treatment plants, polluting factories, and other environmentally undesirable facilities, because their residents lacked the means and the power to refuse. The government even built highways right through the middle of some of these communities, taking property through eminent domain and designating it for urban renewal. Misguided housing policies from the 1950s and ’60s, redlining, blockbusting, and malicious zoning resulted in the destruction of billions of dollars in community wealth for neighborhoods systemically made less desirable than others. This damage is described extensively in “Boston Green Ribbon Commission and Embrace Boston: Our Shared History Report.”

Just as our government and society took intentional steps that resulted in brown zones, as we stand on the brink of energy transformation, we can intentionally create green zones.

Cities account for 80 percent of greenhouse gas emissions and 75 percent of energy consumption. Like a growing number of cities, Boston is now majority minority. Therefore, efforts to reduce climate change must engage stakeholders of color. The challenge is, in the short-term, that African Americans might believe there are more pressing issues.

That’s why we must focus on opportunities for environmental hazard mitigation and environmental sustainability. Black people can make the connection between living in a heat island and having higher electric bills for cooling. They understand the relationship between vehicle exhaust fumes and their children’s asthma. But Blacks have questioned spending billions of dollars to prevent our planet from warming by 1 degree Celsius over the next 50 years while we are not addressing existing environmental hazards such as brownfields and air pollution, which they live with every day. In one poll of African American priorities, tackling climate change ranked 16th out of 17 choices.

We must also link energy and the environment. Black people can understand that the environment in which they live directly affects their health, because they experience the effects of extreme heat and air pollution right now. The reasons for caring about the source of our energy are a little more abstract. By linking the two, we create a bridge that expands the community of concern.

The federal government has made money available through the Bipartisan Infrastructure Law and the Inflation Reduction Act to help areas designated as environmental justice communities. We now need a plan and a process to help those communities make the transition to clean energy and a better environmental future. For this, we can look to the Green Zone planning framework, which is a companion to the Commonwealth Green Zones Act, legislation that I co-wrote and which has been filed in the Massachusetts House and Senate.

Although hundreds of billions — maybe even trillions — of dollars will likely be spent on energy transition and environmental efforts in the coming years, Morgan Stanley pinpoints opportunity for investors in just five areas: renewables, electric vehicles, carbon capture and storage, hydrogen, and biofuels.

Jeff Bussgang, a partner at Flybridge Capital Partners and a senior lecturer at Harvard Business School, sees battery technology as one of the top five sectors for investors. This means that although the public and private sectors will each invest billions, there is not yet a private market, because entrepreneurs have not yet discovered a way to make money by helping environmental justice communities transition to greener, healthier states. That’s a problem.

If we are to achieve a clean energy and environmental future for those living in environmental justice communities, we must create a market for doing so, because the necessary investment will be tremendous. One way to get an idea of the potential market is to multiply the number of environmental justice communities or the number of individuals living in an environmental justice community by the average amount it will take to transition one community or person.

But currently, there is no market for environmental justice. Otherwise, we would see companies entering the space. One problem is that the communities with the greatest need to transition have the least financial ability to do so. Helping them not only means building public infrastructure but subsidizing individuals to make the transition. Imagine legislation that calls for giving Black and Brown homeowners up to $100,000 each to help decarbonize their homes or transition to clean energy. That's a difficult political challenge.

Consider that the transition often requires purchasing new equipment, such as solar panels or heat pumps. Switching to clean energy might result in a 3 percent to 5 percent increase in energy costs. Higher income communities might easily accept the increased cost as necessary for fighting climate change. Communities with less disposable income and a higher energy burden might be forced to reject any solution that results in higher energy costs, no matter how good it is for the environment. Such market friction is not as easy to address as building a new piece of infrastructure.

Given the amount of money required to make the transition to a clean environment and green energy economy, there will be economic implications, which could include opportunities for Black businesses and green economy jobs for those in the transitioning neighborhoods. However, there is a great deal of skepticism about whether those benefits will be realized. The federal government has a poor record of meeting its procurement targets from diverse business enterprises. The same has been true for many workforce development efforts, where the only people to benefit were the trainers.

One concern related to identifying Green Zones and making improvements in those places is that the process will contribute to gentrification and displacement. As the sea level rises, 300,000 people in Boston will need to seek higher ground. Grove Hall, which sits 100 to 200 feet above sea level, is one place that will attract climate change refugees, causing climate change-driven gentrification. Property located the furthest above and away from the water will increase in value, and those living in places such as Grove Hall will be displaced. The goal of the Green Zones legislation is to improve life for residents of brown zones, not make their neighborhoods so attractive that they end up getting pushed out.

To ensure a just transition to a green environmental and energy future, we must acknowledge that there is a green versus brown divide, that the divide was intentionally created, and that racism played a role in its creation. Without serious intervention, history will repeat itself, and those most in need of the help to make the transition won't get it. Instead, the billions or trillions of dollars being invested to address climate change will further increase the wealth gap between the environmental haves and have-nots. Knowing this in advance gives us an opportunity to do something different and create a better future for ourselves. Creating Green Zones and using the Green Zone planning process is one way to ensure that those who most need the help will receive it. Green Zones are a tool for achieving a just energy and environmental transition.

Ed Gaskin is executive director of Grove Hall Main Streets.

Why we need to identify Green Zones

Think of them as spot treatments for environmental hazards

Ed Gaskin

(Originally published to *Commonwealth Magazine* on December 30, 2021)

PRESIDENT BIDEN has signed an infrastructure bill that includes $21 billion for environmental remediation and $150 billion to boost clean energy and promote “climate resilience.” This money presents a tremendous opportunity for our communities to increase green infrastructure, address environmental inequality, and foster innovation, focusing on common environmental problems found in Black and Brown sections of urban areas.

We should use this once in a lifetime funding to build Green Zones across the Commonwealth and across America as a way to further environmental justice and resiliency. Green Zones are areas “in need of critical green intervention” and the process of their creation could be an important planning tool at all levels of government.

Residents of the Grove Hall section of Boston are proposing legislation based on the following principle: Every citizen has a right to know what environmental hazards, as well as opportunities to achieve sustainability, exist in their community. They should also have the opportunity to participate in the development of plans in their communities to mitigate the hazards and harness the opportunities.

The areas where these environmental hazards are clustered are typically within areas called environmental justice communities. These clusters should be designated as Green Zones and receive priority for the implementation of green infrastructure that addresses remediation and sustainability.

The challenge is that federal money targeted for environmental work tends to go to better organized and activist “Tree Hugger” communities, or areas where there is significant opportunity for financial gain. Morgan Stanley estimates that it will cost between $300 billion to $50 trillion to halt global warming and reduce net carbon emissions to zero by 2050. The largest beneficiaries will be companies in renewables, electronic vehicles, carbon capture and storage, hydrogen, and biofuels.

Achieving carbon neutrality is a desirable goal, but what is often missed is we could make the investment to achieve carbon neutrality and still not mitigate local environmental hazards such as brownfields, heat islands, poor air and soil quality, or polluting stormwater management practices.

What are Green Zones?

Green Zones describe a framework for neighborhood development within a designated geographic area, established either informally or formally (via zoning), that prioritizes the environmental and economic health of the community. Zoning has been used for years to achieve certain public policy initiatives and it may be necessary to provide more intervention choices such as taxing options and governance structures. Historically, Green Zones are in communities that have been over-burdened by years of environmental pollution, environmental hazards, and a lack of investment.

A Green Zone represents a justice-oriented approach to new investments, planning decisions, infrastructure development, and community participation.

Food, housing, and the environment are social determinants of health. Poor air, water, and soil quality; lack of green space; and extensive exposure to “heat islands” have a material impact on health, including more asthma, heat cramps, heat exhaustion, heatstroke, and childhood poisoning from environmental toxins. In potential Green Zone locations, there is often waste processing, waste storage, and other environmental pollution. Because of systematic racism, or political vulnerability, these types of environmental challenges tend to be co-located in lower-income and/or communities of color.

A Green Zone is similar to spot treatment given to a soiled garment. The entire garment may need cleaning, but certain spots need special attention. If we give the entire garment equal treatment, the area with the spot will be better, but the spot won’t be removed. Because of the scope of the problem, it’s simply not possible to solve all of the environmental problems at once. Some areas need priority focus, such as Green Zones. For example, even focusing on environmental justice communities is too broad, as 73.9 percent of the city of Boston is considered an environmental justice community.

Why the focus on urban communities of color? Cities account for 80 percent of greenhouse gas emissions and 75 percent of energy consumption. Cities are drivers of climate change and are home to many environmental burdens. To address the climate challenge, we need to see everyone as a stakeholder, and everyone needs to be engaged. It’s hard to convince someone to focus on something that’s going to happen 50 years from now, while ignoring their current environmental challenges, (as well as public safety, healthcare, and educational challenges). But people of color are often ignored.

In the creation of a Green Zone, project selection is another ideal time to make the connection between the city’s role (building green infrastructure) and the individual’s responsibility (green practices). When it comes to energy efficient practices, cumulative small changes can have a significant impact. But solutions must be contextualized for ethnic and/or income groups not typically targeted for environmental initiatives. Rebates on energy-efficient appliances, or tax credits for electric vehicles, aren’t as relevant to people who rent, especially those living in affordable housing, or use public transportation because they can’t afford a car.

It’s unrealistic to expect communities to lead in this area when it is hard to know where to find the environmental quality measures for a given area or what they mean. Without the data and analysis, it’s impossible to advocate for improvement. That’s why we call for legislation that would require every metro area to have an environmental audit and to publish the data widely.

Creating a Green Zone in Grove Hall

Grove Hall is a great case study of what we are talking about. The city of Boston has developed several environmental reports and plans over the years, but these plans don’t address the environmental challenges of Grove Hall, which has 3.3 percent of Boston’s land space but 38.7 percent (or 58) of its brownfields; low amounts of tree canopy in public areas; and a high level of impervious surfaces. As a result, North Dorchester and Roxbury have the highest number of mold hazards/violations, the highest hospital emergency department visit rate for asthma, and high rates of lead contamination in the soil.

Grove Hall also has opportunities — at least 1.25 million square feet of potential flat roof coverage, which could be used for solar energy, roof gardens, or the placement of reflective panels; 31,000 feet of sidewalk area that could be transformed into permeable pavement; and 200,000 square ft of median space on main thoroughfares, where bioswales or rain gardens could be installed.

Knowing the depth and breadth of the problem enables the community to get engaged in developing solutions. Infrastructure projects are often capital budget projects, and depending upon a city's planning horizon, projects identified today won't even start to be implemented for another five to seven years. It's important to look at and bring the community up to speed on emerging technologies.

For Grove Hall, we researched a number of technologies such as bioswales, bioshelters, carbon sequestration, vertical farming, heat pumps, microgrids, commercial rainwater harvesting, urban wind energy solutions, commercial, passive energy heating/cooling systems, and the technologies required to build sponge cities. All of these technologies can play a role in creating a more environmentally just and sustainable Grove Hall.

Green Zone infrastructure projects are large, complex, and require interagency and inter-governmental coordination and funding. We must make creating and implementing Green Zones a pillar of our environmental strategy. If we make it known that Green Zones are a public policy priority, it will encourage the private sector to innovate on typical urban environmental challenges. This, in turn, will make these targeted areas more economically and environmentally self-sufficient and resilient.

In the same way that the Federal Emergency Management Agency requires natural hazard planning, we believe the EPA or environmental planning at the state level, could require an environmental audit and plan. Urban planning is a core government function, why not use it to drive green outcomes? We believe that addressing the environmental hazards in the built environment should be a required part of the urban planning and development process.

If we move now, while the money exists, we can implement plans and finally address the environmental hazards our communities face and leverage the opportunities to make our neighborhoods "cleaner and greener." This would bring environmental justice, improve community health, and produce energy savings for communities that need it while helping save the planet.

Ed Gaskin is the executive director of Greater Grove Hall Main Streets.

There are at least 1,250,000 ft2 potential green roof coverage in Grove Hall.

Combating climate change could yield societal change

Black businesses must be part of the solution

Ed Gaskin

(Originally published to *Commonwealth Magazine* on January 26, 2022)

IT IS HARD to miss the urgent calls to do something about global warming. The Paris Agreement, Greta Thunberg, President Biden's infrastructure legislation — the unusual climate patterns and the destruction they cause serve as a call to action from every corner.

But climate change is not just about climate. It's also an opportunity to address economic disparity. This is something that keeps getting missed by everybody from Boston Mayor Michelle Wu to Gov. Charlie Baker to Sen. Ed Markey.

There will be billions, if not trillions, of dollars spent to address aspects of climate change. This could be a game-changer, or just another missed opportunity, for the Black community.

According to a report from Morgan Stanley, it will cost anywhere from $300 billion to $50 trillion to address global climate change over the next two decades. This is money that will be spent for a good cause. And, as much as possible, it should be spent with BIPOC businesses.

The track record for using public funds to address equity issues is not good. The city of Boston spent $2.1 billion over five years and bought only 0.4 percent of its procured services and products from Black businesses. According to the state's Supplier Diversity Office report, Massachusetts agencies spent $4.8 billion in 2020, but Black-owned businesses were awarded only $11 million in state contracts.

The state's cannabis business should not be the only social equity business supported by the state.

The Morgan Stanley report focuses on five areas: renewables, electric vehicles, carbon capture and storage, hydrogen, and biofuels. There are few Black-owned companies in these areas, which has to change if African Americans are going to participate in a meaningful way in the green economy.

The government could help Black businesses start or expand businesses in these growth areas. (Guaranteed contracts that could be used for financing would be one way to go.) During COVID, the government awarded contracts to businesses that had little or no experience. Emergency declarations meant mayors and governors could and did give out no-bid contracts to businesses that had no prior experience. Too often these declarations are only used to help white businesses,.

The government spent over $2.5 trillion on the pandemic. This crisis created an opportunity for CIC Health, a company run by White executives that did not exist before the pandemic and had no prior experience in healthcare. Not only did the firm receive a contract from the state for testing, but it was able to leverage that contract into ones with 14 other states.

The state should create an inventory or directory of every Black-owned company in the environmental cluster in the Commonwealth, discuss their needs in relation to growth, and develop an implementation plan to address the challenges. Those needs could include grants, patient capital, and employee training. We have to look at these crises as opportunities to deal with other social and economic challenges. The climate crisis could be the biggest opportunity for economic development for Black businesses or the biggest missed opportunity of the century.

We need to apply the “Massport Model,” which is now a Kennedy School case study, to all environmental projects across the state. The Massport Model calls for a 25 percent diversity, equity, and inclusion requirement and recommends that diversity efforts include equity participation; workplace and supplier diversity; wrap-around services to enhance the effectiveness of workforce and supplier diversity efforts; and a strong performance metrics and accountability system. The Massport Model was used with remarkable success in the development of the new $550 million Omni Hotel in the Seaport, and Massport has used it on other projects.

Elizabeth Turnbull Henry and L. Duane Jackson have called for the Massport Model to be used for wind energy procurement, which would require a $4-5 billion investment.

This same model should be applied to the development of any public asset in the Commonwealth, whether it’s investments in clean energy innovations or economic development legislation.

Diversity needs to be a part every aspect of these projects from investment and ownership to development, construction, operations, and ongoing maintenance. Demand for Black businesses to meet diversity requirements will increase the supply. Majority companies will partner with Black companies to increase their supply, so as a team, they are more competitive.

After spending billions if not trillions addressing climate change, we need to make sure two things happen. First, we must mitigate environmental hazards and harness environmental opportunities, even if they do not help us achieve carbon neutrality. Second, we need to use this opportunity to reduce the wealth gap by providing investment and equity opportunity for people of color, even if that is just employee ownership. The all-out effort to mitigate climate change is an opportunity to reduce wealth disparity, or will it be another missed opportunity?

The choice is ours.

Ed Gaskin is the executive director of Greater Grove Hall Main Streets.

Viewpoint: Using Green Zones to drive environmental justice, spur innovation

Ed Gaskin

(Originally published to *Boston Business Journal* on April 21, 2022)

According to a Morgan Stanley report, it will cost from $300 billion to $50 trillion to address global climate change over the next two decades. Morgan Stanley sees opportunities for investors in five areas: renewables, electric vehicles, carbon capture and storage, hydrogen, and biofuels. The opportunity exists because a large and growing market exists.

If we want to achieve environmental justice, we need to create a market for it. Otherwise, we will spend billions if not trillions of dollars to achieve carbon neutrality while still not addressing the environmental hazards that exist today in our vulnerable Black and brown urban areas, nor harness opportunities to achieve sustainability.

Green Zones are areas "in need of critical green intervention." Their use represents a justice-oriented approach to new investments, planning decisions, infrastructure development and community participation. Green Zones can take the form of a legislatively created or virtual zone. Consider washing a soiled garment: Every part of the garment gets equal treatment. But if there is a spot, the spot should get special treatment — otherwise it might be lighter, but it will still remain.

Think of Green Zones as an environmental spot treatment.

The creation of Green Zones starts by conducting an environmental audit, looking at environmental hazards such as brownfields, heat islands, stormwater runoff, and the environmental quality of air, water, and soil — in addition to looking at a range of demographic data, such as housing stocks, and health and wellness statistics in a given area. The environment is a social determinant of health, (SDOH). Poor air quality brings cases of asthma. Heat islands bring heat cramps, heat exhaustion, heat stroke and death. Poor soil quality brings childhood poisoning from unremoved environmental toxins. Where there are clusters of environmental problems, those become Green Zones.

Green Zones are typically smaller than designated environmental-justice communities. For example, 73.9% of the city of Boston is considered an environmental-justice community. Because of the depth and breadth of environmental problems, it's simply not possible to address them all at once. A systems approach is needed, because the problems present are interrelated. Addressing the solar opportunities in an area, but not addressing the heat islands, air, and soil quality, will only create incremental improvement.

Our audit discovered that while Grove Hall consisted of 3% of the city of Boston's geography, it accounted for 38% of the city's brownfields, totaling 20.26 acres in Grove Hall. As a result, we started developing ideas for brownfield remediation and reuse. When conducting the audit for Grove Hall, we noticed a significant amount of the housing had flat roofs — at least 1.25 million square feet of potential flat roof coverage, providing a range of opportunities from solar to reflective panels and roof gardens.

Boston's Grove Hall neighborhood has at least 1.25 million square feet of potential flat-roof coverage, providing a range of opportunities from solar to reflective panels and roof gardens, Ed Gaskin writes.

GARY HIGGINS / BOSTON BUSINESS JOURNAL

Proposed Green Zones legislation for the state could say an environmental audit must be conducted so that every citizen in a metro area of 100,000 or more people has a right to — and can know — the environmental hazards and quality of variables, such as air, water and soil, in their area. The results of the audit must be published widely and plans must be developed in partnership with the community to remediate hazards and harness sustainability opportunities. If people know the results of the environmental audit, then they can become part of the solution.

No market for justice

Currently, there is no market for environmental justice, since the government has not expressed an interest in environmental-hazard mitigation or increasing the opportunities to increase sustainability. As a result, there is not as much innovation. The creation of Green Zones could change that by creating a market.

With awareness of the extent of the problems and opportunities, (this provides a sense of the market size for businesses), city planners can start incorporating solutions into city budgets and developing RFPs. If not, stakeholders can put pressure on government authorities to fund implementation plans. The funding of such plans creates a market, which in turn leads to business opportunities for new businesses or businesses that want to enter this market. With new market opportunities, there will be innovation focused on addressing the environmental challenges and opportunities found in urban areas. The building of green infrastructure is typically part of a city's capital planning and budgeting process and has a five-year lead time, enough for interested businesses to participate.

If we are to effectively address the challenges of climate change, we need everyone to participate. Residents in these communities are more likely to participate in solutions to address long-term climate change problems if they know they are connected to their short-term felt needs. In other words making the connection between fighting climate change and helping my child's asthma or reducing my electric bill.

With the passage of Biden's infrastructure legislation, there is $21 billion for the construction of environmental infrastructure. This is an ideal time for Mayor Wu, who included the creation of Green Zones as part of her campaign platform, and the next governor to create and start the planning for the implementation of Green Zones across the city and state.

This money presents a tremendous opportunity for our communities to increase green infrastructure, address environmental inequality, and foster innovation, focusing on common environmental problems found in Black and Brown sections of urban areas.

Ed Gaskin is the executive director of Greater Grove Hall Main Streets.

Section 2
The Green Zone Legislation Text, HD.4162 and SD.2493

HOUSE DOCKET, NO. 4161 FILED ON: 2/16/2023

HOUSE . . . . No.

The Commonwealth of Massachusetts

PRESENTED BY:

Christopher J. Worrell

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled:

The undersigned legislators and/or citizens respectfully petition for the adoption of the accompanying bill:

An Act of improving environmental justice in Black communities.

PETITION OF:

NAME:	DISTRICT/ADDRESS:	DATE ADDED:
Christopher J. Worrell	*5th Suffolk*	*2/16/2023*

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HOUSE DOCKET, NO. 4161 FILED ON: 2/16/2023

HOUSE . . . . No.

By Representative Worrell of Boston, a petition (subject to Joint Rule 12) of Christopher J. Worrell that the Executive Office of Environmental Affairs be authorized to conduct an environmental audit of environmental justice neighborhoods. Environment and Natural Resources.

The Commonwealth of Massachusetts

In the One Hundred and Ninety-Third General Court
(2023-2024)

An Act of improving environmental justice in Black communities.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Whereas Black/African American, Asian, Indigenous, Latino/Hispanic, and low-income persons of the Commonwealth have been adversely and disproportionally impacted by environmental burdens posed by living and working in environmental justice neighborhoods, it is the intention of the general court, to authorize meaningful actions to redress said impacts. To achieve the purposes as stated in this section as well as sections 2 and 3, inclusive, this Act shall be known as the Commonwealth GREEN ZONES ACT.

SECTION 2. As used in sections 1 through 4, inclusive, the following words shall, unless the context clearly requires otherwise, have the following meanings:—

“Environmental Audit” means a comprehensive study undertaken by the secretary for the purpose of identifying and quantifying the number and type of environmental burdens as defined herein and shall include but not be limited to public health data, public safety data, energy

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burden, transportation access data, and land use where such data is useful in quantifying the environmental burden within an environmental justice neighborhood.

Where clusters of environmental burden and/or opportunity to create environmental sustainability and Environmental resilience exist, those areas will be defined as “Green Zones” for the purpose of planning and funding.

The audit will include determining prior causes of environmental burden, where possible if those conditions still exist, and the ideal future “Green” state.

“Environmental Burdens” means (a) any destruction, damage, or impairment of natural resources that is not insignificant, resulting from intentional or reasonably foreseeable causes, including but not limited to climate change, air pollution, water pollution, soil contamination, improper sewage disposal, dumping of solid wastes and other noxious substances, excessive noise, activities that limit access to natural resources and constructed outdoor recreational facilities and venues, inadequate remediation of pollution, reduction of groundwater levels, impairment of water quality, increased flooding or stormwater flows, and damage to inland waterways and waterbodies, wetlands, marine shores, and waters, forests, open spaces, and playgrounds from private industrial, residential, commercial and government operations or other activity that contaminates or alters the quality of the environment and poses a risk to public health.

“Environmental sustainability” means the ability to maintain an ecological balance in the natural environment and conserve natural resources to support the well-being of current and future generations.

“Environmental resilience” means the capacity of an ecosystem to respond to a perturbation or disturbance by resisting damage and recovering quickly.

“Environmental Justice Neighborhood” means a neighborhood located within a municipality designated as an Environmental Justice Community and which meets one or more of the following criteria: (i) the annual median household income is not more than 65 percent of the statewide annual median household income; (ii) minority individuals comprise 40 percent or more of the population; (iii) 25 percent or more of households lack English language proficiency or (iv) minorities comprise 25 percent or more of the population and the annual median household income of the municipality in which the neighborhood is located does not exceed 150 percent of the statewide annual median household income.

“Green Zone” means an area or areas within a targeted environmental justice neighborhood identified pursuant to an environmental audit in which specific strategies to mitigate, redress and eliminate environmental burdens and the ability to improve and increase environmental sustainability and resilience exists.

"Lack of English Language Proficiency" refers to households that, according to federal census forms, do not have an adult proficient in English.

“Minority” refers to individuals who identify themselves as Latino/Hispanic, Black/African American, Asian, Indigenous people, and people who otherwise identify as non-white.

“Neighborhood” means a census block group as defined by the U.S. Census Bureau but not including individuals who live in college dormitories or individuals under formally authorized, supervised care or custody, including but not limited to federal prisons, state prisons, or county house of corrections.

"Officer", "officers" and "administrative officers", means, when used without further qualification or description, any person or persons in charge of any department or division of a city.

“Secretary” means the secretary of the executive office of energy and environmental affairs.

“Targeted Environmental Justice Community” means a municipality designated as an environmental justice community that meets two or more of the following criteria: (i) the municipality is comprised of 100 or more block groups; (ii) the percentage of block groups defined as environmental justice block groups is not less than 75% of all block groups located within the municipality; or (iii) the population of individuals residing within environmental justice block groups is not less than 100,000

“Targeted Environmental Justice Neighborhood” means an environmental justice neighborhood within a Targeted Environmental Justice Community in which areas within the environmental justice neighborhood may be designated or otherwise identified as green zones.

SECTION 3. (a) Notwithstanding any general or special law to the contrary, the Secretary of the Executive Office of Environmental Affairs is hereby authorized and directed to conduct an environmental audit of environmental justice neighborhoods located within the Commonwealth.

(b) In furtherance of conducting the environmental audit, the secretary is hereby authorized to create an environmental audit working group, consisting of not less than nine persons who live or work in an environmental justice neighborhood, to provide advice to the secretary on the conduct of said environmental audit. Said members of the environmental audit working group shall serve without compensation but may be reimbursed for expenses necessarily incurred in the performance of serving on the working group.

(c) The secretary upon completion of an environmental audit shall transmit the findings of said environmental audit, in report format, to the officer of the municipality in which the environmental justice neighborhood is located, pursuant to the environmental audit, shall identify and designate within said environmental justice neighborhoods areas to be known as green zones.

(d) Pursuant to subsections (a) and (b) of this section, the secretary shall, bi-annually, not later than October 1, shall report to the clerks of the house of representatives and senate, chairs of house and senate committees on ways and means, and the chairs of the joint committee on environment, natural resources and agriculture the findings of said environmental audit and shall cause said environmental audit to be published on the main webpage of the executive office of environmental affairs.

(e) In addition to conducting an environmental audit, the secretary shall designate green zones within targeted environmental justice neighborhoods; provided that in addition to the working group created pursuant to subsection (c) of this section, the Secretary shall consult and otherwise provide opportunities for input by residents of targeted environmental justice neighborhoods in the process of designating said green zones.

(f) Pursuant to this Section, the Secretary is hereby authorized to enter into an intrastate compact with the officer of the environmental justice community for which an environmental audit was conducted. Said intrastate compact shall be designed to establish and define the levels of cooperation that may be developed in an effort to realize the goals and objectives of green zones, so designated, within a targeted environmental justice neighborhood. Said levels of cooperation may include, be limited to, the designation of agency staff, the provision of other technical assistance, the making of planning grants, and such other means that are otherwise authorized by existing state law.

SECTION 4. Notwithstanding any general or special law to the contrary, this act shall take effect immediately.

SENATE DOCKET, NO. 2493 FILED ON: 3/2/2023

SENATE . . . . No.

The Commonwealth of Massachusetts

PRESENTED BY:

Liz Miranda

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled:

The undersigned legislators and/or citizens respectfully petition for the adoption of the accompanying bill:

An Act to improve environmental justice in the Commonwealth.

PETITION OF:

NAME:	DISTRICT/ADDRESS:
Liz Miranda	*Second Suffolk*

SENATE DOCKET, NO. 2493 FILED ON: 3/2/2023

SENATE . . . . No.

By Ms. Miranda, a petition (accompanied by bill) (subject to Joint Rule 12) of Liz Miranda for legislation to improve environmental justice in the Commonwealth by establishing the Green Zones Act. Environment and Natural Resources.

The Commonwealth of Massachusetts

In the One Hundred and Ninety-Third General Court
(2023-2024)

An Act to improve environmental justice in the Commonwealth.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Whereas Black/African American, Asian, Indigenous, Latino/Hispanic, and low-income persons of the Commonwealth have been adversely and disproportionally impacted by environmental burdens posed by living and working in environmental justice neighborhoods, it is the intention of the general court, to authorize meaningful actions to redress said impacts. To achieve the purposes as stated in this section as well as sections 2 and 3, inclusive, this Act shall be known as the Commonwealth GREEN ZONES ACT.

SECTION 2. As used in sections 1 through 4, inclusive, the following words shall, unless the context clearly requires otherwise, have the following meanings:—

“Environmental Audit” means a comprehensive study undertaken by the secretary for the purpose of identifying and quantifying the number and type of environmental burdens as defined herein and shall include but not be limited public health data, public safety data, energy burden, transportation access data, and land use where such data is useful in quantifying the environmental burden within an environmental justice neighborhood.

Where clusters of environmental burden and/or opportunity to create environmental sustainability and Environmental resilience exist, those areas will be defined as “Green Zones” for the purpose of planning and funding.

The audit will include determining prior causes of environmental burden, where possible, if those conditions still exist, and the ideal future “Green” state.

“Environmental Burdens” means (a) any destruction, damage, or impairment of natural resources that is not insignificant, resulting from intentional or reasonably foreseeable causes, including but not limited to climate change, air pollution, water pollution, soil contamination, improper sewage disposal, dumping of solid wastes and other noxious substances, excessive noise, activities that limit access to natural resources and constructed outdoor recreational facilities and venues, inadequate remediation of pollution, reduction of ground water levels, impairment of water quality, increased flooding or storm water flows, and damage to inland waterways and waterbodies, wetlands, marine shores and waters, forests, open spaces, and playgrounds from private industrial, residential, commercial and government operations or other activity that contaminates or alters the quality of the environment and poses a risk to public health.

“Environmental sustainability” means the ability to maintain an ecological balance in the natural environment and conserve natural resources to support the wellbeing of current and future generations.

“Environmental resilience” means the capacity of an ecosystem to respond to a perturbation or disturbance by resisting damage and recovering quickly.

“Environmental Justice Neighborhood” means a neighborhood located within a municipality designated as an Environmental Justice Community and which meets one or more of the following criteria: (i) the annual median household income is not more than 65 per cent of the statewide annual median household income; (ii) minority individuals comprise 40 per cent or more of the population; (iii) 25 per cent or more of households lack English language proficiency or (iv) minorities comprise 25 per cent or more of the population and the annual median household income of the municipality in which the neighborhood is located does not exceed 150 per cent of the statewide annual median household income.

“Green Zone” means an area or areas within a targeted environmental justice neighborhood identified pursuant to an environmental audit in which specific strategies to mitigate, redress and eliminate environmental burdens and the ability to improve and increase environmental sustainability and resilience exists.

"Lack English Language Proficiency" refers to households that, according to federal census forms, do not have an adult proficient in English.

“Minority” refers to individuals who identify themselves Latino/Hispanic, Black/African American, Asian, Indigenous people, and people who otherwise identify as non-white.

“Neighborhood” means a census block group as defined by the U.S. Census Bureau but not including individuals who live in college dormitories or individuals under formally authorized, supervised care or custody, including but not limited to federal prisons, state prisons, or a county house of corrections.

"Officer", "officers" and "administrative officers", means, when used without further qualification or description, any person or persons in charge of any department or division of a city.

“Secretary” means the secretary of the executive office of energy and environmental affairs.

“Targeted Environmental Justice Community” means a municipality designated as an environmental justice community and that meets two or more of the following criteria: (i) the municipality is comprised of 100 or more block groups; (ii) the percentage of block groups defined as environmental justice block groups is not less than 75% of all block groups located within the municipality; or (iii) the population of individuals residing within environmental justice block groups is not less than 100,000

“Targeted Environmental Justice Neighborhood” means an environmental justice neighborhood within a Targeted Environmental Justice Community in which areas within the environmental justice neighborhood may be designated or otherwise identified as green zones.

SECTION 3. (a) Notwithstanding any general or special law to the contrary, the Secretary of the Executive Office of Environmental Affairs is hereby authorized and directed to conduct an environmental audit of environmental justice neighborhoods located within the Commonwealth.

(b) In furtherance of conducting the environmental audit, the secretary is hereby authorized to create an environmental audit working group, consisting of not less than nine persons who live or work in an environmental justice neighborhood, to provide advice to the secretary on the conduct of said environmental audit. Said members of the environmental audit

working group shall serve without compensation but may be reimbursed for expenses necessarily incurred in the performance of serving on the working group.

(c) The secretary upon completion of an environmental audit shall transmit the findings of said environmental audit, in report format, to the officer of the municipality in which the environmental justice neighborhood is located, pursuant to the environment audit, shall identify and designate within said environmental justice neighborhoods areas to be known as green zones.

(d) Pursuant to subsections (a) and (b) of this section, the secretary shall, bi-annually, not later than October 1, shall report to the clerks of the house of representatives and senate, chairs of house and senate committees on ways and means, and the chairs of the joint committee on environment, natural resources and agriculture the findings of said environmental audit and shall cause said environmental audit to be published on the main webpage of the executive office of environmental affairs.

(e) In addition to conducting an environmental audit, the secretary shall designate green zones within targeted environmental justice neighborhoods; provided that in addition to the working group created pursuant to subsection (c) of this section, the secretary shall consult and otherwise provide opportunities for input by residents of targeted environmental justice neighborhoods in the process of designating said green zones.

(f) Pursuant to this Section, the Secretary is hereby authorized to enter into an intrastate compact with the officer of the environmental justice community for which an environmental audit was conducted. Said intrastate compact shall be designed to establish and define the levels of cooperation that may be developed in an effort to realize the goals and objectives of green zones, so designated, within a targeted environmental justice neighborhood. Said levels of cooperation may include, be limited to, the designation of agency staff, the provision of other technical assistance, the making of planning grants, and such other means that are otherwise authorized by existing state law.

SECTION 4. Notwithstanding any general or special law to the contrary, this act shall take effect immediately.

Section 3
The Green Zone Methodology

The Green Zone Methodology

Ed Gaskin

Several cities have already passed Green Zone legislation, including:

- Minneapolis. Minesota
- Los Angeles. California.
- Seattle. Washington
- Oakland, California.
- Portland, Oregon.
- Providence, Rhode Island.

Our approach is not city-specific legislation but rather a process that any municipality can use.

- We use the term Green Zone to mean a specific geographic area, such as a community or a neighborhood, where there is a cluster of environmental hazards and or opportunities for sustainability. Communities where those hazards and opportunities exist in clusters are designated as Green Zones. These are areas that need special treatment.
- The Green Zone planning process is the planning and implementation framework necessary for a just environmental and energy transition.
- The Green Zone methodology is designed to be replicable and scalable. It encourages cities to create their own specific legislation that spells out:
    - Goals.
    - Timelines.
    - New regulations.
    - Accompanying action plans.

Our approach is also community-based, with these goals:

- Concentrating resources in the areas with the most need.
- Maximizing community engagement.

Creating Green Zones

Step 1: Identification

We conduct an environmental audit to look for:

- Environmental hazards to mitigate, such as:
  - Soil contamination/brownfields.
  - Poor indoor and outdoor air quality.
  - Solar hazards/heat islands.
  - Storm water management issues.
- Sustainability opportunities, including the potential to:
  - Incorporate clean energy, such as wind, solar energy, and water.
  - Improve air quality through decarbonization efforts.
  - Improve storm water management to:
    - Enhance water conservation.
    - Reduce pooling.
    - Reduce flooding.
    - Reduce downstream storm water pollution.
  - Repurpose abandoned or contaminated land and buildings to create green space, community gardens, housing, and other beneficial spaces.

For each environmental hazard identified, it's essential to determine whether the cause of the problem has been addressed. If not, the problem will be ongoing, and it will be impossible to truly make the transition.

Second, it is critical to determine the ideal future state for the designated Green Zone. Similar to the LEED program, the SITES system has different certification levels for sustainability. It is necessary to determine the SITES level for each initative.

Step 2: Developing a Complete Picture

To obtain a more complete picture of each area, we combine:

- Environmental data.
- Public safety data.
- Health data.
- Demographic data.

With so much data to analyze, it is important to provide data visualization to enable people to connect the dots and better understand the data and its implications for their specific community.

By limiting the size of Green Zones, we keep the focus on neighborhoods and maximize community engagement.

Step 3: Needs Analysis/Feasibility Studies

A second round of studies may be required to provide the necessary due diligence for federal, state, and private grants. These studies:

- Scope the problems and opportunities.
- Attempt to quantify and qualify the benefits.

Funding is typically available for such efforts, and the data from the environmental audit supports the process.

Step 4: Publish the Findings Widely

Publishing the findings widely promotes:

- Transparency.
- Community engagement.

As the primary stakeholders, the residents of designated Green Zones should have a material way to participate in the planning process. When the community is well-informed about the identified problems or opportunities and the proposed technological solutions, community-based organizations can be meaningfully involved in making decisions about these matters.

Step 5: Develop a Master Plan based on a Systems Perspective

Government programs are typically organized by government verticals, such as:

- Environment.
- Energy.
- Housing.

With projects assigned within these verticals, it can be difficult to get a holistic view of all the work being planned and done. Instead, what we usually see is a series of one-off or ad hoc projects.

The Green Zone planning framework provides a holistic environmental view that enables the development of a master plan. This plan identifies:

- The types of public infrastructure that would most benefit a community.
- Which investments should come from the municipality.
- Which investments should come from private sources, including individual property owners.

The Green Zone methodology:

- Starts with a horizontal view for the environmental audit.
- Moves to a vertical perspective after analysis to match the way funding and expertise is organized.

This both/and perspective is valuable because it:

- Increases visibility for the entire plan.

- Makes it easier to manage programs and projects.
- Improves visibility into planned and ongoing projects.
- Shows how projects will contribute to achieving a clean energy and environmental future.

Cities often do their capital planning with a five-year horizon, well before most residents realize there is even a problem or project. Publishing the master plan widely with all the supporting data enables community members to inform themselves and participate in potential solutions early in the process.

To develop a master plan, we must:

- Understand the community's desired vision for its energy and environmental future.
- Determine where proposed new initiatives fit in relation to existing ones.

In the same way the Federal Emergency Management Agency requires natural hazard mitigation planning, we believe man-made hazard mitigation planning should be required as well. In the case of Green Zones, the man-made hazards are the existing environmental hazards, and the Green Zone methodology includes the creation of a plan to mitigate these hazards.

Creating General and Specific Evaluation Criteria

After collecting the data and publishing it widely, it's time to discuss possible solutions. Often there are several possible ways forward, and this provides an opportunity for community engagement.

Through a method called visual leadership, we at Greater Grove Hall Main Streets try to describe solutions visually, so people don't have to imagine them or read about them. It is important to help community members understand the implications of various options, so they can participate in discussions from an informed perspective.

Some solutions are associated with specific environmental metrics. A scoring matrix can help when weighing solutions against one another. Ideally, the matrix includes criteria such as:

- Environmental impact.
- Ease of implementation.
- Governance (ownership or control of shared infrastructure).
- Cost.
- Funding potential.
- Ability to advance environmental, spatial, racial, and social justice.
- Workforce development and entrepreneurship opportunities.
- Community ranking.

Identify Related Municipal Initiatives

Many municipalities already have ongoing initiatives around sustainability, environmental justice, and green development. During and after the process of selecting desired solutions for a Green Zone community, it is important to understand these municipal initiatives, for several reasons:

- It provides insight into local case studies and context-specific implementation strategies, which are often more successful.
- Cross-collaboration prevents redundancy and gives access to more resources, data, and funding.
- Municipalities often have specialists or experts in these solutions who can help answer questions and provide informed insight to help with decision making.

If done well, identifying related initiatives and working collaboratively with the municipality can benefit a city by furthering its own goals and help a Green Zone community successfully complete projects.

Implementation and Funding

After choosing their desired solutions, Green Zone communities need to:

- Issue requests for proposals.
- Apply for funding.

Although the federal government is one potential source of funding, it is not the only one. The federal grant-making process is modeled on the procurement process, which often implicitly incorporates political power and thus contributes to selection disparities. The current process favors incumbent (often white) businesses.

Gregory King of TSK Energy Solutions LLC has been working on a social return metric that could measure a project’s impact rate of return, or iRR, with the goal of attracting social enterprise investors. Because it doesn’t rely on a moral or ethical imperative to address environmental and energy challenges, King’s methodology could help:

- Identify and prioritize clean energy and environmental mitigation and sustainability projects.
- Provide a competitive advantage to environmental justice communities looking for investments via grants or social impact investments.

Section 4
Green Zones, Past and Present

Green Zones: Lessons Learned and Recommendations From Six Municipal Case Studies

Greater Grove Hall Main Streets, Chadwick Bowlin

Introduction

Sen Ed Markey and Congresswoman AOC talked about a Green New Deal for America and Mayor Wu talked about a Green New Deal for Boston. Boston has made some key hires in the environmental area, but do we have a Green New Deal yet? In order to contribute to the conservation, we looked at cities that have passed "Green Zone" legislation and their corresponding action plans. What follows is research done by Chadwick Bowlin a student at Harvard's Graduate School of Design.

Greater Grove Hall Main Streets aims to pioneer the first Green Zone in Boston to foster green design interventions, green businesses, practices and technologies. The Green Zone aims to provide healthier environments and economic opportunities for the benefit of disproportionately underprivileged communities of color. In this context, a Green Zone can be defined as an area within an environmental justice community transformed from a highly polluted, economically depressed neighborhood into a vibrant area with green business practices, a healthier environment and a stronger economic future.

To understand what potential work can be done to create Green Zones in Boston, MA, it is critical to understand what work is already being done, or has been done, in other jurisdictions. We wanted to look at the various initiatives in two categories, the legislation and the call to action or implementation plan. These become instructive for what we might do here in Boston.

This report summarizes some key case studies of Green Zones in other cities, what legislation or plans seems to be most comprehensive or effective, and what recommendations can be formed specific to Boston based on these case studies.

This white paper is divide into the following sections:

I. **Case Studies Individual Summaries**

II. **Similarities and Differences in Case Study Approaches**

III. **Lessons Learned From Case Studies**

IV. **Recommendations for Boston, MA**

Summary of Six Case Studies

Case Study	Related Legislation	Related Plans	Implementation Timeline
Oakland, CA: Oakland 2030 Equitable Climate Action Plan (ECAP)	Oakland City Council Resolution 87397 (2018)	Equitable Climate Action Plan Racial Equity Impact Assessment	2020 - 2030 (10 Years)
Minneapolis, MN: Environmental Justice and Green Zones Policy	City Council Resolution 2016R-040	Minneapolis 2040	2016 - 2040 (20 Years)
Los Angeles, CA: Clean Up Green Up (CUGU)	Los Angeles City Council Ordinance No. 184246	N/A	Not specified
Seattle, WA: Green New Deal	Green New Deal Resolution (City of Seattle Res 31895) Green New Deal Executive Order (EO-2020-01) Ordinance 125926	N/A	2019 - 2030 (10 Years)
Providence, RI: Providence's Climate Justice Plan	Executive Order 2016-3	Providence's Climate Justice Plan Just Providence Framework	2019 - 2050 (30 Years)
Portland, OR: Climate Emergency Workplan	Resolution No. 37494	Climate Emergency Workplan	2022 - 2050 (30 Years, with additional short term workplans)

Section I. Case Studies Individual Summaries

We examined six different cities for Green Zone-type legislation, including Oakland, California; Portland, Oregon; Minneapolis, Minnesota; Los Angeles, California; Seattle, Washington; and Providence, Rhode Island. We focused more specifically on three aspects of each case: legislation, plans, and implementation timeline. Below is a summary of the case studies.

Case Study 1: Oakland, CA: Oakland 2030 Equitable Climate Action Plan (ECAP)

In 2018, Resolution No. 187397, a Climate Emergency Declaration for Oakland, was introduced by councilmembers Rebecca Kaplan and dan Kalb, Mayor Libby Schaaf, and City Attorney Barbara J. Parker to Oakland City Council. This resolution "committed to the creation of a strategy to bring about a just transition to a low carbon future that creates good green jobs, improves health, mobilizes our resources, and addresses the inequalities that climate change has worsened". [1]

Following the resolution, starting in May 2019, community input was conducted, and the ECAP Ad Hoc Community Advisory Committee worked with several other committees to create a draft of the Action Plan. Additionally, an Equity Facilitator team crafted a Racial Equity Impact Assessment and Implementation Guide "to ensure that the final Actions truly reflected [their] commitment to racial justice". [2] The final draft of the Oakland 2030 Equitable Climate Action Plan was passed unanimously in July 2020.

Much of the advocacy work for the Equitable Climate Action Plan was conducted by a community-based organization, the California Environmental Justice Alliance, which has created a Green Zones Initiative since 2010, as noted in the most recent report in 2018: "Green Zones: Transforming Toxic Hot Spots into Healthy and Thriving Neighborhoods" [3]

Case Study 2: Minneapolis, MN: Environmental Justice and Green Zones Policy

The Green Zone program in Minneapolis, MN originated in the Minneapolis Climate Action Plan of 2013, as one of the "Cross-Cutting Strategies". [4] In February of 2016, the City Council Resolution 2016R-040 created the Green Zones Workgroup, which created a set of recommendations of where to designate the Green Zone areas, creating a Northside Green Zone and Southside Green Zone. [5] Currently, the Northside Green Zone Task Force and Southside Green Zone Council are responsible for implementation and recommendations, respectively.

Green Zones are also a part of Minneapolis 2040, adapted in 2020, as "Policy 61: Environmental Justice and Green Zones: Establish environmental justice frameworks for policy, resources and regulation." [6]

Case Study 3: Los Angeles, CA: Clean Up Green Up

As summarized on the Clean Up Green Up website:

> "In 2006, grassroots groups from three heavily polluted LA neighborhoods — Boyle Heights, Pacoima, and Wilmington — joined together to form the Los Angeles Collaborative for Environmental Health and Justice. Other organizations such as Communities for a Better Environment, the Coalition for a Safe Environment, Pacoima Beautiful, and Unión de Vecinos also joined in later years.
>
> Together, members of the collaborative have developed the Clean Up Green Up (CUGU) initiative to transform their neighborhoods into safer and more vibrant communities. Their goals are to minimize the overconcentration of environmental hazards in overburdened neighborhoods, reduce pollution, and help businesses clean up and green up their operations while still retaining and creating more jobs in the neighborhood." [7]

The CUGU Ordinance, the Los Angeles City Council Ordinance No. 184246, passed in 2016. It proposed changes to Sections 12.04, 12.20,12.24 and 12.32 of Article 2, and Sections 13.03, 13.18 and 13.19 of Article 3 of Chapter 1 of the Los Angeles Municipal Code. [8]

Case Study 4: Seattle, WA: Green New Deal

In 2020, both the Green New Deal Resolution (City of Seattle Res 31895) and the Green New Deal Executive Order (EO-2020-01) were passed. Res 31895 "establishing goals, identifying actions necessary to meet these goals, affirming the federal Green New Deal resolution, and calling for the federal government to enact policies to advance a Green New Deal", while the Green New Deal Executive Order "directed all City departments to work together with the Green New Deal Oversight Board, the Environmental Justice Committee, and other key stakeholders". [9]

After this, the Seattle City Council voted to form the Green New Deal Oversight Board (Ordinance 125926), to advance the work of Seattle's Green New Deal. [10] It consists of 19 people.

Case Study 5: Providence, RI: Providence's Climate Justice Plan

On Earth Day in 2016, Mayor Jorge O. Elorza passed Executive Order 2016-3, which called for Providence to become carbon neutral by 2050, beginning the processes of the Equity in Sustainability Initiative. [11] Additionally, the Racial and Environmental Justice Committee (REJC) was formed, as a collaborative partnership between the Environmental Justice League of Rhode Island, Groundwork Rhode Island, and the City of Providence's Office of Sustainability. [12]

The REJC crafted the Just Providence Framework, a framework for approaching the Climate Justice Plan, which lists elements of "a racially equitable & just Providence". [13] The framework was adopted by the Office of Sustainability in 2017, and was used as the backbone for the Climate Justice Plan, including quotes gathered in the community input process. The final version of Providence's Climate Justice Plan was released in October 2019.

Case Study 6: Portland, OR: Climate Emergency Workplan

In 2020, the City Council of Portland, OR passed Resolution No. 37494, a Climate Emergency Declaration for the City of Portland. This "directed City bureaus to restore a safe climate for all Portlanders, centering the needs and priorities of Black and Indigenous communities, people experiencing low income, and community members who are most at-risk and vulnerable to the impacts of climate change." [14] One year later, a progress report was made assessing what had been implemented. Following the declaration, a shorter-term plan was developed, the Climate Emergency Workplan, which creates priorities to be implemented immediately between 2022-2025, and creates a plan to eliminate carbon emissions by 2050.[15]

Section II. Similarities and Differences in Case Study Approaches

Similarities Regarding Approach

Across the board, there seems to be two major approaches to creating Green Zones. The first approach is creating a resolution that frames the urgent issues facing that city in the face of climate change, explaining how they affect frontline communities most, and creating specific goals the initiative would accomplish (such as Seattle, WA's Green New Deal Resolution, or Oakland's Climate Emergency Declaration).

The alternative approach is based on the municipal code; it requires modifying the municipal code, such as the zoning code, to add specific regulations to new, overlaid districts (such as LA CUGU), or to establish new positions of governance that are responsible for Green Zone work (such as Seattle, WA's Ordinance).

The resolutions proposed by the City of Oakland, City of Seattle, Providence, and City of Portland preface their actions by explaining the urgency internationally, nationally, and locally to act on the climate crisis. The City of Oakland, City of Seattle, and Providence also call on other jurisdictions, and the federal government, to take similar actions in dealing with the climate crisis. Finally, all of these case studies explicitly explain the need to prioritize frontline communities, who will be most affected by the effects of anthropogenic climate change.

Other Similarities

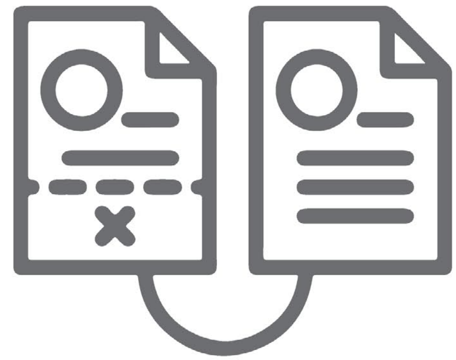
Another notable similarity among all case studies was the need to create a council that handles execution and community engagement, with residents being a part of the committee, if not forming the entire committee. Portland is unique in the sense that it emphasizes cross-department work through an 'action group', but still emphasizes the importance of community input.

Finally, all plans, but most notably with Los Angeles and Providence, included a major component of community engagement. In the case of LA, the CUGU reform to the municipal code directly drew from comments and visual observations from the community members experiencing environmental injustice, and their suggestions for reform. Providence created a Racial and Environmental Justice Committee, whose recommendations directly informed the structure of Providence's Climate Justice Plan final plan. Additionally, Providence included quotations and comments from frontline communities to reinforce the argument for, and urgency of, climate reform.

Differences

Despite similarities in language, all of these case studies are highly specific. Spatial approaches that worked in Los Angeles were based on certain types industrial production in the city. While Oakland's Action Plan calls out the Port of Oakland as a topic of interest, and divided the plan by pollution source, Minneapolis divided their plan by goals, topics, and planning policies, that overlap one another. It is critical to understand what is unique to Boston's social and environmental context, in considering what approach is best.

Two Common Approaches to Climate Equity Legislation



Goal-oriented Approach (Resolutions, E.O.s)

- **Outlines the urgency** of addressing the environmental and/or climate justice in the municipality
- **Creates a set of steps or action items** for the municipality that address the issue
- Often **has a call to action** directed to other municipalities, or higher levels of government

Amend Current Municipal Code (Ordinances)

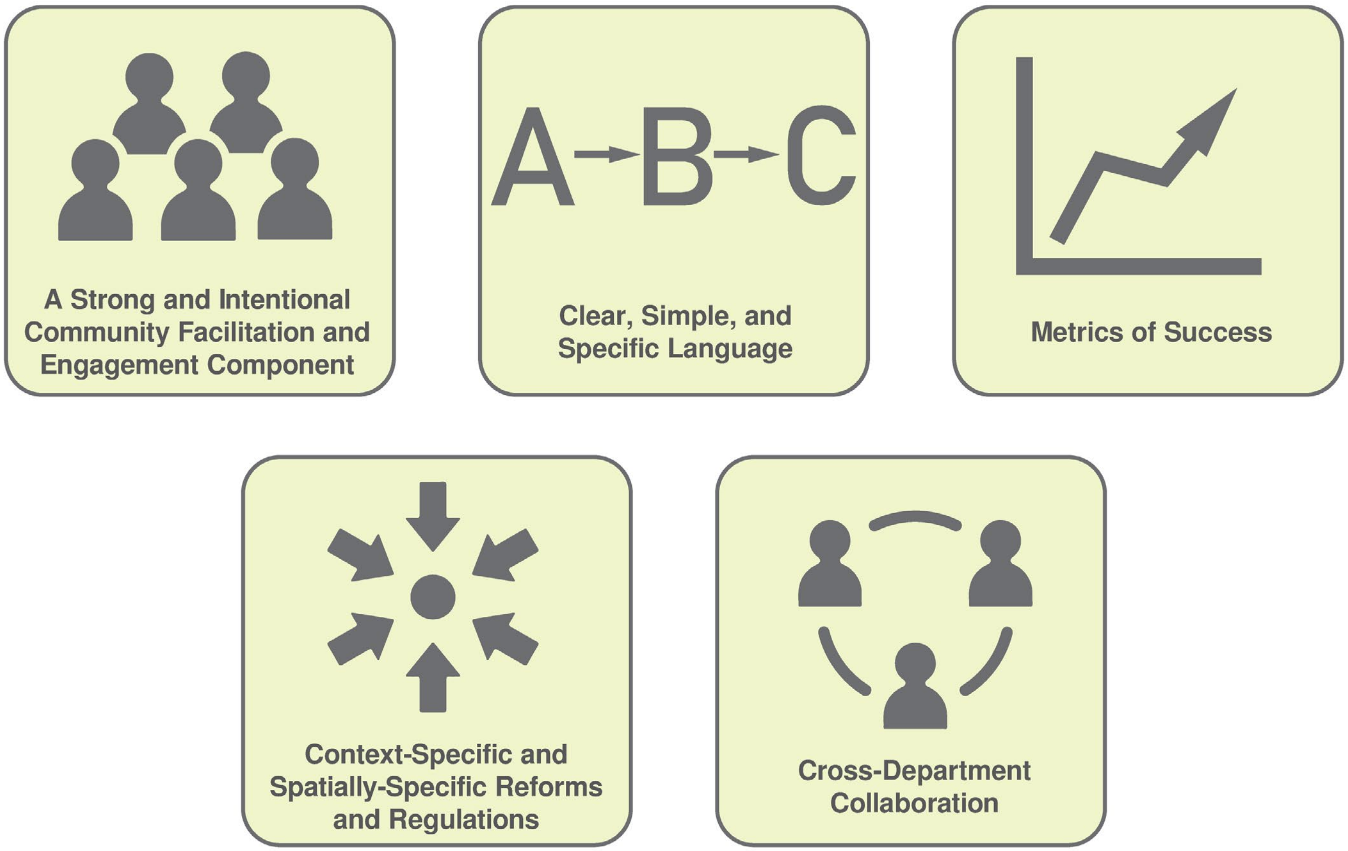
- Creates **amendments to the current municipal code**, such as:
  - Adding an **'overlay district'** to designate zones of intervention
  - Adding new **regulations**, such as buffer zones or additional signage
  - Adding a **new responsibility** to a current department, or creating **new positions or boards** responsible for executing climate equity work

Section III: Lessons Learned from Case Studies

Whether they use the term ‘Green Zone’ or not, the municipalities listed, in different ways, address the intersection of environmental justice, social justice, and/or the impacts of climate change. Elements that tended to be most successful and critical to many of these case studies include:

1. **A Strong and Intentional Community Facilitation and Engagement Component**: The case studies that were most equity-driven and specific to the municipality relied on comments and dialogue from frontline communities. This was especially true with Providence’s case, which used recommendations and the framework from community engagement to create the goals of the Climate Justice Plan.
2. **Clear, Simple, and Specific Language**: Many of the case studies foregrounded their proposals with framing the problem of local climate threats. The most coherent and intentional plans defined their terminology, included a glossary, and were easy for anyone to understand. Additionally, defining terms like frontline community for that municipality, allows for more specific strategies and action items
3. **Metrics of Success:** In order to implement Green Zones, there must be ways to identify the hazards and opportunities that exist, and determine how successful the intervention was. Publishing and updating data that exposes underlying hazards, and determining metrics of success, allows for transparency in how effective a plan is, ability to course-correct if needed, and the ability to prove how successful a Green Zone is to other municipalities and sources of investment. Portland’s carbon calculation revealed how much of a priority decarbonization was for the city, and will, in the future, demonstrate how successful their efforts will be.
4. **Context-Specific and Spatially-Specific Reforms and Regulations**: All of these case studies are specific to their municipality’s environmental issues. For example, LA’s CUGU ordinance addresses the impacts of industrial pollution, while Portland’s plan prioritizes decarbonization. Any Green Zone proposal must address the environmental and climate challenges of that municipality, and have an understanding of existing efforts and regulations.
5. **Cross-Department Collaboration:** Green Zones must address environmental injustice and climate risk from social, economic, and environmental perspectives. By encouraging, or explicitly mandating, collaboration between different departments of the city, the municipality can levee the specialization of different departments in implementing a Green Zone. Portland’s ‘Disaster Resilience and Recovery Action Group’ is an excellent example.

Lessons Learned: Elements of Successful Green Zone Legislation and Action Plans



Section VI: Recommendations for Boston, MA

Boston has already implemented many policies to be more sustainable and resilient, most notably with the 2016 Climate Ready Boston report and initiative. Many of Boston's citywide efforts, including the Healthy Places Initiative, acknowledge and address the disproportionate impact of climate change on frontline communities. The Heat Plan, Urban Forest Plan, and Open Space and Recreation plan also address current hazards, and future environmental hazards.

However, there is a need for more neighborhood-specific approach, that fills a gap between the many city-wide plans, and the pressing urgency of environmental justice and climate action in a specific neighborhood. Additionally, there are smaller areas within larger neighborhoods (such as Grove Hall in Dorchester) which need more attention or specific needs, that cannot be captured in the larger neighborhood strategy alone. Without a way of reaching specific areas that need the most intervention, frontline communities that already experience social and environmental injustice will be further disadvantaged due to lack of sustainable investment.

A Green Zone approach in Boston, therefore, may be most effective as a program that determines priority frontline communities, and facilitates the implementation of various plans and initiatives that the City of Boston has already adapted, or needs to adapt. After reviewing these case studies, and the lessons learned as they relate to the City of Boston, the following actions are recommended:

1. **Create an executive order or resolution that clearly defines Green Zones for Boston**. In this framework, a Green Zone is 'an area in a community transformed from a highly polluted, economically depressed neighborhood into a vibrant area with green business practices, a healthier environment and a stronger economic future.'
2. **Establish a City of Boson interdepartmental Bureau of Green Zones (BGZ)** to keep record of all citywide initiative and plans that relate to the Green Zone definition, determine eligibility for Green Zones, and provide a method to environmentally audit for Green Zones.
3. For every Green Zones determined by the Bureau of Green Zones, **create a Green Zone Execution Committee (GZEC)** of neighborhood residents and or community leaders responsible for facilitating projects and initiatives in the Green Zone

Endnotes

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5 Gordon and Cano, “Resolution No. 2016R-040 Promoting Racial Equity and Sustainable Community Revitalization through the Development of a Green Zones Policy and Creating the Green Zones Policy Task Force.” (City of Minneapolis, February 20, 2016), https://lims.minneapolismn.gov/Download/PriorMetaData/-53364/2016R-040.pdf.February 20, 2016

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Section 5
Methodology in Action

Suggestions for Identifying and Addressing Environmental Hazards and Opportunities

Section Contents

How to Use this Section

Every subsection of this portion of the documents has two components:

Implementation Methodologies: These contain a suggested method for determining environmental hazards and/or opportunties around a topic (for example, flooding and heat islands) for a given community. They incoorperate the Green Zone Methodology frameworks, which identifies hazards, opportunities, feasibility, and project selection. Some topics only include oppertunties.

This component also includes images that use Grove Hall as a visualization tool in applying the methodology. Most of the methodologies include flowcharts to help facilitate decision-making.

Solutions Bank: Each solution bank compliments the methodology or methodologies of the subsection, by providing more information about each solution discussed in the methodology. They also include an image of that solution, and some preliminary considerations when implementing those solutions.

These solution banks may include redundant information from other parts of the section, as some solutions, such as green roofs, may address multiple subsections and topics.

Subsection 1: Stormwater as Hazard and Opportunity

i. A Methodology for Evaluating Stormwater Pollution and Potential Project Implementation Sites
ii. A Methodology for Evaluating High Flood Risk and Potential Project Implementation Sites
iii. Stormwater Solutions Bank

A Methodology for Evaluating Stormwater Pollution and Potential Project Implementation Sites

Chadwick Bowlin
Greater Grove Hall Main Streets

July 2023

1.1 Identify Hazards

Part of an Environmental Audit to determine the existing environmental hazards and opportunities for sustainability.

A. Identify Specific Stormwater Pollution/Discharge Sources

A comprehensive method for determining stormwater contamination source includes:

1. Initial Mapping Effort
    a. Locating drainage basins and all stormwater outfalls
    b. Identify land use with high risk within drainage basins leading to outfalls (industrial, some commercial, and some municipal)
2. Outfall Screening Analysis
    a. Sample dry flow from all sewer outflows using visual and chemical tests
    b. Identify potential sources based on tests
3. Confirm Screening
4. Follow-up Sewerage and Site Investigations

(Adapted from *Methods For Detection Of Inappropriate Discharges To Storm Drainage Systems* by Robert Pitt, EPA, 2001)

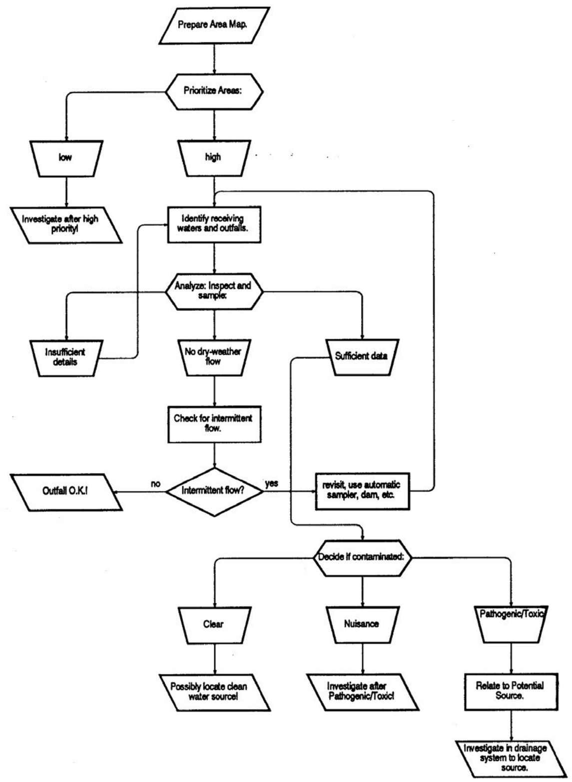
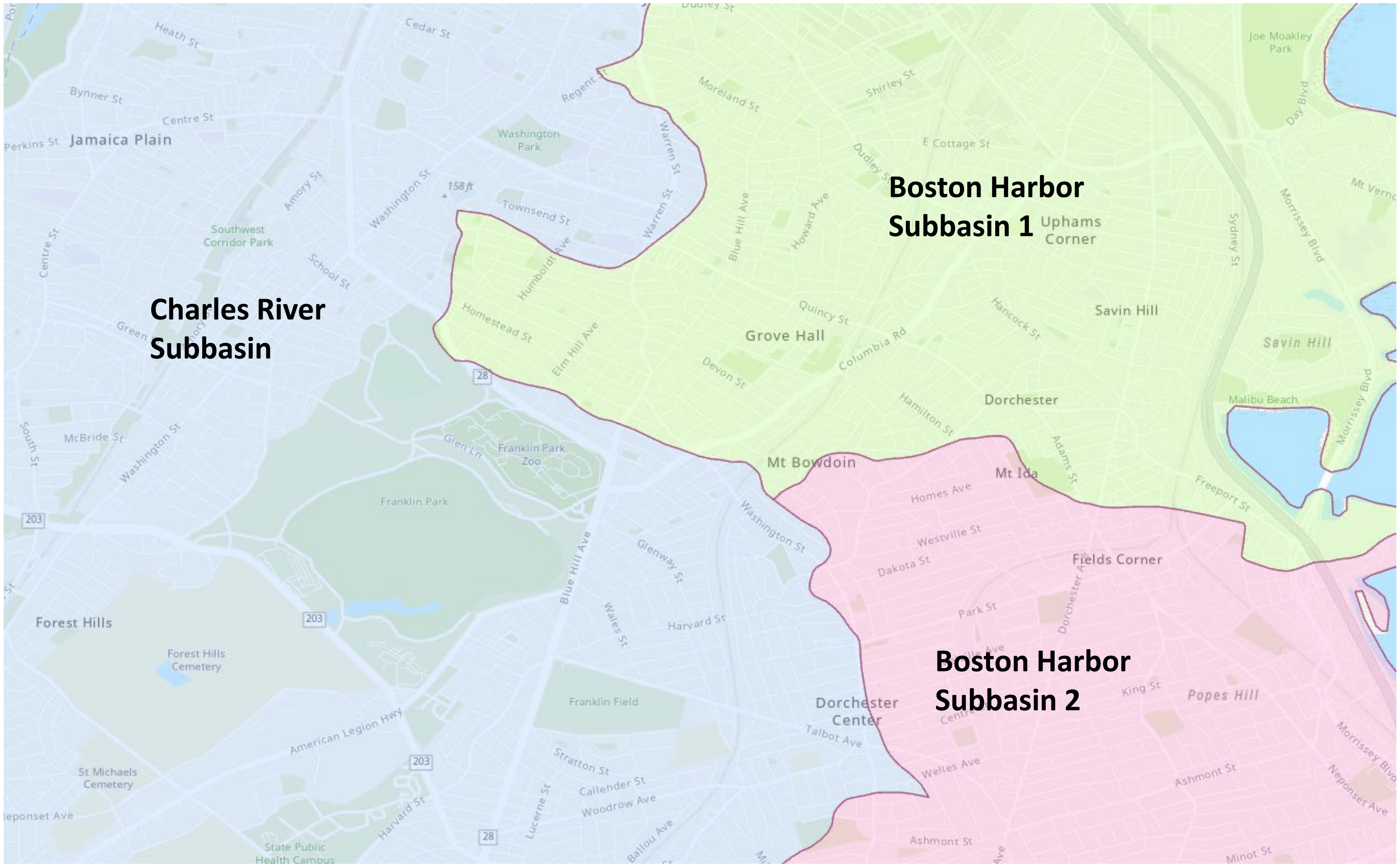


Figure 1. Flow chart for investigative procedures.

Sample investigative flowchart (From *Methods For Detection Of Inappropriate Discharges To Storm Drainage Systems* by Robert Pitt, EPA, 2001)

A. Identify Specific Stormwater Pollution/Discharge Sources (Cont.)

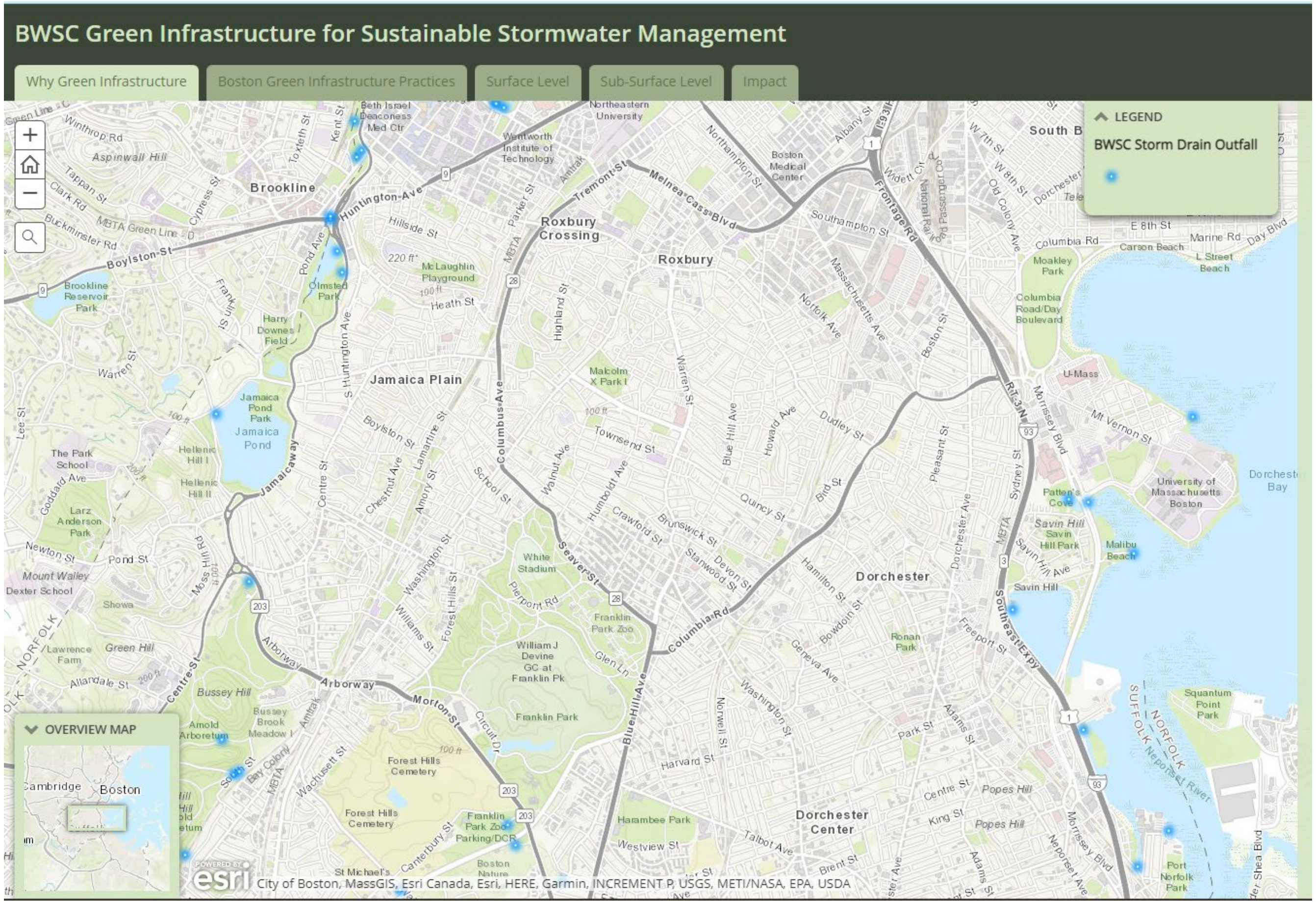
- A **drainage basin** is an area of land where all flowing surface water converges to a single point, such as a river mouth, or flows into another body of water, such as a lake or ocean.
  - **Subbasins** are smaller areas within drainage basins. Some neighborhoods and communities may contain just one subbasin, while others may have multiple subbasins.
- When treating or managing stormwater, **it is important to know what body of water surface stormwater flows into**, and how large that area is.
  - Most municipalities and states have GIS databases that contain watershed and drainage basin information



Locations of Major Watershed Subbasins near Grove Hall, Boston, MA
(Source: MassGIS)

A. Identify Specific Stormwater Pollution/Discharge Sources (Cont.)

- **A traditional "gray" stormwater system** is designed to move urban stormwater away from the built environment and includes curbs, gutters, drains, piping, and collection systems.
  - In older cities like Boston, **a combined sewer system** may be used, which directs stormwater into the sewage system. Thus, there are no separate stormwater and sewer treatment drains.
  - During heavy storm events, the stormwater system may be overwhelmed by sewage and water, **releasing excess sewage directly into waterbodies**
- A **storm drain outfall** is where a storm drain, pipe, or channel discharges stormwater runoff to a natural waterbody.



Locations of Storm Drain Outfalls near Grove Hall, Boston, MA
(Source: Boston Water and Sewer Commission)

TABLE 8. POTENTIAL INAPPROPRIATE ENTRIES INTO STORM DRAINAGE SYSTEMS

Potential Source:	Storm Drain Entry: Direct	Storm Drain Entry: Indirect	Flow Characteristics: Continuous	Flow Characteristics: Intermittent	Contamination Category: Pathogenic/Toxic	Contamination Category: Nuisance	Contamination Category: Clear
Residential Areas:							
Sanitary wastewater	X	x	X	x	X		
Septic tank effluent		X	X	x	X		
Household chemicals	x	X		X	X		
Laundry wastewater	X			X		X	
Excess landscaping watering		X		X	x	x	X
Leaking potable water pipes		X	X				X
Commercial Areas:							
Gasoline filling station	X	x		X	X		
Vehicle maintenance/repair	X	x		X	X		
Laundry wastewater	X		X	x	x	X	
Construction site de-watering		X	X	x		X	
Sanitary Wastewater	X	x	X		X		
Industrial Areas (see Section 9):							
Leaking tanks and pipes	x	X	X	x	X		
Many process waters	X	x	X	x	X	x	x

Note: **X**: most likely condition
x: may occur
blank: not very likely

Potential Sources of Pollution into Storm Drains, and likelihood (From *Methods For Detection Of Inappropriate Discharges To Storm Drainage Systems* by Robert Pitt, EPA, 2001)

B. Evaluate Other Options for Addressing Stormwater Pollution

- **Green infrastructure interventions alone may not be sufficient** for addressing stormwater contamination
  - For example, in situations where an extensive number of sewer lines are directly connected to stormwater drains, treating surface runoff alone will not improve water quality
- Other approaches to addressing stormwater pollution include:
  - "public education,
  - an organized systematic program of disconnecting commercial and industrial non- stormwater entries into the storm drainage system,
  - tackling the problem of widespread septic system failure,
  - disconnecting direct sanitary sewerage connections,
  - rehabilitating storm or sanitary sewers to abate contaminated water infiltration, and
  - developing zoning and ordinances."

(From *Methods For Detection Of Inappropriate Discharges To Storm Drainage Systems* by Robert Pitt, EPA, 2001)

1.2 Identify Opportunities

Part of an Environmental Audit to determine the existing environmental hazards and opportunities for sustainability.

A. Determine Priorities for Runoff Pollution Management

- If implemented properly, **green infrastructure can treat stormwater** runoff by catching and/or treating pollutants as it passes through plants and soil
  - Using plants to remediate pollution is know as **phytoremediation**
- Green infrastructure has a few key features:
  1. **Capture and retain stormwater** so it drains more slowly (and in doing so, filters out pollutants)
  2. **Allow stormwater to infiltrate** into the ground (which prevents pollutants from entering the storm drains)
  3. **Collect stormwater for use** in residential and commercial buildings (which prevents rainwater from picking up pollutants on road surfaces)

C. Identify and Inventory Potential Impervious Implementation Sites

- **Larger, impervious surfaces** are ideal places to **capture, retain, and collect stormwater.** They can also **treat stormwater pollution on-site** before entering the stormwater system.
- Examples include:
  - Parking lots
  - Roofs
  - Major streets
  - Plazas
- Note the following for each impervious site:
  - Site use and potential contaminants
  - If it is at street level or not
  - Slope of impervious surface
  - Subsurface (underground) condition, such as soil permeability
  - Where stormwater collects and drains typically on the site

Grove Hall Landscape Analysis

Grove Hall Overview | Land Use | Land Cover | Impervious Surface | Buildings | Parcels | Brownfields | Gas Leaks | Rooftops and Solar Energy Gene...

Impervious Surface

The impervious surface includes artificial structures such as cement, pavement, asphalt, etc.

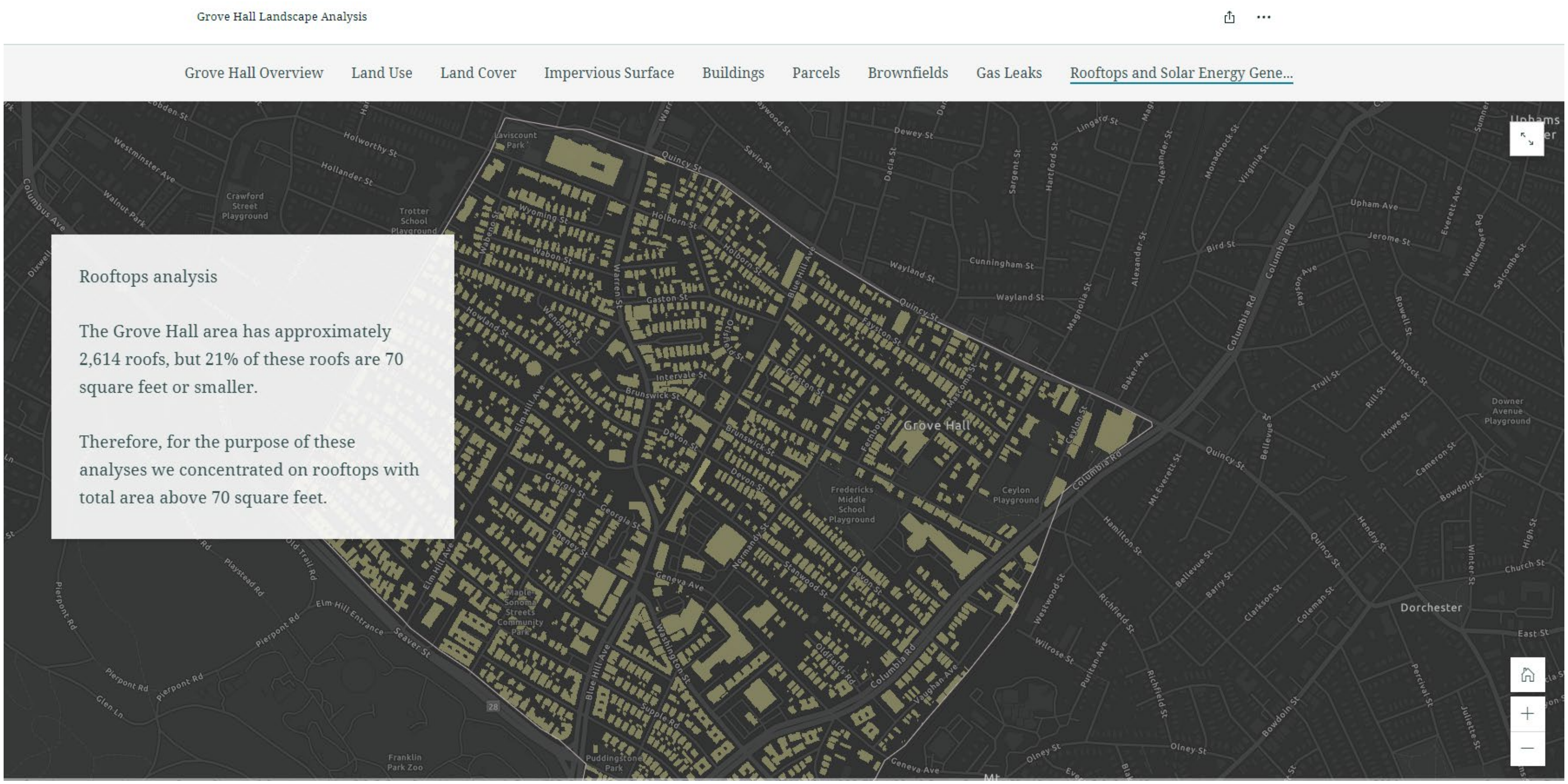
The total area of Grove Hall is 0.69 square miles and the impervious surface represents approximately **70%** of all land cover which accounts for **0.48 sq miles**.

The impervious surface can have a significant negative impact on communities:

- prevents water from penetrating the ground leading to increased runoff and a higher risk of **flooding**
- causes decline, displacement, or extermination of wildlife
- degrading water quality in streams and rivers
- contributes to the **heat island** effect, which raises temperatures in urban areas and consequently leads to increased energy used for cooling, air pollution, and heat-related illnesses and deaths

Impervious surfaces, particularly dark materials such as

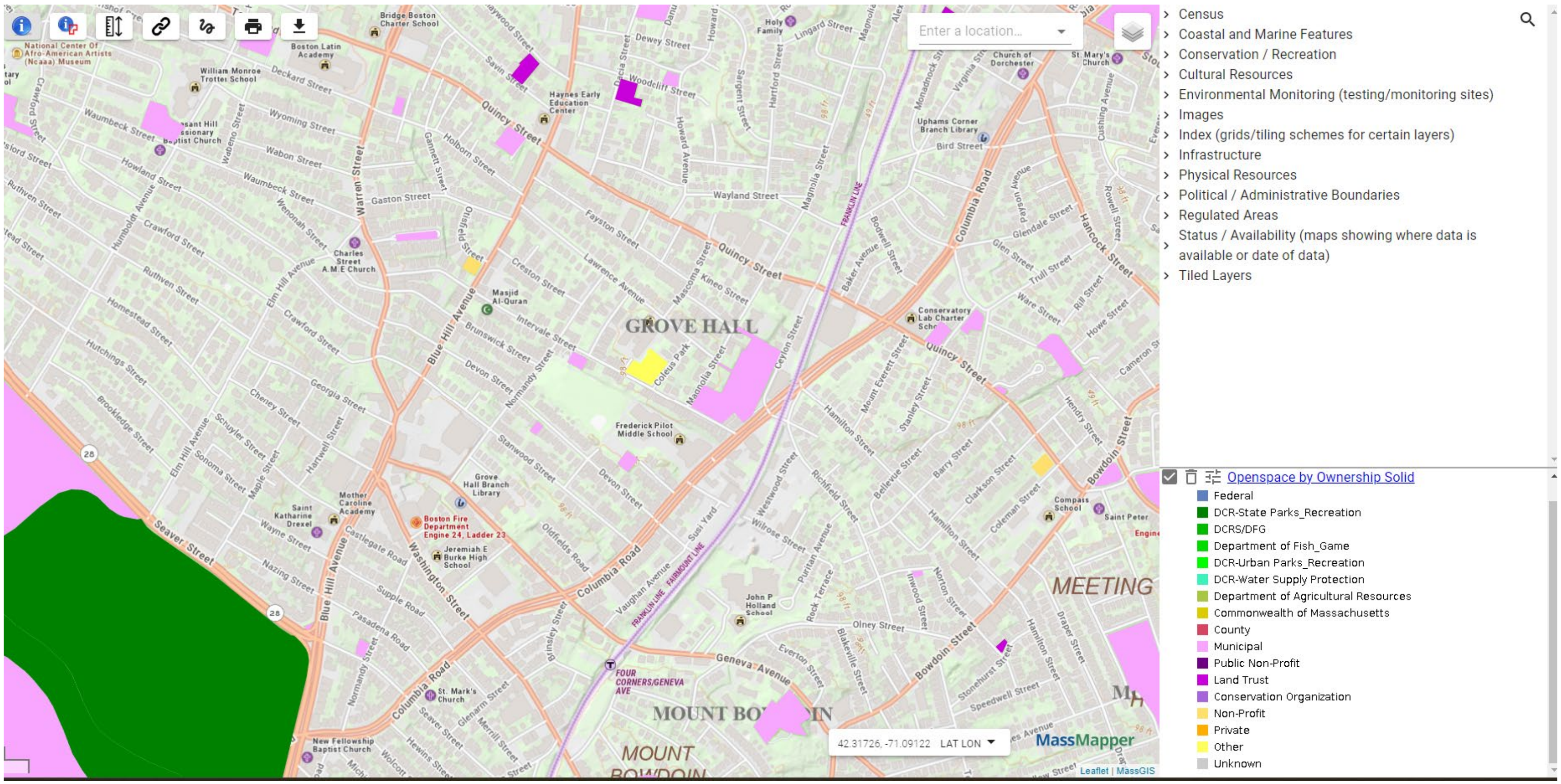
Impervious Surface Cover in Grove Hall, Boston, MA
(Source: Grove Hall Landscape Analysis, Anna Krzystyniak Sobiewska)



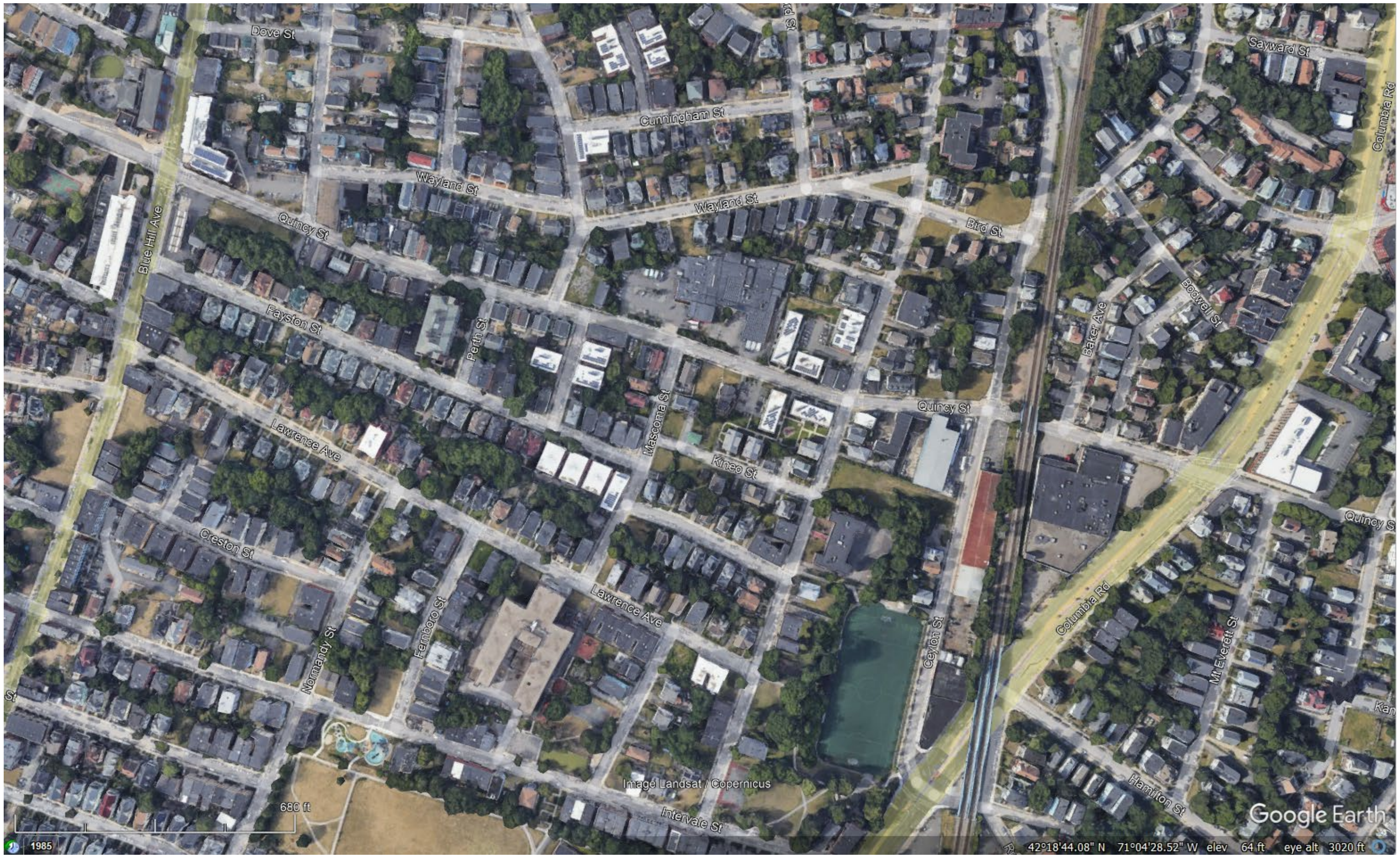
Building Footprints in Grove Hall, Boston, MA
(Source: Grove Hall Landscape Analysis, Anna Krzystyniak Sobiewska)

D. Identify and Inventory Potential Pervious Implementation Sites

- **Pervious areas** can serve as **stormwater infiltration** sites within the community. They also can **provide opportunities to treat stormwater** before it enters the stormwater system.
- Examples include:
  - Parks and open space
  - Existing planted areas and landscaping near buildings
  - Street medians
  - Front yards
  - Nature areas
- Note the following for each impervious site:
  - Proximity to any impervious surfaces, such as streets or buildings
  - Subsurface (underground) condition, such as soil permeability
  - Presence of vegetation, such as grasses or trees, if any
  - Where stormwater collects and drains typically on the site



Open Spaces in Grove Hall, Boston, MA
(Source: MassGIS Data)



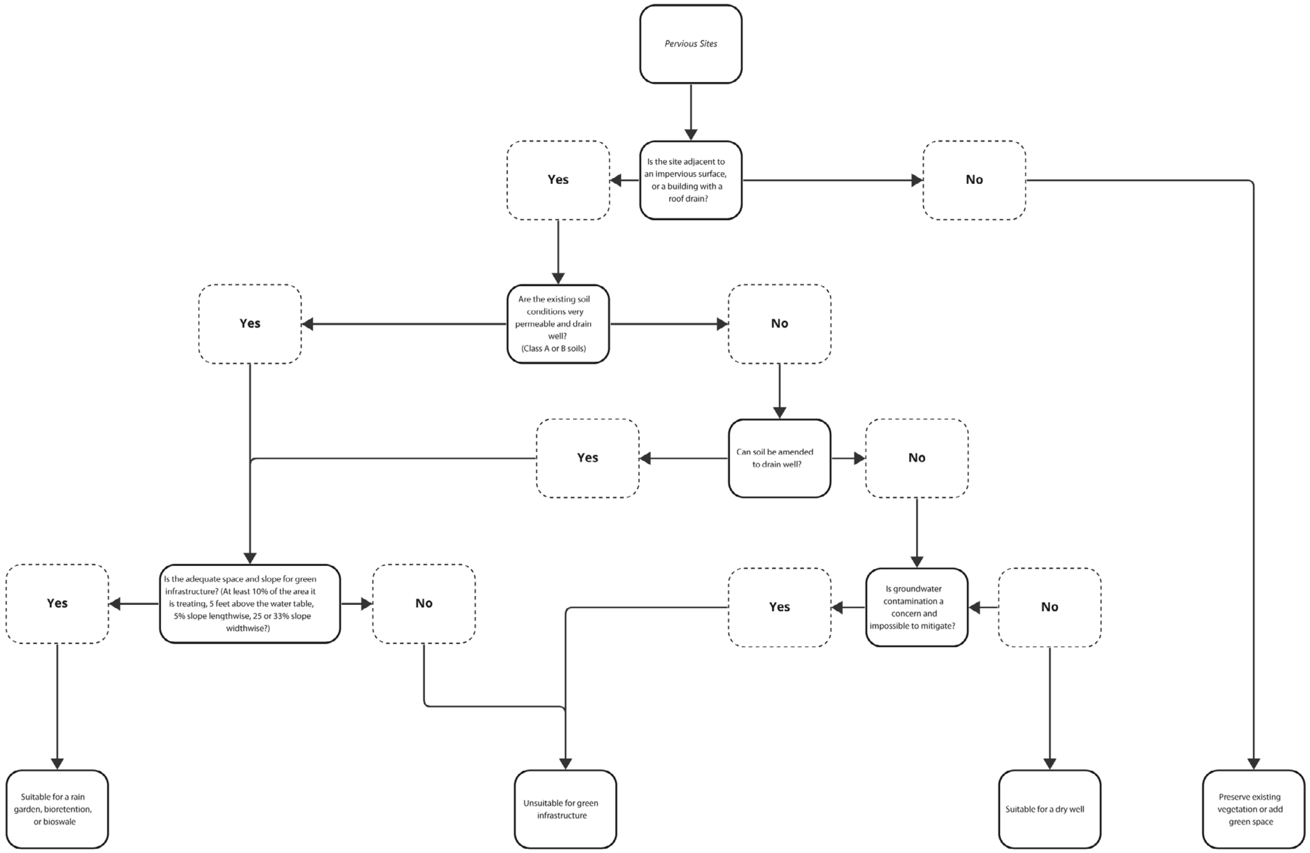
Aerial Imagery Revealing Pervious Surfaces, Grove Hall, Boston, MA
(Source: Google Earth)

2 Site Feasibility Evaluation

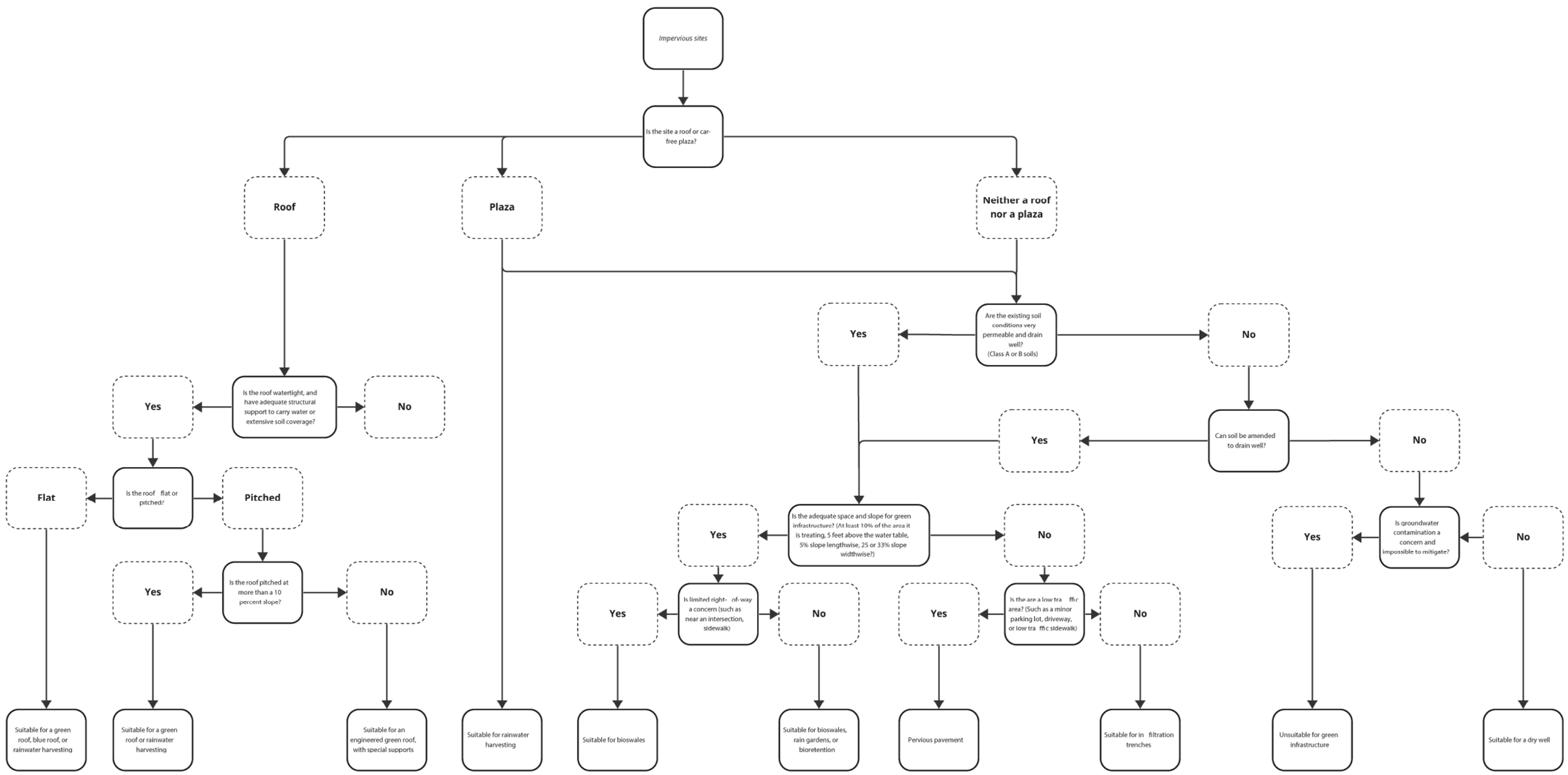
Feasibility Studies

A. Evaluate Feasibility of Site for Intervention

- All sites that are inventoried should be reviewed for feasibility, and for their potential for green infrastructure
- Many sites may have multiple potential design interventions. In these situations, priorities and community preferences should be evaluated



Flowchart for Evaluating Green Infrastructure Feasibility and Interventions for Pervious Sites



Flowchart for Evaluating Green Infrastructure Feasibility and Interventions for Impervious Sites

B. Use a scoring matrix to determine which projects to implement

- Use criterion such as:
  - Environmental impact,
  - Ease of implementation,
  - Governance,
  - Cost,
  - Funding potential,
  - Community ranking,
  - Environmental metrics such as clean energy generation, decarbonization, stormwater management, and heat island mitigation.

IV. Solution Evaluation Matrix

Intervention or Solution	Positive environmental impact 1 = least 5 = most	Ease of implementation 1 = difficult 5 = easiest	Governance 1 = least agency 5 = most agency	Cost 1 = high cost 5 = low cost	Funding potential 1 = least 5 = most	Ability to advance justice 1 = least impact 5 = most impact	Workplace development or entrepreneurship oppertunities 1 = least 5 = most	Community ranking 1 = lowest 5 = highest	Total Score
Site 1	*4*	*3*	*1*	*4*	*4*	*2*	*3*	*4*	***25***
Site 2	*5*	*2*	*3*	*2*	*4*	*3*	*4*	*3*	***26***
Site 3	*3*	*5*	*4*	*4*	*3*	*2*	*3*	*2*	***26***
Site 4	*5*	*4*	*4*	*3*	*5*	*4*	*3*	*5*	***33***
Site 5	*2*	*4*	*3*	*2*	*2*	*5*	*2*	*3*	***23***

Scoring Matrix for Potential Interventions

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A Methodology for Evaluating High Flood Risk and Potential Project Implementation Sites

Chadwick Bowlin

Greater Grove Hall Main Streets

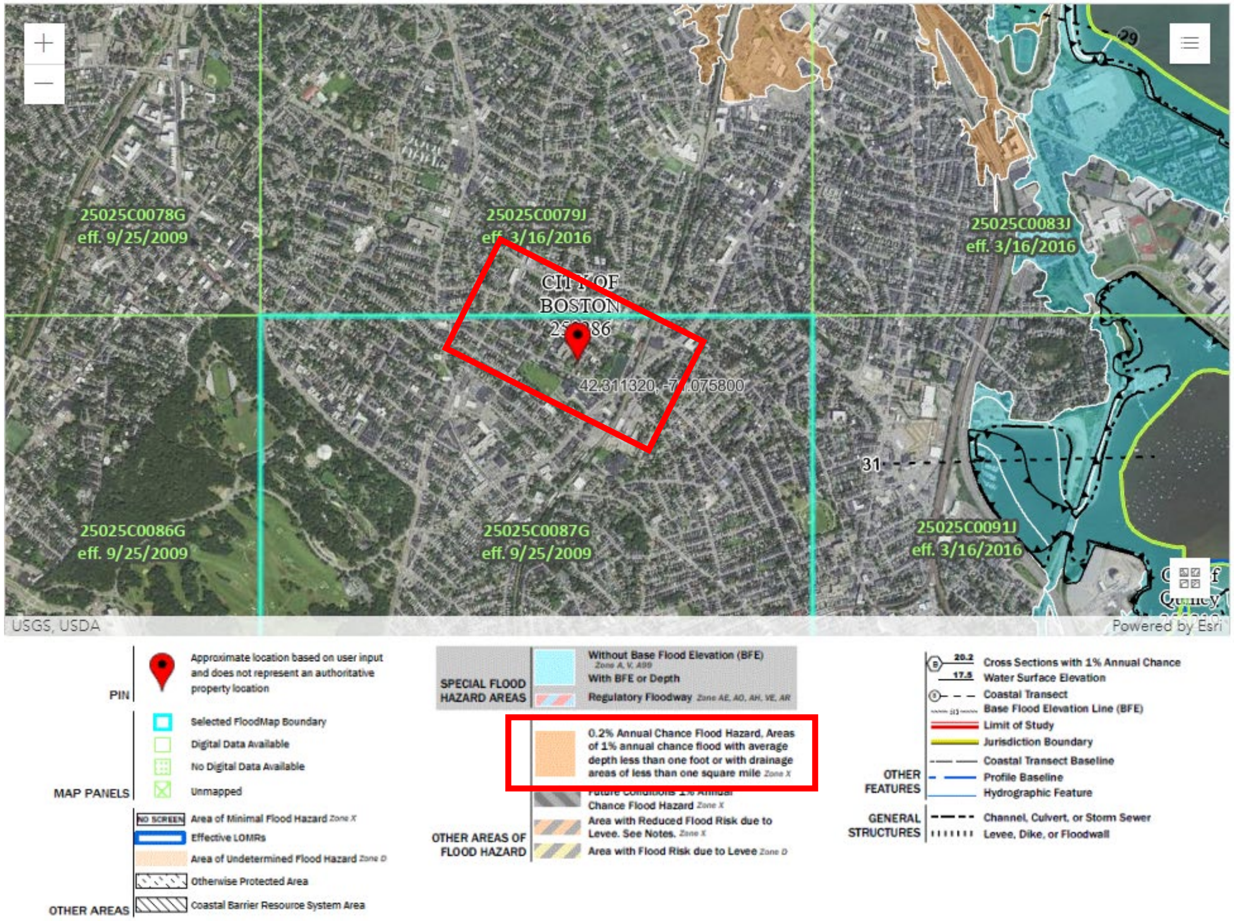
July 2023

1.1 Spatial Analysis of Hazards

Part of an Environmental Audit to determine the existing environmental hazards and opportunities for sustainability.

Ai. Identify Areas of High Flood Probability Through FEMA National Flood Hazard Layer

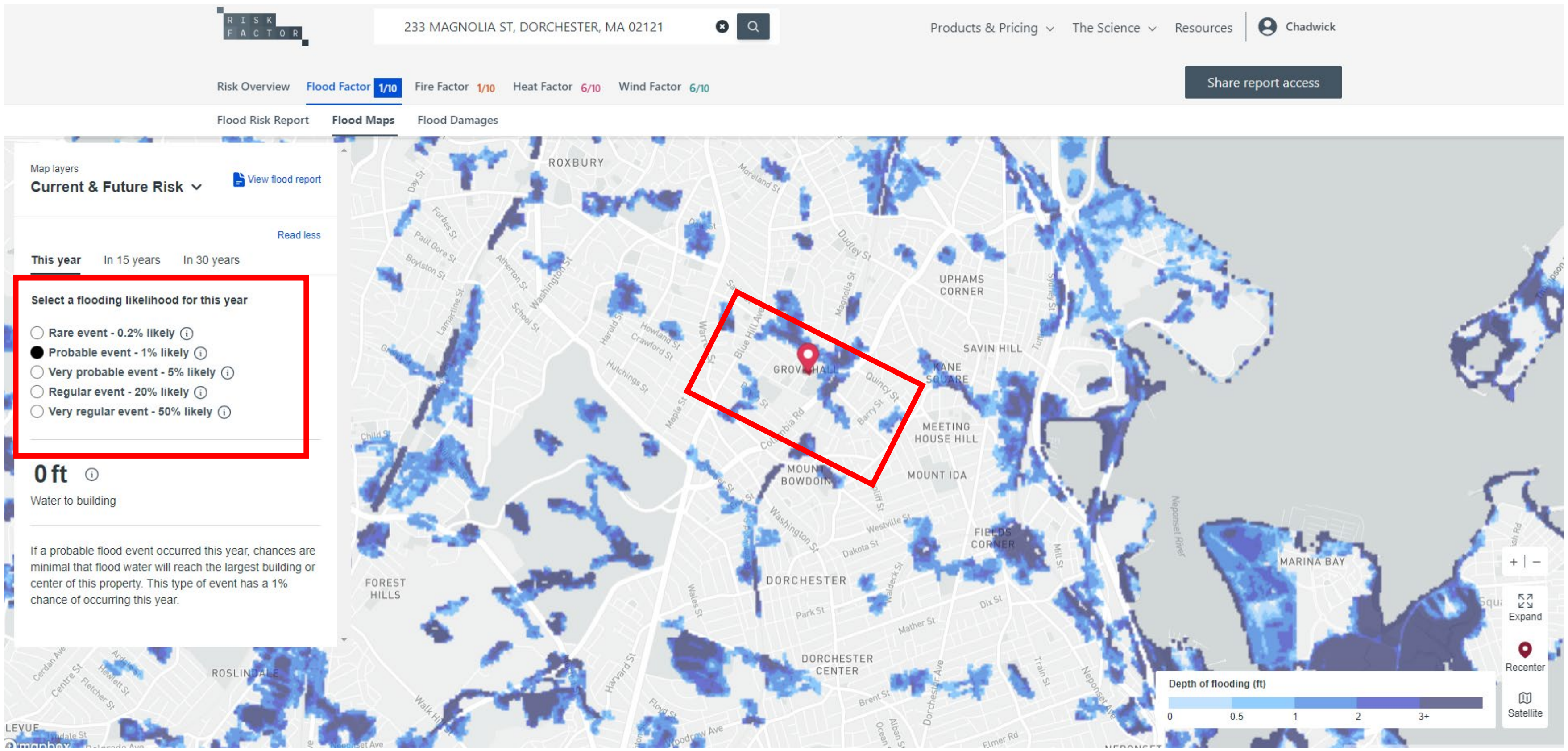
- "The National Flood Hazard Layer (NFHL) is a geospatial database that contains current effective flood hazard data. FEMA provides the flood hazard data to support the National Flood Insurance Program"
  - NFHL covers 90 percent of the United States population
  - Continuously updated to reflect changes called "Letters of Map Change" (LOMC)
- Areas of high risk have a 1% chance - a "100-year storm event" – or higher



FEMA National Flood Map Hazard Layer Viewer, Grove Hall, Boston, MA
(Source: Federal Emergency Management Agency)

Aii. Identify Areas of High Flood Probability Through First Street Foundation Flood Model

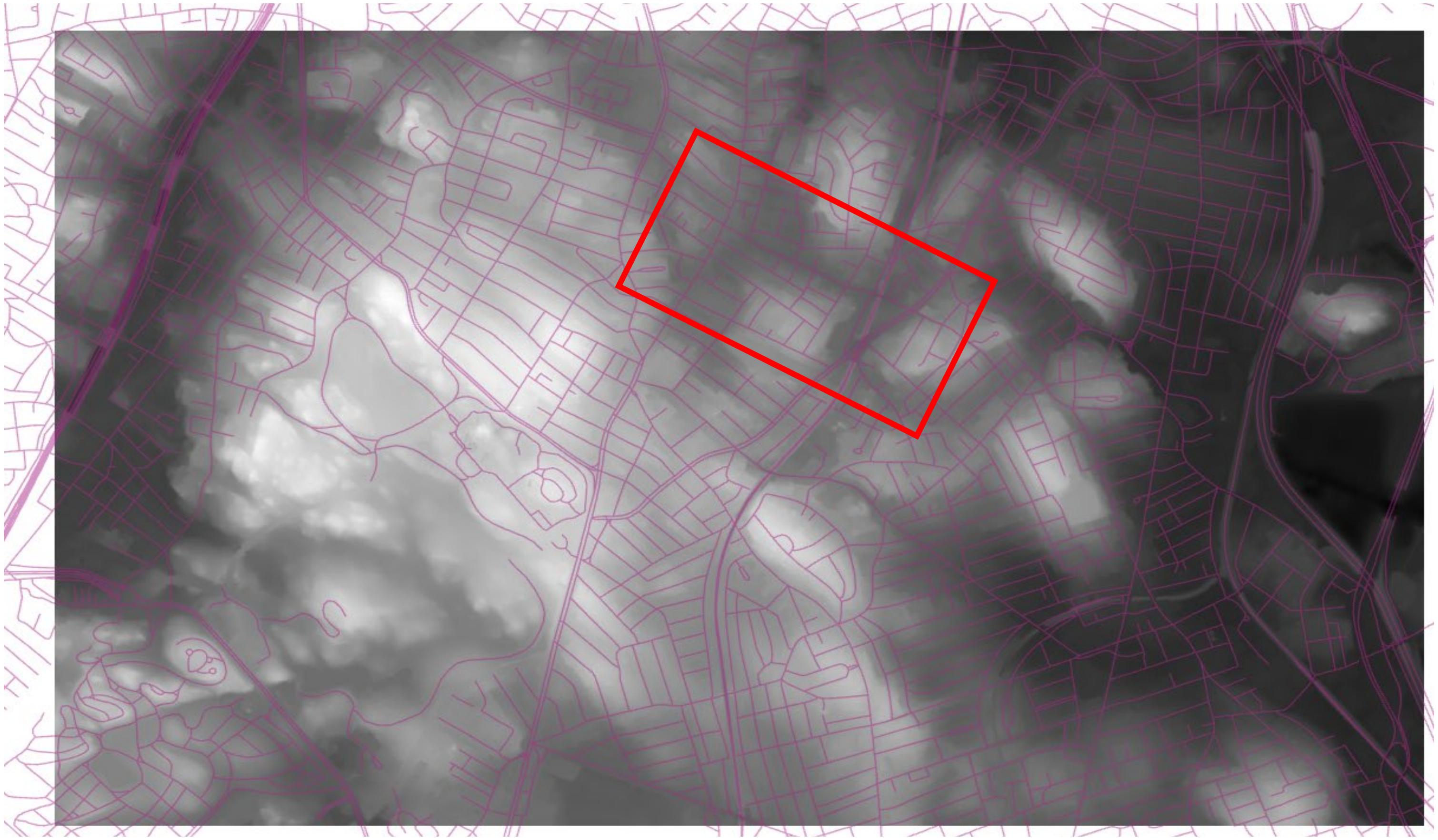
- “The First Street Foundation Flood Model is a nationwide probabilistic flood model that shows the risk of flooding at any location in the contiguous 48 states due to rainfall (pluvial), riverine flooding (fluvial), and coastal surge flooding.”
  - This model differs from FEMA, as it accounts for many different types of flooding
  - This model also projects flood risk based on more severe and heavy storm events due to climate change
- Website: https://riskfactor.com/



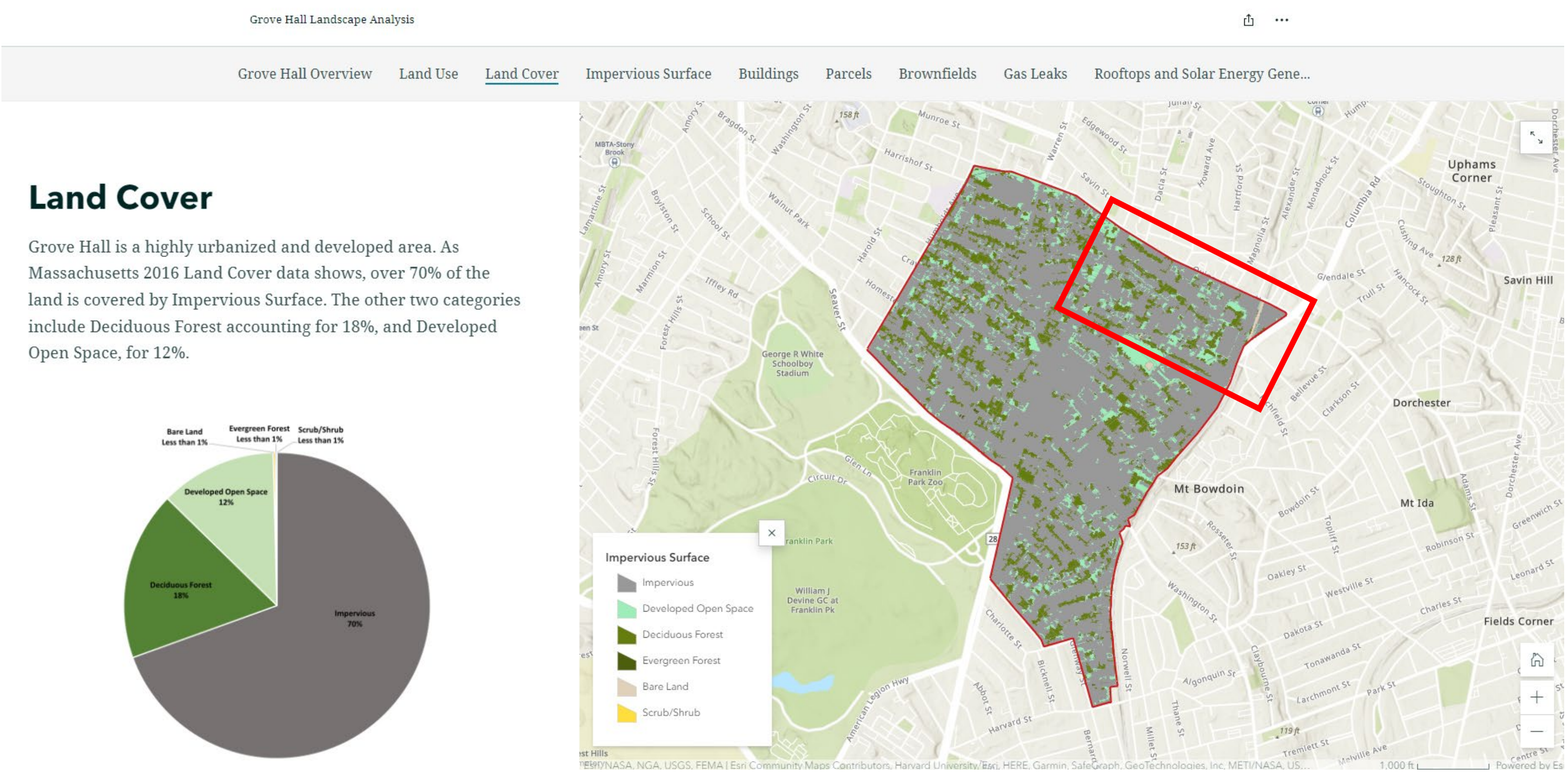
Current and Future Risk of Flooding, 100-year flood risk, Grove Hall, Boston, MA
(Source: First Street Foundation Flood Model, Riskfactor.com)

B. Determine Major Contributions to Flood Risk

- Topographic analysis: Areas of **lower elevation tend to be more prone to flooding** and **require the most intervention**
  - Using a Digital Elevation Model, or a contour map, can help identify the low points in an area
- Percent impervious: Areas and neighborhoods that are **highly impervious create more runoff,** which causes a **higher risk of flooding**
  - Many states and nation datasets include land cover or impervious surface data



Digital Elevation Model and Street Lines of Grove Hall, Boston, MA
(Dark grey represent lower elevation, and lighter greys represent higher elevation)
(Source: MassGIS)



Land Cover GIS Data in Grove Hall, Boston, MA
(Source: Grove Hall Landscape Analysis, Anna Krzystyniak Sobiewska)

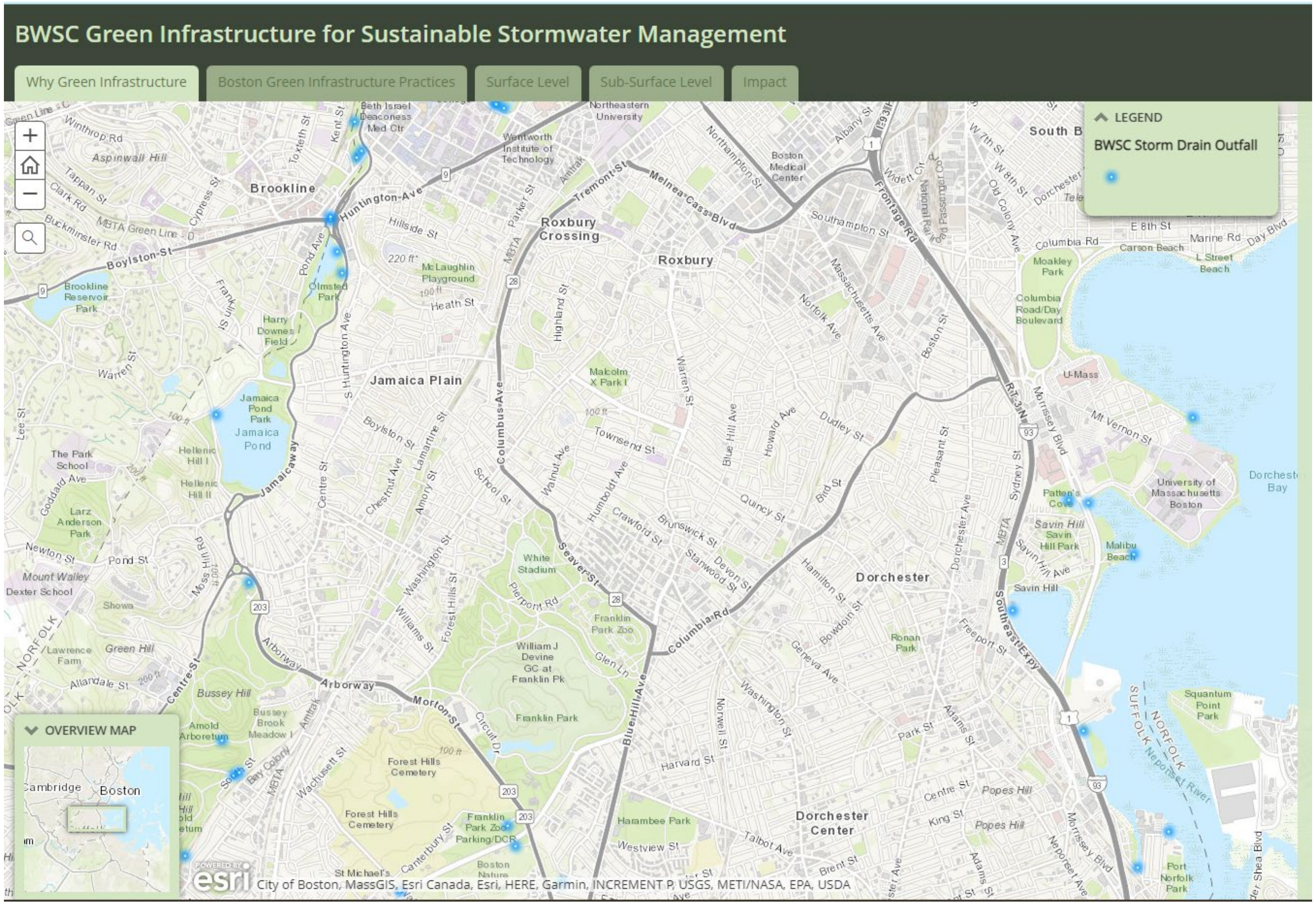
Arial Image of Potential High Flood Risk Area in Grove Hall, Boston, MA
(Image Source: Google Earth)

1.2 Identify Opportunities

Part of an Environmental Audit to determine the existing environmental hazards and opportunities for sustainability.

A. Identify capacity and problems with current stormwater management system

- **Traditional "gray" stormwater** is designed to **move urban stormwater away from the built environment** and includes curbs, gutters, drains, piping, and collection systems.
  - In older cities like Boston, a **combined sewer system** may be used, which directs stormwater into the sewage system. Thus, there are no separate stormwater and sewer treatment drains.
- Evaluating questions may include:
  - Is the system **often overwhelmed** during storm events?
  - What **types of storm intervals**, or at **what flow rate**, is the system built to handle?
  - What **green infrastructure** is already in place? How can future green infrastructure projects **expand or enhance** these existing projects?



Locations of Storm Drain Outfalls near Grove Hall, Boston, MA
(Source: Boston Water and Sewer Commission)

Locations of Green Infrastructure Projects near Grove Hall, Boston, MA
(Source: Boston Water and Sewer Commission)

B. Determine Priorities for Stormwater Management

- Solutions that decrease flood risk often fall into one or more of these three approaches:
    1. **Capture and retain stormwater** so it drains more slowly
    2. **Allow stormwater to infiltrate** into the ground
    3. **Collect stormwater for use** in residential and commercial buildings
- Although these solutions often are implemented together, **there can be trade-offs between strategies,** and specific geographic needs
    - For example, many infiltration strategies cannot incorporate rainwater collection, as the water cannot be collected over an impermeable surface
    - Communities that are water scarce may prioritize rainwater collection over other strategies, due to their indoor and outdoor water needs

C. Identify and Inventory Potential Impervious Implementation Sites

- Larger, impervious surfaces are ideal places to capture, retain, and collect stormwater. Examples include:
  - Parking lots
  - Roofs
  - Major streets
  - Plazas
- Note the following for each impervious site:
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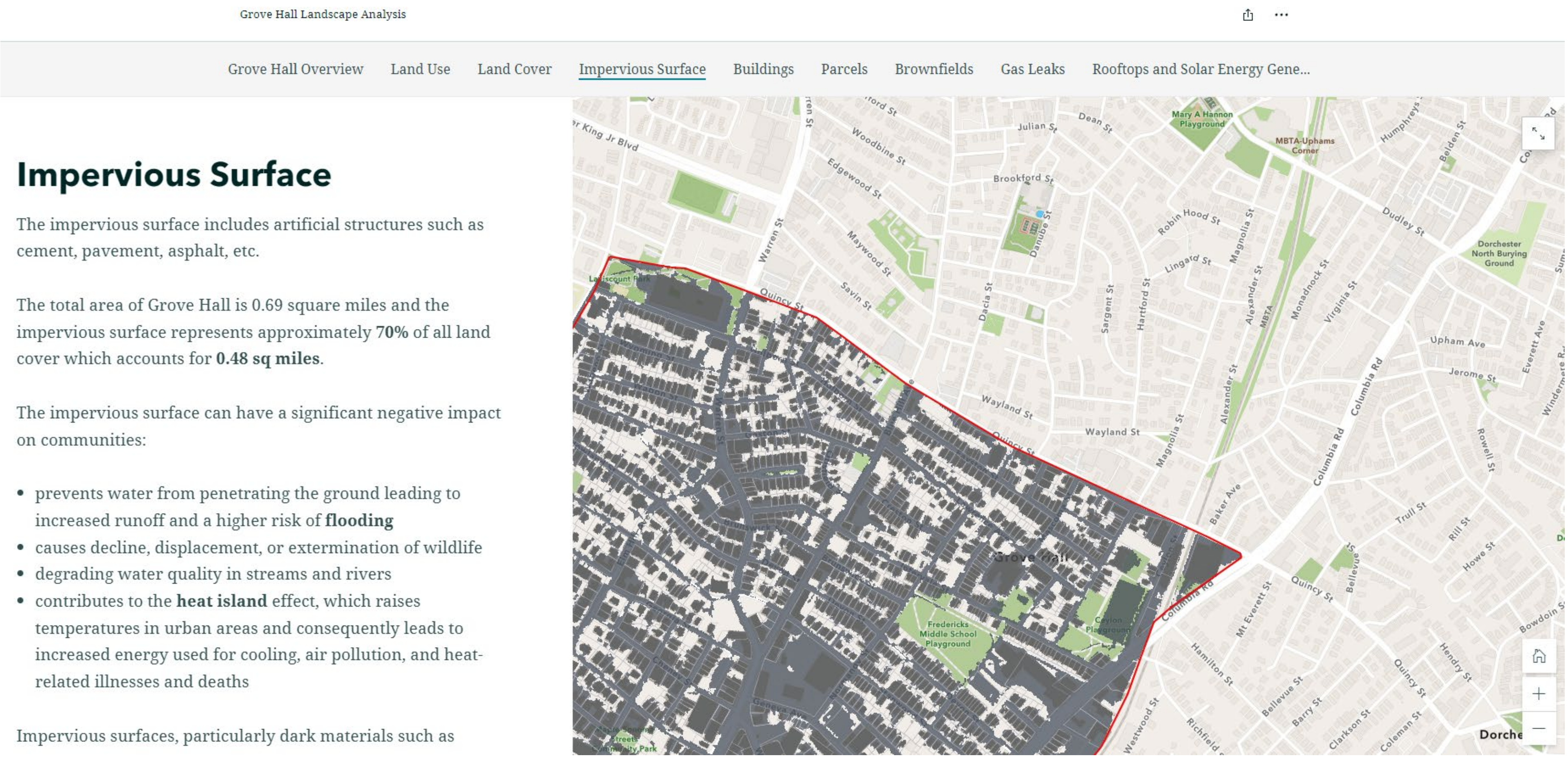
Grove Hall Landscape Analysis

Grove Hall Overview | Land Use | Land Cover | Impervious Surface | Buildings | Parcels | Brownfields | Gas Leaks | Rooftops and Solar Energy Gene...

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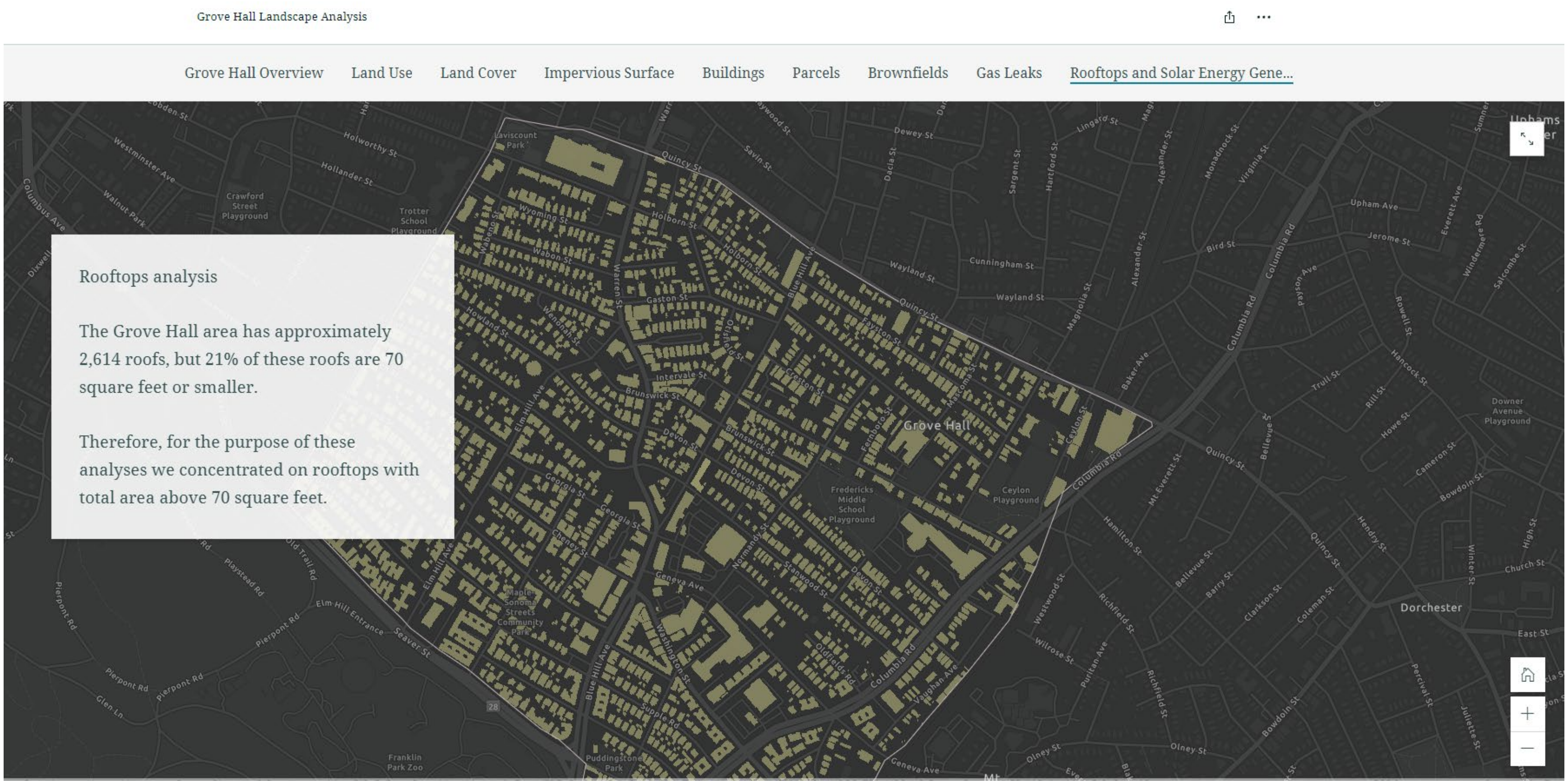

Building Footprints in Grove Hall, Boston, MA
(Source: Grove Hall Landscape Analysis, Anna Krzystyniak Sobiewska)

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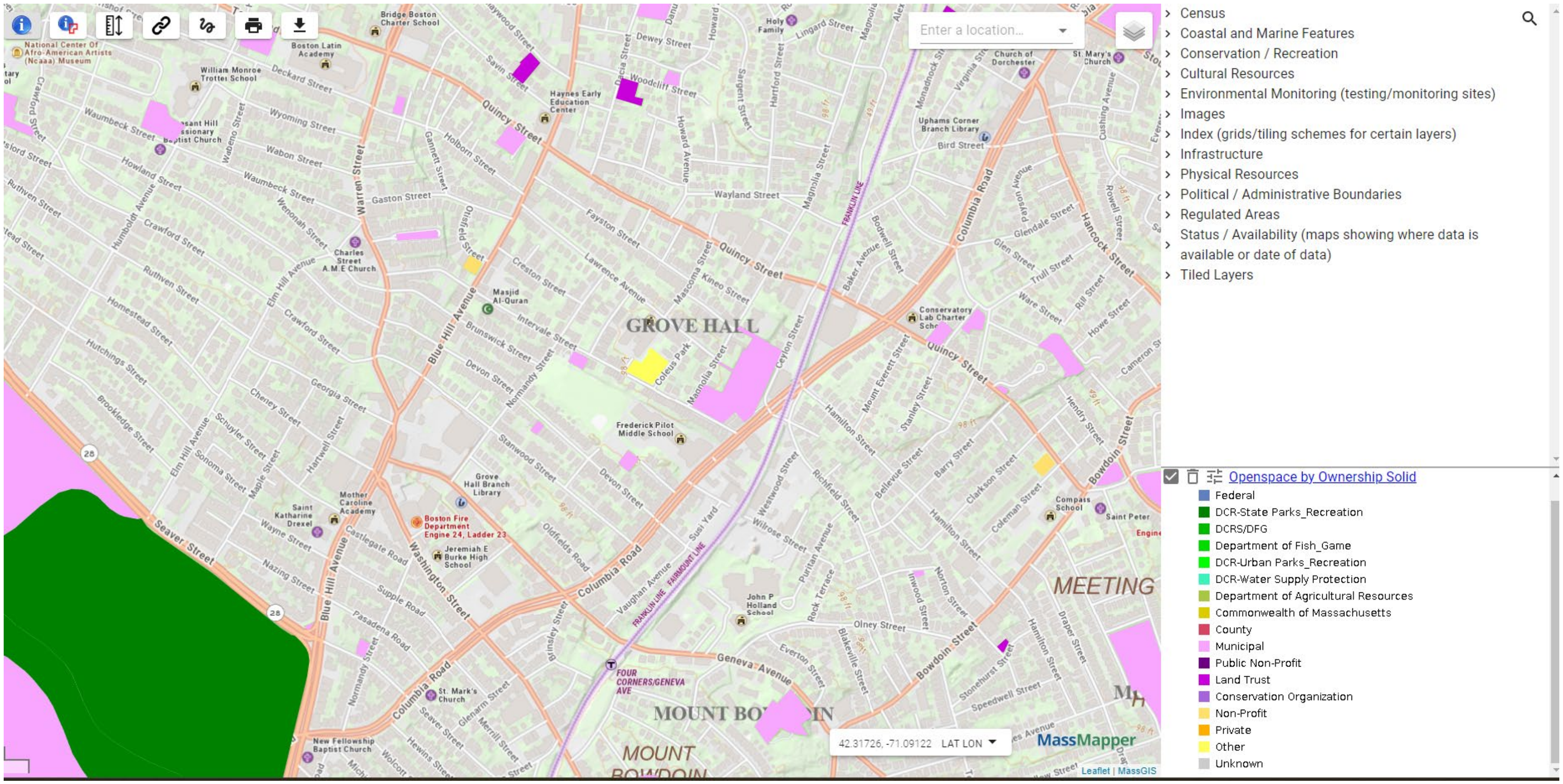
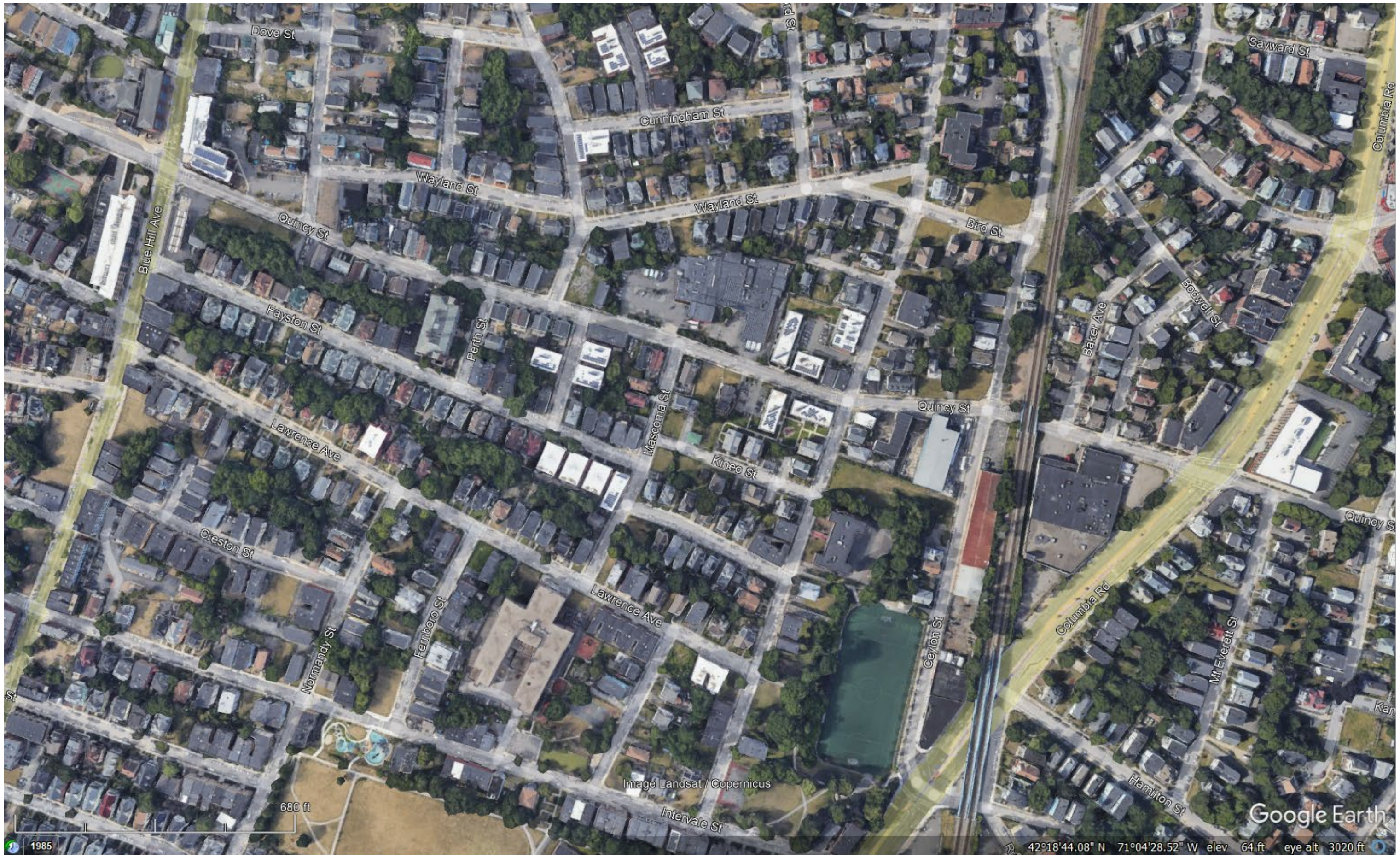


Open Spaces in Grove Hall, Boston, MA
(Source: MassGIS Data)



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Feasibility Studies

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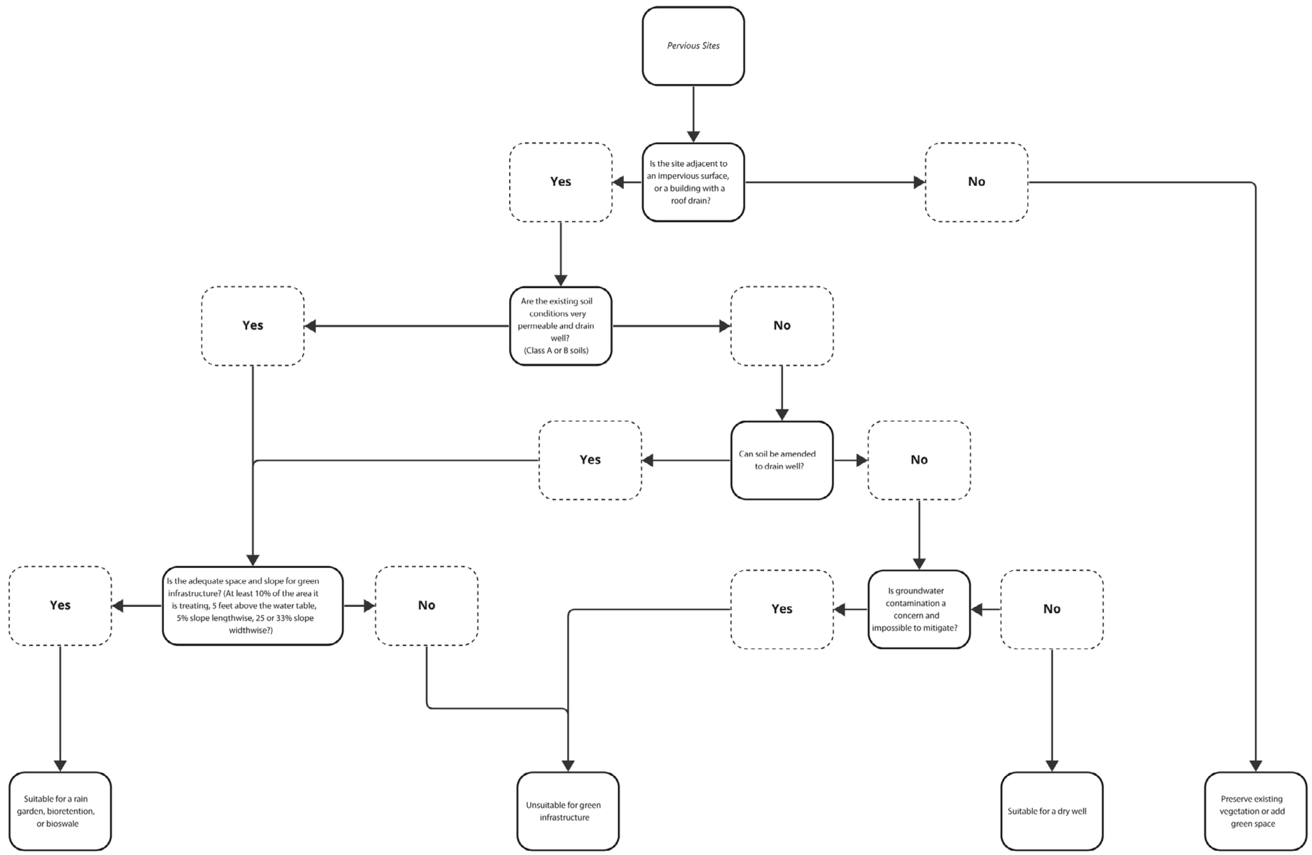
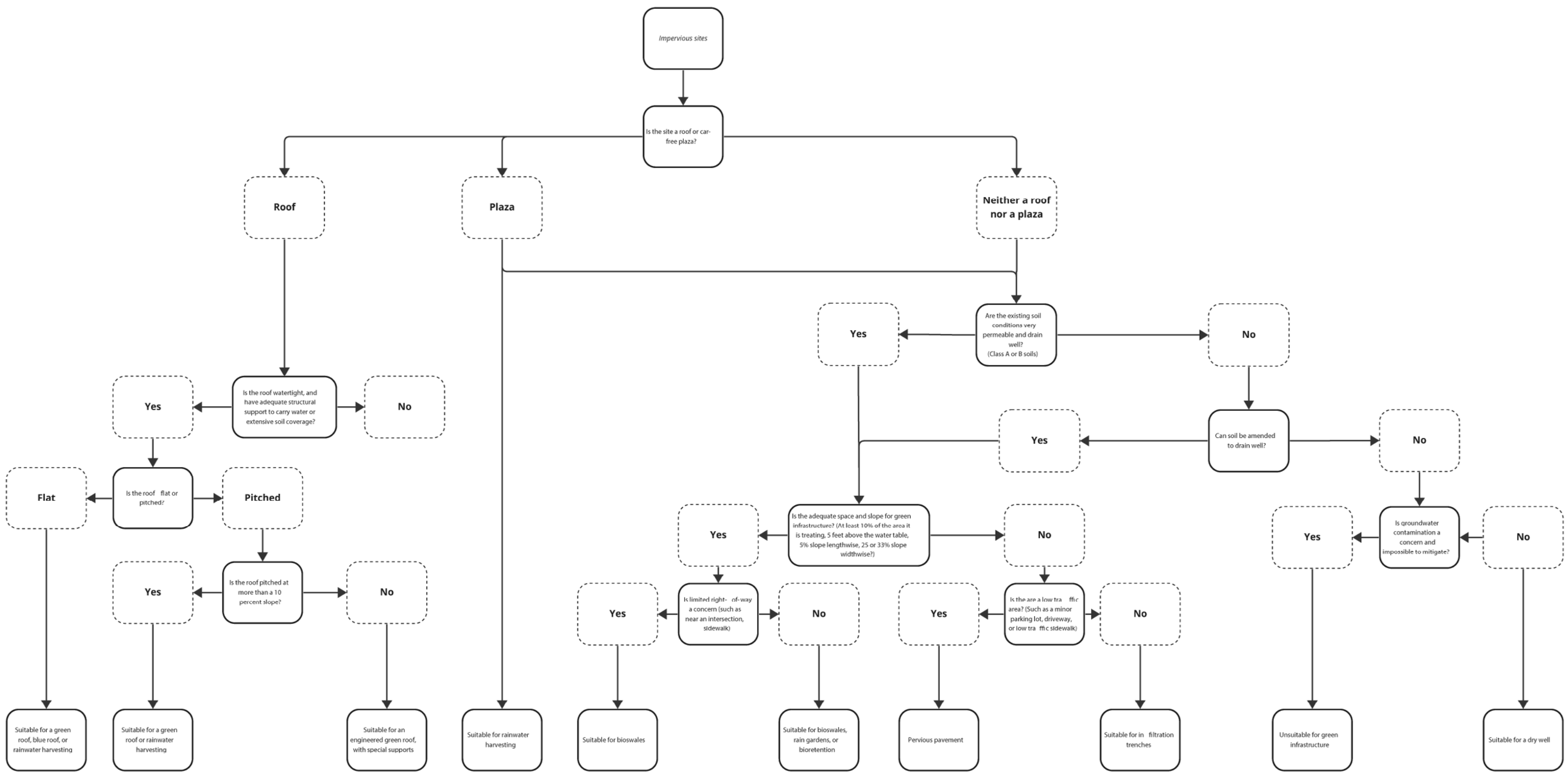


Flowchart for Evaluating Green Infrastructure Feasibility and Interventions for Pervious Sites



Flowchart for Evaluating Green Infrastructure Feasibility and Interventions for Impervious Sites

B. Use a scoring matrix to determine which projects to implement

- Use criterion such as:
  - Environmental impact,
  - Ease of implementation,
  - Governance,
  - Cost,
  - Funding potential,
  - Community ranking,
  - Environmental metrics such as clean energy generation, decarbonization, stormwater management, and heat island mitigation.

IV. Solution Evaluation Matrix

Intervention or Solution	Positive environmental impact 1 = least 5 = most	Ease of implementation 1 = difficult 5 = easiest	Governance 1 = least agency 5 = most agency	Cost 1 = high cost 5 = low cost	Funding potential 1 = least 5 = most	Ability to advance justice 1 = least impact 5 = most impact	Workplace development or entrepreneurship oppertunities 1 = least 5 = most	Community ranking 1 = lowest 5 = highest	Total Score
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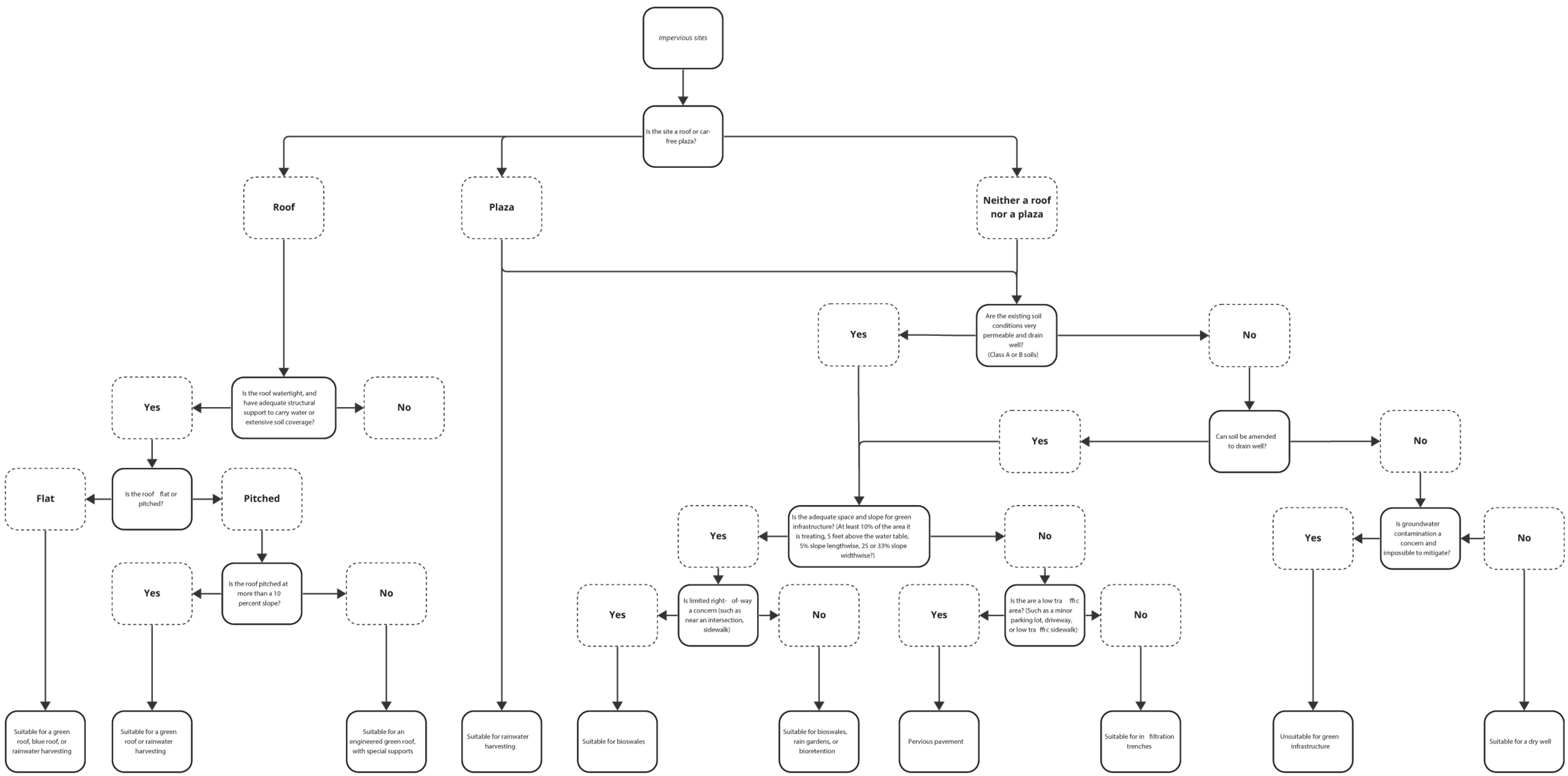
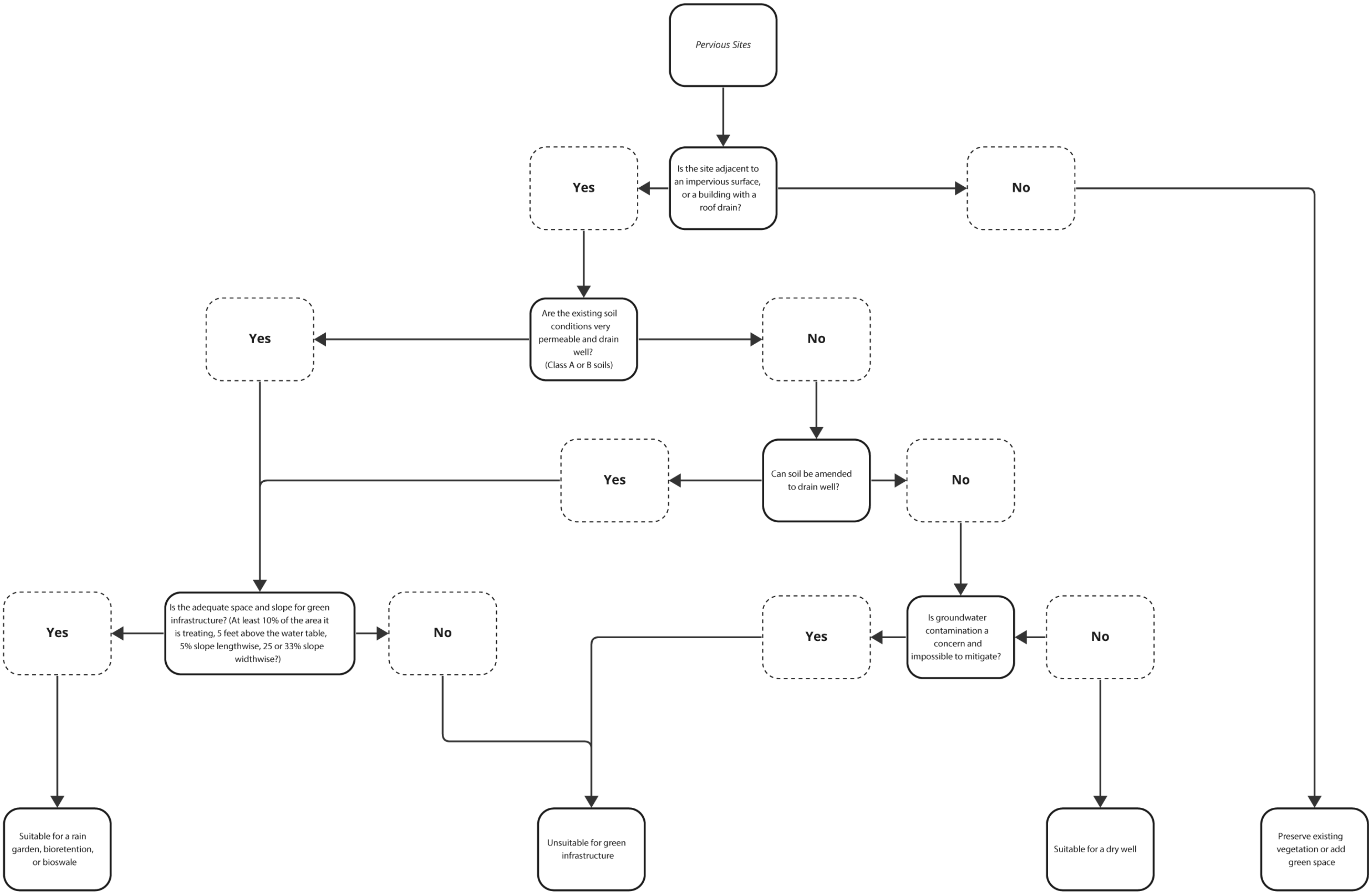
Scoring Matrix for Potential Interventions

References

Krzystyniak Sobiewska, A. (2023, February 12). Grove Hall Landscape Analysis. *Grove Hall Landscape Analysis*. https://storymaps.arcgis.com/stories/a391ab26379641babc66f7e76c61bff9

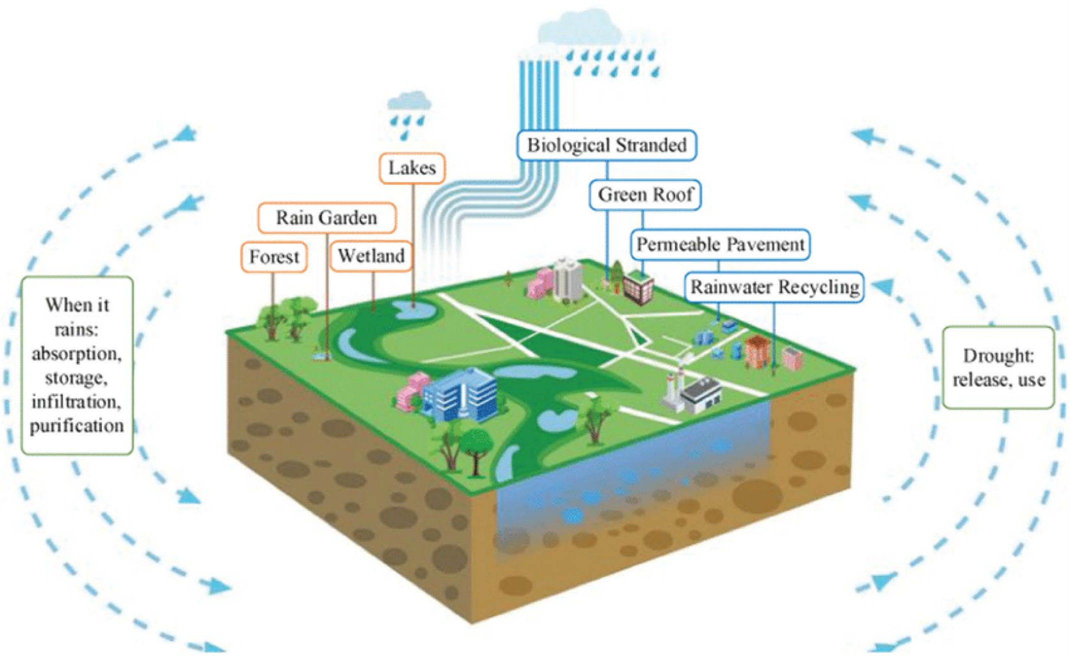


Impervious sites
Is the site a roof or car-free plaza?
Roof
Plaza
Neither a roof nor a plaza
Is the roof watertight, and have adequate structural support to carry water or extensive soil coverage?
Yes
No
Is the roof flat or pitched?
Flat
Pitched
Is the roof pitched at more than a 10 percent slope?
Yes
No
Suitable for a green roof, blue roof, or rainwater harvesting
Suitable for a green roof or rainwater harvesting
Suitable for an engineered green roof, with special supports
Suitable for rainwater harvesting
Are the existing soil conditions very permeable and drain well? (Class A or B soils)
Yes
No
Can soil be amended to drain well?
Yes
No
Is the adequate space and slope for green infrastructure? (At least 10% of the area it is treating, 5 feet above the water table, 5% slope lengthwise, 25 or 33% slope widthwise?)
Yes
No
Is limited right-of-way a concern (such as near an intersection, sidewalk)
Yes
No
Is the are a low traffic area? (Such as a minor parking lot, driveway, or low traffic sidewalk)
Yes
No
Is groundwater contamination a concern and impossible to mitigate?
Yes
No
Suitable for bioswales
Suitable for bioswales, rain gardens, or bioretention
Pervious pavement
Suitable for infiltration trenches
Unsuitable for green infrastructure
Suitable for a dry well



Pervious Sites
Is the site adjacent to an impervious surface, or a building with a roof drain?
Yes
No
Are the existing soil conditions very permeable and drain well? (Class A or B soils)
Yes
No
Can soil be amended to drain well?
Yes
No
Is the adequate space and slope for green infrastructure? (At least 10% of the area it is treating, 5 feet above the water table, 5% slope lengthwise, 25 or 33% slope widthwise?)
Yes
No
Is groundwater contamination a concern and impossible to mitigate?
Yes
No
Suitable for a rain garden, bioretention, or bioswale
Unsuitable for green infrastructure
Suitable for a dry well
Preserve existing vegetation or add green space

Sponge City



Summary

A 'sponge city' is an urban development concept and approach designed to manage and utilize rainwater in a sustainable and environmentally friendly manner. The idea behind a sponge city is to mimic the natural hydrological cycle by allowing the city to "absorb" and "hold" rainwater like a sponge, rather than repelling it like traditional concrete-dominated urban areas.

Sponge cities incorporate innovative stormwater management techniques, such as permeable pavements, green roofs, rain gardens, and bioswales. These systems help capture, retain, and infiltrate rainwater into the ground, reducing the amount of runoff and mitigating flooding risks. Sponge cities also emphasize the collection and storage of rainwater for later use. Captured rainwater can be treated and utilized for non-potable purposes, reducing the demand on traditional water sources.

By increasing the ability to retain rainwater on-site, sponge cities enhance their resilience to flooding during heavy rainfall events by helping reduce the burden on drainage systems, preventing overwhelming and potential damage. Sponge cities also increase access to green space, which improves quality of life and air quality, adapt to a climate with more frequent and extreme flooding and weather events, and involve community members to increase awareness of water conservation, responsible water use, and stormwater management.

Sponge City (Cont.)

Many of the solutions outlined in the following cards work together to create a sponge city. All of them do one or more of the following:

1. Capture and retain stormwater so it drains more slowly
2. Allow stormwater to infiltrate into the ground
3. Collect stormwater for use in residential and commercial buildings

These techniques include:

- **Bioswales**: Shallow, vegetated channels or depressions engineered to capture, slow down, and filter stormwater runoff, allowing it to infiltrate into the ground and recharge the groundwater system.
- **Rainwater Gardens**: Slightly sunken gardens that allow collected water to be taken up by plants or slowly infiltrated, reducing the amount of water running off site.
- **Pervious pavement**: A type of surface material that allows water to pass through it, thereby reducing stormwater runoff and promoting groundwater recharge.
- **Green roofs**: Roof systems that are partially or completely covered with vegetation and growing medium with many benefits, including stormwater management.
- **Blue roofs:** Rooftop infrastructure designed to manage stormwater runoff in urban areas by temporarily storing rainwater on rooftops and slowly releasing it back into the drainage system or allowing it to evaporate over time.
- **Rainwater Harvesting:** The process of capturing rainfall from rooftops, land surfaces, or other surfaces and channeling it into storage tanks, cisterns, or underground reservoirs for later use.

Rainwater Harvesting (Residential)

Summary

Rainwater harvesting is the process of collecting and storing rainwater for later use. In resiential settings, it most often involves capturing rainfall from rooftops and channeling it into storage tanks or cisterns. This harvested rainwater can then be used for various non-potable purposes, such as irrigation, watering plants, washing clothes, and flushing toilets. Non-potable water is not suitable for drinking but may still be used for other purposes.

The basic components of a rainwater harvesting system typically include a collection surface, such as a roof, a gutter or a series of pipes to direct the flow of rainwater, a filter to remove debris and impurities, a storage tank to hold the collected water, and a distribution system to supply water where it is needed.

Considerations

- **Can reduce stormwater runoff**
- **Especially well-suited for drier climates and drought-affected areas**
- **Reduces costs for potable water, which provides cost savings long-term**
- **Can be simple, cheap, and accessible to most homeowners**
- **Requires a water-tight, impervious roof surface**
- **May require permits or compliance with restrictions in order to collect rainwater in some states**

Bioswales

Summary

A bioswale, also known as a vegetated swale or a biofiltration swale, is a type of landscape feature designed to manage stormwater runoff and improve water quality. It is a shallow, vegetated channel or depression that is specifically engineered to capture, slow down, and filter stormwater runoff, allowing it to infiltrate into the ground and recharge the groundwater system.

The main purpose of a bioswale is to effectively manage and treat stormwater by mimicking the natural processes of a wetland or a meadow. It is typically constructed with a combination of engineered materials and vegetation to create a functional and visually appealing feature.

Considerations

- **Often placed near impervious surfaces, such as a parking lot or street**
- **Captures stormwater runoff, reducing burden on the stormwater system**
- **Allows for groundwater infiltration**
- **Increases stormwater runoff quality**
- **Well-chosen trees can often thrive within bioswales**
- **Requires regular maintenance, such as plant trimming and unclogging**
- **Bioswale may take up sidewalk space**

Rainwater Gardens

Summary

Rain gardens are specially designed and planted depressions in the ground that collect, filter, and treat stormwater. These slightly sunken gardens allow collected water to be taken up by plants or slowly infiltrated (i.e., filtered into the ground), reducing the amount of water running off site.

Rain garden soils—which are typically amended with mulch and sand to promote proper moisture levels and drainage properly—also remove pollutants before they reach groundwater or flow to coastlines and local waterbodies. By preventing stormwater from running into roads, storm drains, and waterways, rain gardens may also help reduce localized flooding and erosion.

Considerations

- **Decreases stormwater runoff, reducing burden on the stormwater system**
- **Allows for infiltration into the soil**
- **A low-cost solution that can be implemented most places with proper soil conditions**
- **Must be placed away from homes or other structures**
- **Requires yard space at a residential scale**
- **Must be maintained regularly, and should be installed considering current slope and topography**
- **Cannot be used alone, and can only manage smaller areas**

Permeable Pavement

Summary

Permeable pavement, also known as porous pavement or pervious pavement, is a type of surface material that allows water to pass through it, thereby reducing stormwater runoff and promoting groundwater recharge. Unlike traditional impervious surfaces like concrete or asphalt, which prevent water from infiltrating the ground, permeable pavement is designed to allow water to permeate into the underlying soil

Benefits include decreasing stormwater runoff, improving water quality by removing sediments, reduction of urban heat island, improved safety from decreased risk of slipping. They can also be aesthetically pleasing. Examples include porous asphalt, permeable concrete, permable pavers, resin-bound aggregates, and grid systems

Considerations

- **Reduces the burden on the stormwater system, and improves water quality**
- **Rainwater cannot be collected on pervious pavement**
- **Increases safety due to less water and ice pooling**
- **Can be more expensive to install than concrete, especially aggregates**
- **Requires occasional maintenance to continue to function well**
- **Requires monitoring to ensure the surface is flat, especially when used near trees**

Bioretention and Biodetention Ponds

Summary

Bioretention and biodetention ponds are engineered stormwater management systems designed to capture and treat stormwater runoff. They utilize natural processes and vegetation to filter pollutants, reduce erosion, and promote water infiltration.

Bioretention is a stormwater management practice that involves the use of shallow depressions or basins filled with engineered soil media, vegetation, and an underdrain system. These basins mimic the functions of natural ecosystems by capturing and treating stormwater runoff. Biodetention is a similar stormwater management technique to bioretention, but it often refers to larger-scale systems used for managing larger volumes of stormwater. Biodetention ponds are typically larger than individual bioretention basins and can accommodate higher flows and longer detention times.

Considerations

- **Filters water and increases water quality**
- **Reduces burden on stormwater system and allows for infiltration into soil**
- **Often requires a very large amount of space**
- **Risk of drowning for parents with small children**
- **Require occasional changes in soil and vegetation to maintain performance**
- **Often designed to a specific water volume threshold**

Green Roofs

Summary

Green roofs, also known as vegetative or living roofs, are roof systems that are partially or completely covered with vegetation and growing medium. They provide a layer of living plants on top of a building, creating a green space that offers numerous environmental, aesthetic, and functional benefits.

The benefits of green roofs include stormwater management, improved air quality, biodiversity and habitat creation, energy efficiency, and aesthetics. Green roofs are increasingly popular in urban areas where open space is limited, and there is a growing emphasis on sustainable and environmentally friendly building practices.

Considerations

- **Decreases stormwater runoff by catching rainwater above ground**
- **Has many additional benefits, including reducing urban heat island, and ecological benefits.**
- **Depending on the extensiveness of the green roof, buildings must have enough structural support to support the growth medium**
- **Can sometimes be costly to construct, especially slanted roofs**
- **Must be properly maintained, with service access for maintenance workers**

Blue Roofs

Summary

A blue roof is a type of rooftop infrastructure designed to manage stormwater runoff in urban areas. It is a technique used to mitigate the negative impacts of urbanization on water systems by reducing the volume and rate of stormwater runoff, as well as improving water quality.

Blue roofs help to alleviate these issues by temporarily storing rainwater on rooftops and slowly releasing it back into the drainage system or allowing it to evaporate over time. This process reduces the peak flow rate during heavy rain events and helps prevent overwhelming the stormwater infrastructure.

Detention blue roofs are designed to store and slowly release rainwater. They use various mechanisms such as specially designed outlets, flow restrictors, or control devices to regulate the discharge rate. Retention blue roofs are designed to hold water for longer periods, allowing it to slowly evaporate or be absorbed by plants on the roof.

Considerations

- **Blue roofs reduce stormwater runoff and slow the flow of runoff**
- **Must have a flat roof, and a roof that can handle the weight of water**
- **Can be expensive to implement, and must be maintained regularly to ensure longevity**

Rainwater Harvesting (Commercial)

Summary

Similarly to residential rainwater harvesting, commercial harvesting involves collecting and storing rainwater for later use. Commercial systems are designed to meet the water demands of larger buildings, facilities, or commercial operations. They have a higher capacity for water storage, and the scale can range from moderate-sized structures to large-scale commercial or industrial facilities.

Commercial operations may have more diverse and substantial water demands. They can use rainwater for non-potable applications, and, in some cases, for potable uses (after appropriate treatment). Additionally, commercial systems tend to be more complex. The design may involve multiple collection areas, like plazas and large roofs, larger storage tanks or cisterns, advanced filtration and treatment systems, and pumps to distribute water throughout the facility.

Considerations

- **Can reduce stormwater runoff significantly**
- **Requires large, impervious surfaces to collect water, which can range in scale and use**
- **High upfront capital cost, but reduces costs for potable water, which provides cost savings long-term**
- **Due to impact on water resources, may face more stringent regulations and permitting processes**

Dry Well

Summary

A dry well, in the context of stormwater management, is an underground structure designed to collect and manage stormwater runoff. Dry wells act as an effective stormwater management solution by providing temporary storage and infiltration. They are commonly used in areas with impervious surfaces like parking lots, rooftops, and roads.

The dry well receives stormwater runoff from various sources, and is temporarily stored in the underground chamber of the dry well. As the dry well stores the runoff, the water gradually percolates into the surrounding soil through the bottom and the sidewalls of the well.

Considerations

- **Cost-effective and relatively simple stormwater management tool**
- **Can be used in soils that do not drain well at the surface, such as due to a layer of clay**
- **May not be suitable for all soil types and site conditions, so must be designed to prevent clogging or contamination**
- **Local regulations and guidelines often dictate the construction and use of dry wells in stormwater management plans**
- **Does not require much space, if at all, above ground, unlike many other green infrastructure solutions**

Infiltration Trench

Summary

An infiltration trench, also known as a soakaway trench or a dry well trench, is a stormwater management practice designed to manage and control the flow of rainwater runoff. It is an excavated trench filled with aggregate or other permeable materials that allow stormwater to infiltrate into the surrounding soil, effectively recharging the groundwater and reducing the burden on local sewer systems.

An infiltration trench is dug into the ground, typically in a long and narrow shape. The trench is then filled with a permeable material like gravel, crushed stone, or engineered soil mixtures. As stormwater runoff from impervious surfaces, such as rooftops, parking lots, or roadways, enters the trench, it percolates through the permeable fill material and into the surrounding soil.

Considerations

- **Reduces the burden on the stormwater system and promotes infiltration of water into soil for groundwater discharge**
- **Cost-effective and relatively simple design; can even be done by most homeowners**
- **Suitability depends on the soil's permeability and the local groundwater conditions**
- **Does not require much space, if at all, above ground, unlike many other green infrastructure solutions**

Water-efficient building and irrigation upgrades

Summary

A water-efficient building refers to a property that incorporates various upgrades and features designed to minimize water consumption and maximize water conservation. These upgrades can be implemented in both indoor and outdoor areas of the home. Similarly, water-efficient irrigation refers to systems and practices that minimize water usage in landscaping and garden irrigation.

Indoor upgrades include low-flow fixtures, efficient appliances, and leak detection and repair. Outdoor upgrades include adding drip irrigation, and using smart irrigation controllers. All of these techniques can be combined with greywater reuse, or drought-tolerant landscaping.

Considerations

- **Water-efficient upgrades can be implemented in most buildings, from homes to commercial or office buildings**
- **Can often be installed with limited or no maintenance skills**
- **May have a high upfront capital cost, but saves on water expenses in the long term**

Drought-Tolerant Landscaping

Summary

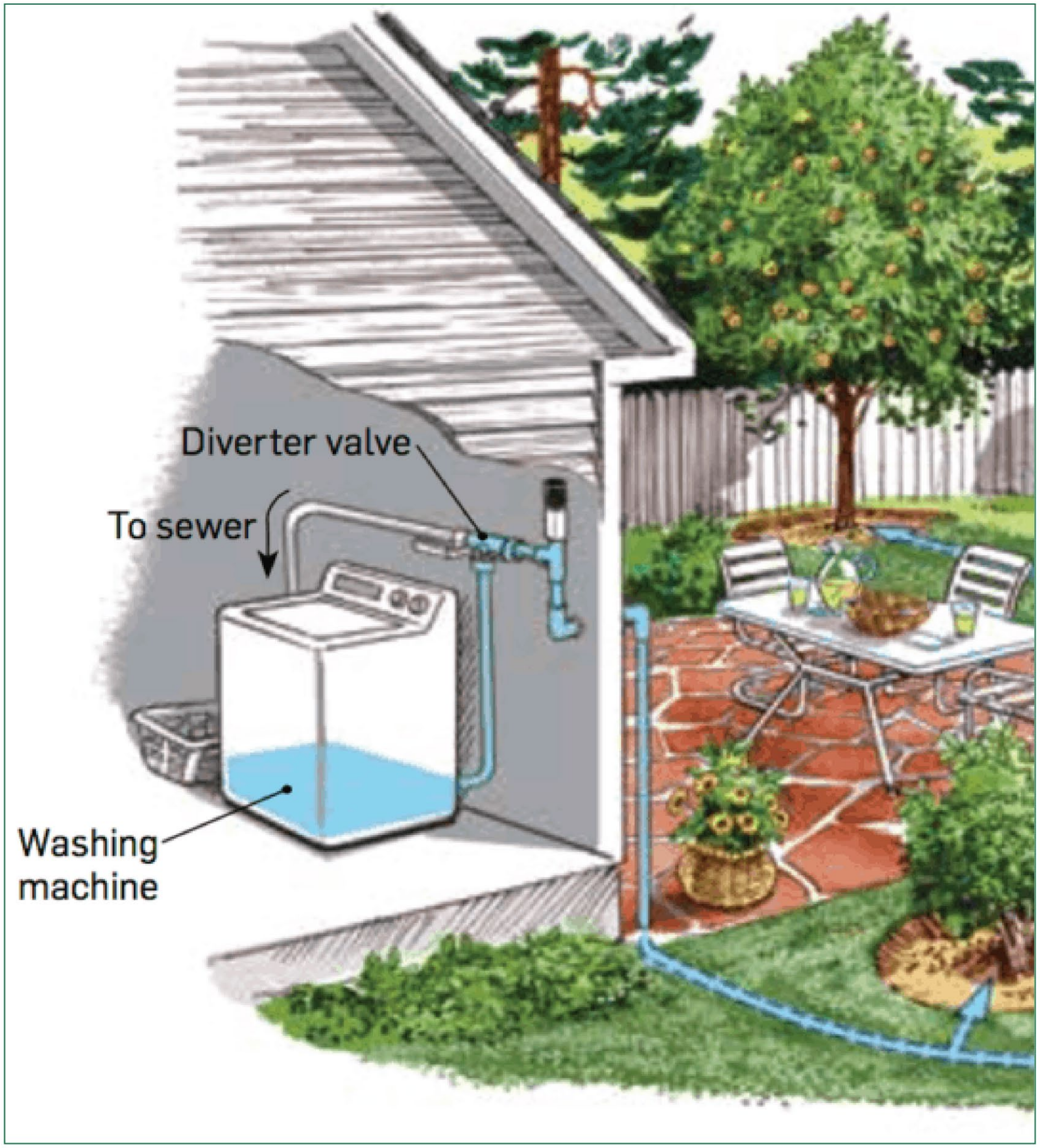
A drought-tolerant landscape, also known as a xeriscape or water-wise landscape, is a type of landscaping design that focuses on reducing water usage and conserving water during periods of drought or water scarcity. It involves selecting and incorporating plants, materials, and practices that can thrive with minimal or no supplemental irrigation.

The main objective of a drought-tolerant landscape is to create an aesthetically pleasing and sustainable outdoor environment while minimizing the need for water. It takes into account the local climate, soil conditions, and available water resources to create a resilient and water-efficient landscape.

Considerations

- **Tend to be lower maintenance compared to more traditional landscapes, as well as need far less water**
- **In drought-prone areas, more adapted to the environment, and thus more successful and less likely to fail**
- **Can be combined with water-efficient drip irrigation**
- **Can be implemented in most outdoor spaces, from front yards, to plazas and parks**
- **Requires upfront capital costs, but long-term return on investment**

Greywater Reuse



Summary

Greywater reuse refers to the practice of treating and reusing water that has been used in household activities such as bathing, laundry, and dishwashing. Unlike blackwater, which contains sewage and human waste, greywater is relatively clean and can be recycled for non-potable purposes. This environmentally-friendly approach helps conserve fresh water resources and reduce the strain on wastewater treatment systems.

Greywater typically consists of water from bathroom sinks, showers, bathtubs, and washing machines. It does not include water from toilets or kitchen sinks, as it may contain higher levels of contaminants. Greywater can be collected and treated on-site using various filtration and disinfection methods to remove impurities and pathogens, making it suitable for reuse.

Considerations

- **Greywater can be used for a variety of purposes, such as landscape irrigation, flushing toilets, and washing clothes**
- **Can reduce demand for potable water, and reduce water utility costs**
- **On-site filtration requires maintenance to maintain water safety**
- **Some jurisdictions have regulations and laws regarding greywater reuse**

Replacing Lead Pipes

Summary

Lead pipes are plumbing pipes made primarily from lead metal. They were commonly used in the past for water distribution systems in residential and commercial buildings. Lead pipes were especially prevalent in older homes and buildings constructed before the mid-20th century. However, due to the recognized health risks associated with lead exposure, the use of lead pipes in plumbing systems has been phased out and replaced with safer alternatives.

Over time, corrosive water or acidic conditions can cause the lead pipes to deteriorate, leading to the release of lead particles into the water supply. This poses a significant health risk as consuming water contaminated with lead can lead to lead poisoning and various adverse health effects.

To mitigate these risks, it is recommended to replace lead pipes with modern plumbing materials, such as copper, plastic (e.g., PVC or PEX), or other approved materials that do not leach harmful substances into the water supply.

Considerations

- **May be an expensive upfront investment, including labor, inspection, and material costs**

Addressing point-source pollution in water

Summary

Point source pollution refers to the pollution that originates from a specific, identifiable source or location. It occurs when pollutants are discharged or released into the environment from a single point, such as a pipe, chimney, or outlet, making it easier to trace the exact origin of the pollution.

Examples of point source pollution include industrial discharges, municipal wastewater treatment plants, power plants, oil spills, landfills, and chemical storage facilities.

Considerations

- **Often a regulatory framework must be used to enforce pollution laws and regulations**
- **Pollution often must be monitored and reported regularly to maintain accountability**
- **Educating the public about the impacts of point source pollution and encouraging citizen involvement can be an effective way to address the issue.**

Phytoremediation

Summary

Phytoremediation is a process that uses plants to clean up and remove contaminants from soil, water, or air. It is a cost-effective and environmentally friendly approach to remediate polluted sites.

Plants used in phytoremediation are selected for their ability to absorb, metabolize, or sequester pollutants through various mechanisms. They can uptake contaminants from the soil or water through their roots, and then translocate them to other plant parts such as leaves, stems, or roots. Once in the plant, the contaminants can be degraded, immobilized, or volatilized, depending on the plant species and the specific pollutants involved.

There are different types of phytoremediation techniques, including phytoextraction, phytostabilization, rhizofiltration, phytodegradation, and phytovolatilization.

Considerations

- **Phytoremediation can be used to treat or absorb contaminants in stormwater, especially when placed in stormwater treatment infrastructure such as bioswales**
- **Requires the occasional removal or maintenance of the plants used**
- **Plants used in phytoremediation should not be consumed**

Elevating or Regrading

Summary

Elevating or regrading refers to the process of modifying the existing ground level of a property to increase its elevation or alter its slope. These modifications are typically done to raise the property's level above the floodplain or to improve its drainage characteristics.

Elevating a parcel involves physically raising the ground level of the property. This can be achieved through various methods, such as adding fill material to build up the land, constructing a raised platform or foundation for structures, or using pilings or stilts to lift the building above the ground.

Regrading refers to the process of reshaping or recontouring the land to create a desired slope or drainage pattern. It involves removing or redistributing soil or other materials to alter the topography of the property. This can be done to redirect water flow away from structures or to create natural contours that enhance drainage and prevent water pooling.

Considerations

- **Elevating or regrading is often expensive, and may give a false sense of security to property owners**
- **Elevation does not reduce stormwater runoff or infiltration, and does not have any ecological benefit**
- **In some areas, elevation or regrading must be used with other stormwater management methods, or be the only feasible option**

Subsection 2: Heat and Solar Energy as Hazard and Opportunity

i. A Methodology for Measuring and Assessing Heat Islands and Potential Project Implementation Sites
ii. A Methodology for Assessing Solar and Wind Power Generation Potential, and Project Implementation Sites
iii. Heat and Solar Energy Solutions Bank

A Methodology for Measuring and Assessing Heat Islands and Potential Project Implementation Sites

Chadwick Bowlin
Greater Grove Hall Main Streets

July 2023

1.1 Identify Hazards

Part of an Environmental Audit to determine the existing environmental hazards and opportunities for sustainability.

A. Designing an Approach for Assessing Your City's Heat Island

A comprehensive method for determining stormwater contamination source includes:

1. Clarifying Objectives
2. Design Overall Approach/Identifying Data Needs
   a. Geographic Coverage
   b. Types of Temperature Data and Technologies for Capturing Data
   c. Account for Key Considerations

(Adapted from *Measuring Heat Islands* on the EPA website https://www.epa.gov/heatislands/measuring-heat-islands#identifying)

A.1 Clarifying Objectives

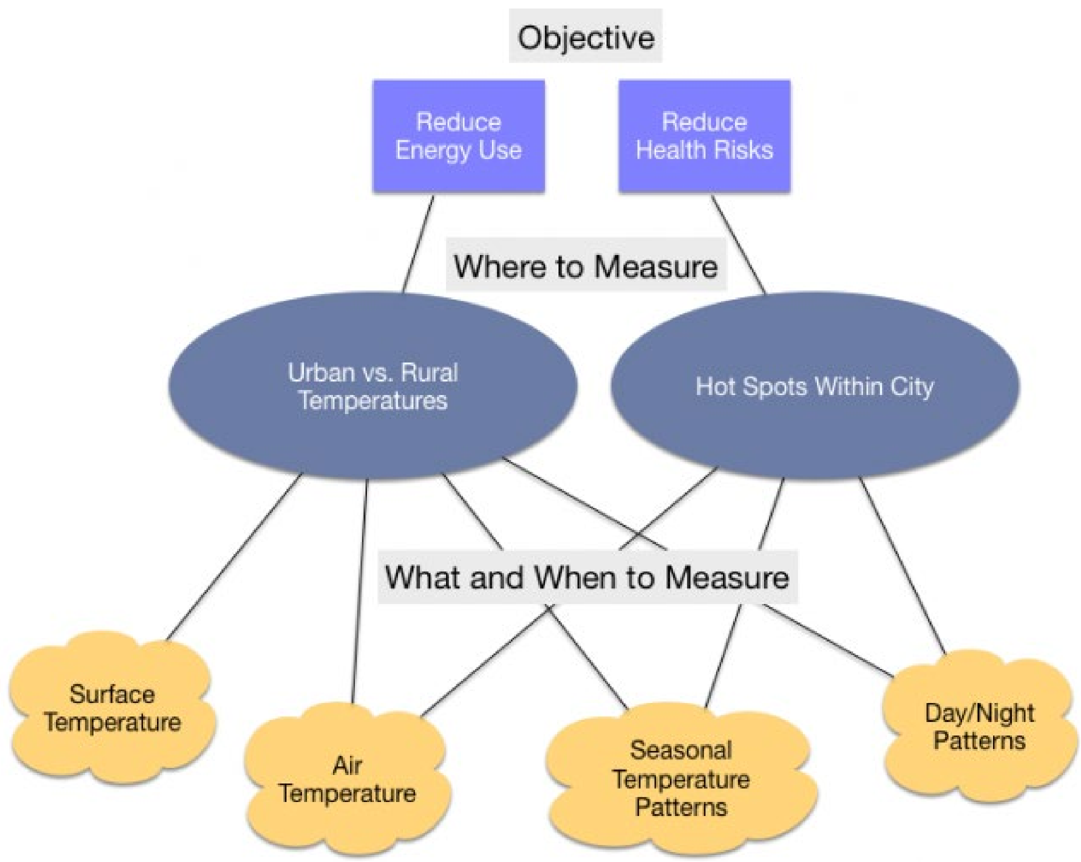
- The two most common reasons for conducting a heat island assessment are **reducing energy use** and **reducing health risk**
- **Identifying objectives** helps identify what data points should be gathered, and the approach to measuring these heat islands.

(Adapted from *Measuring Heat Islands* on the EPA website https://www.epa.gov/heatislands/measuring-heat-islands#identifying)

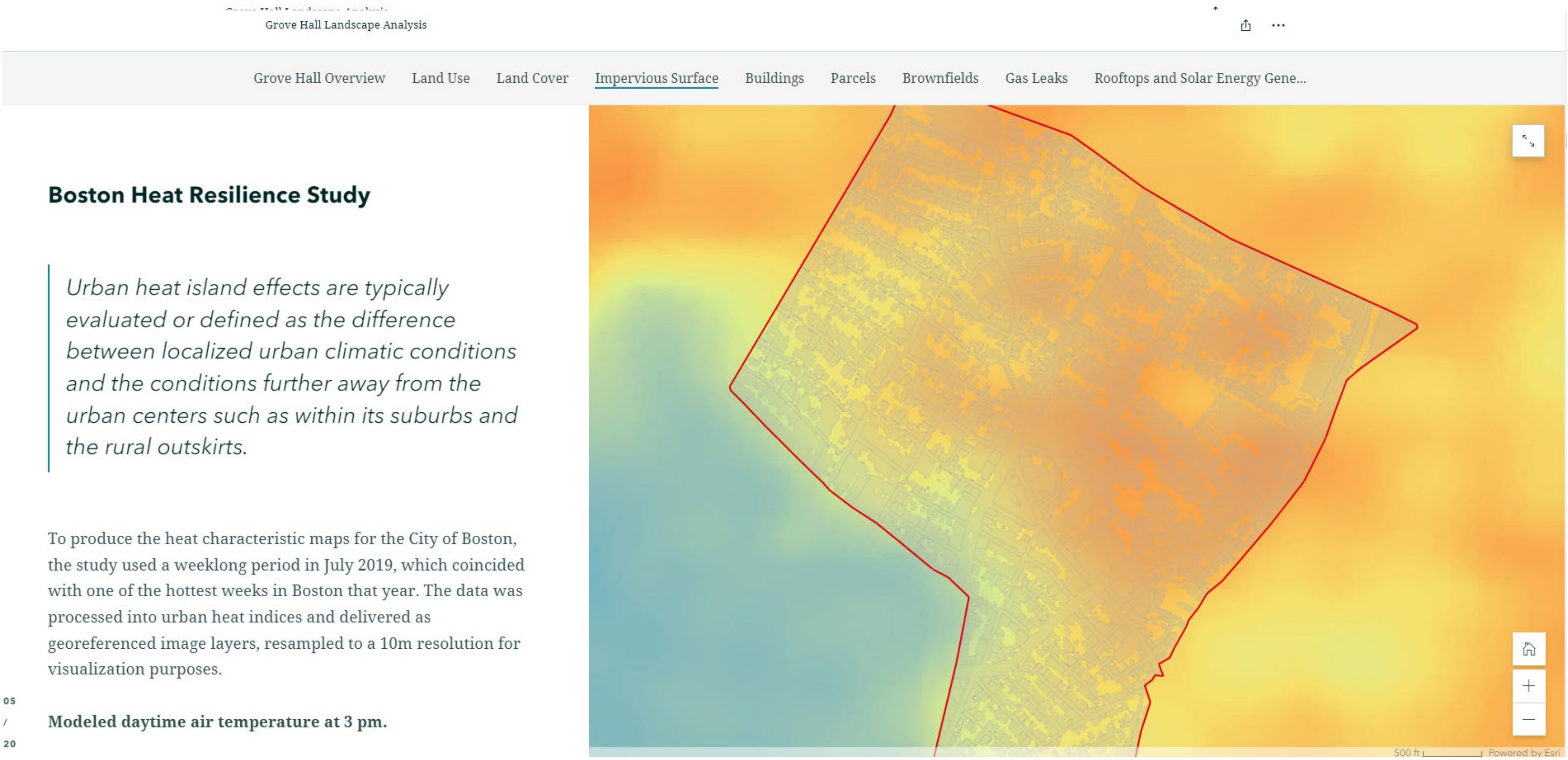
A.2 Identifying Data Needs

- **Geography**
  - Energy-related assessment involves comparing rural vs urban temperatures, while health-related assessment compares areas within the same city.
- **Types of temperature data**
  - Air temperatures are more useful for health-related impacts, as they more-so reflect the temperatures experienced by residents. These are collected via weather station networks
  - Surface temperatures are helpful for understanding heat energy given off on surfaces. They are often collected via satellite.
- **Fluctuations in seasons/days**
  - Account for the changes in temperature in the summer day, for example, versus nights.

(Adapted from *Measuring Heat Islands* on the EPA website https://www.epa.gov/heatislands/measuring-heat-islands#identifying)



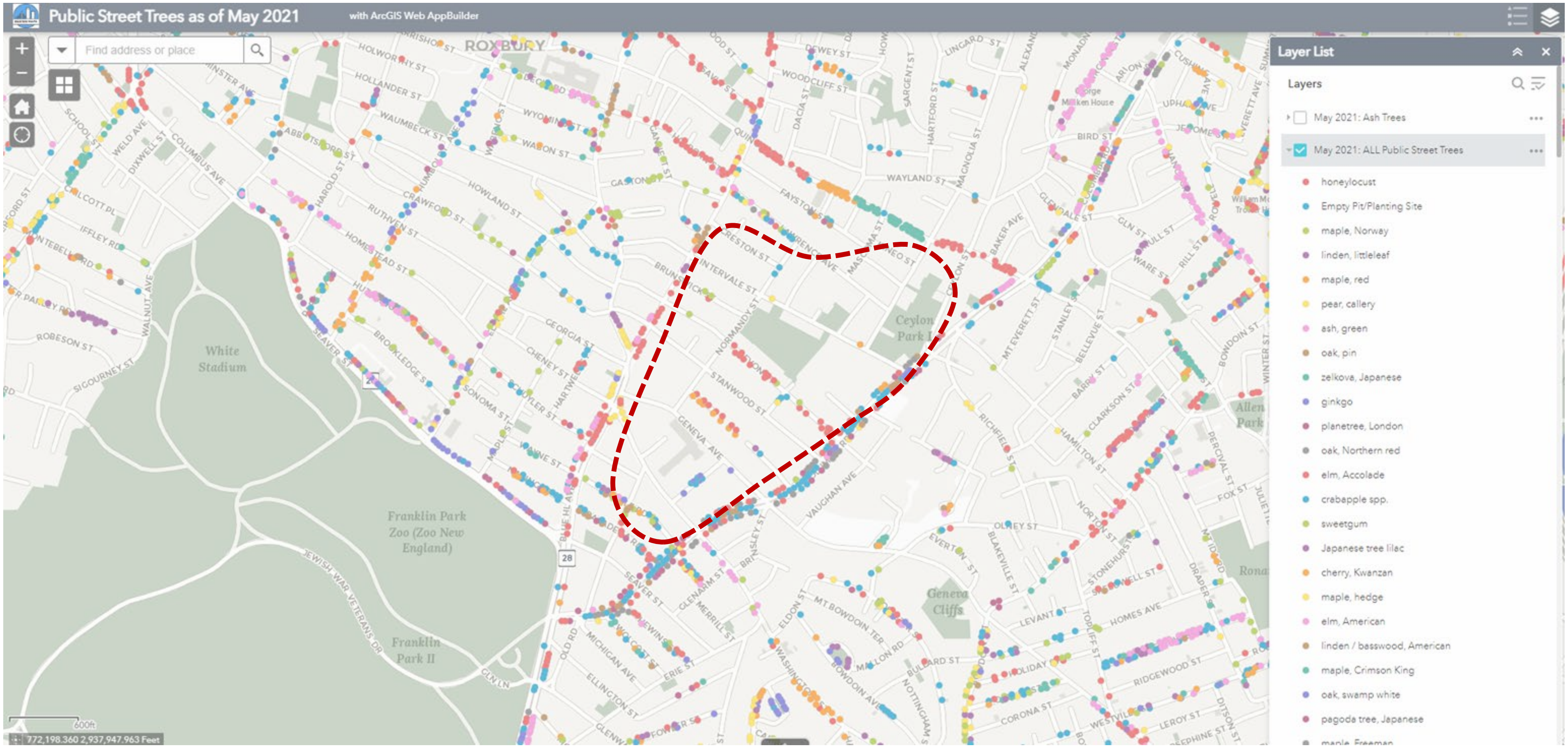
A simplified decision tree for selecting an approach to assessing a city's heat island
(From "*Measuring Heat Islands" on the EPA website)*



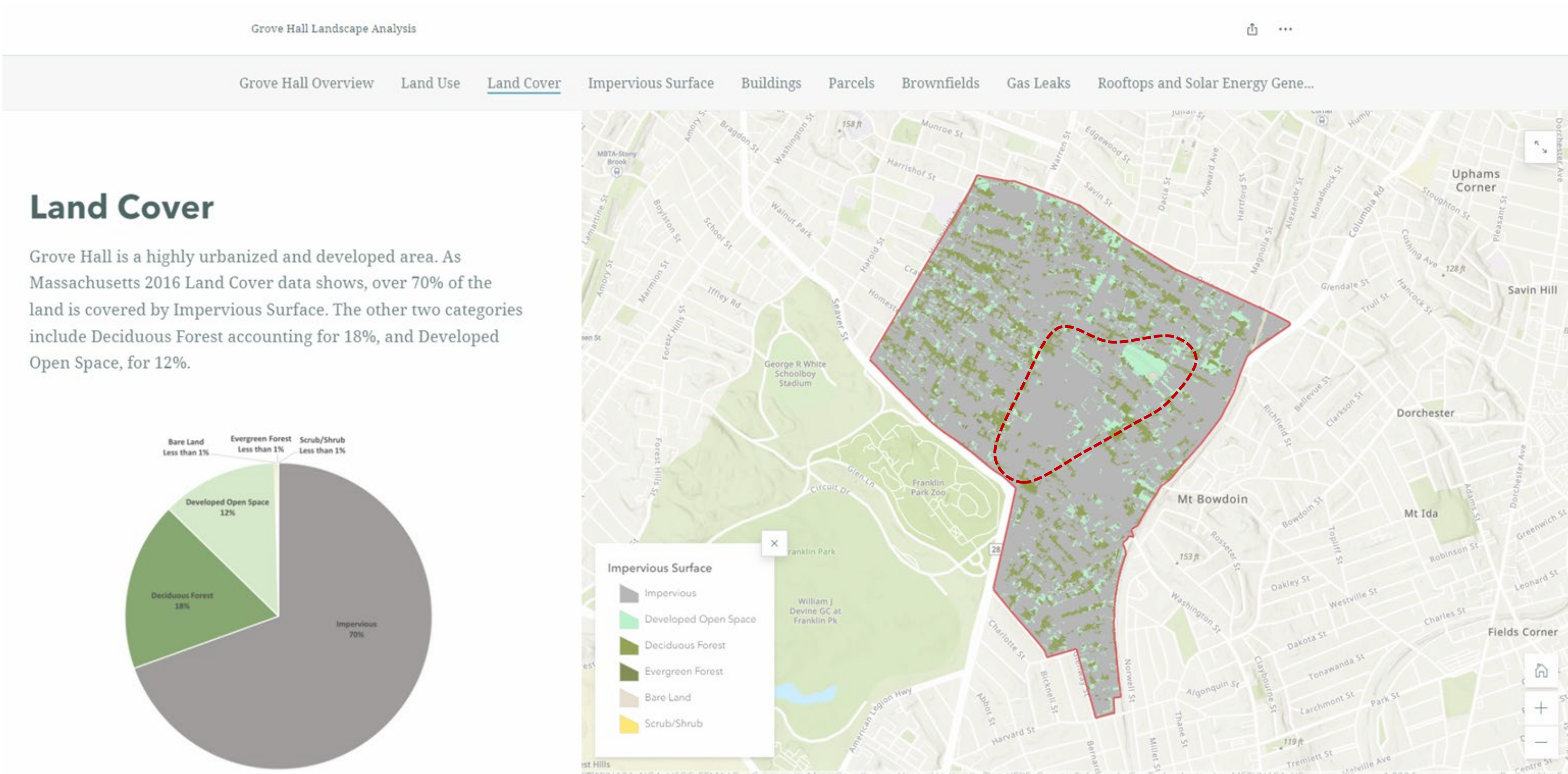
Daytime Air Temperature in Grove Hall, Boston, MA
(Source: Grove Hall Landscape Analysis, Anna Krzystyniak Sobiewska)

B. Determine Major Contributions to Urban Heat Island

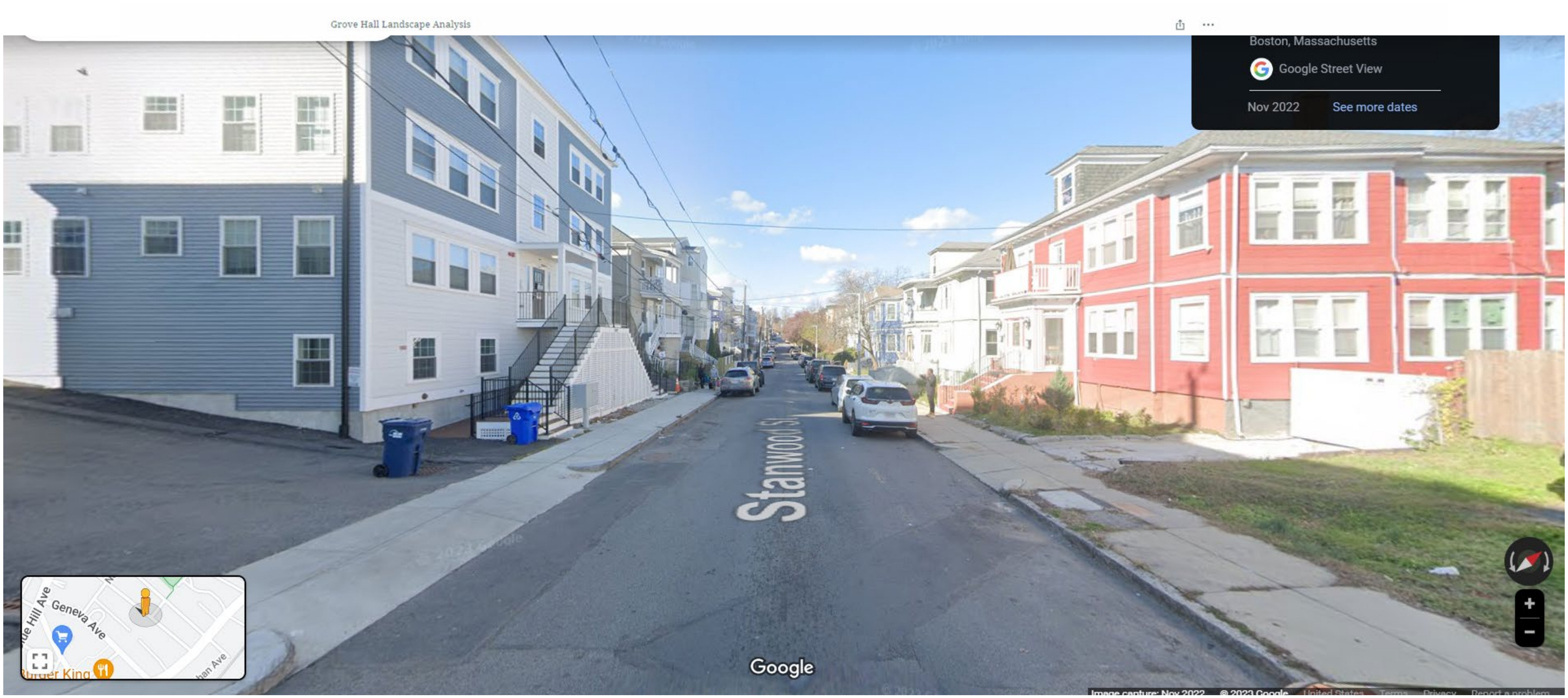
- Lack of Tree Canopy and/or Green Space: Areas with **little or no tree canopy or green space lack natural shade and cooling**, and thus have **higher urban heat island effect**
  - Using a municipal or state dataset on canopy coverage and open spaces can help identify areas of need
- Percent impervious: Areas and neighborhoods that are **highly impervious tend to hold and radiate heat,** which causes a **higher surface temperature and more intense heat island**
  - Many states and nation datasets include land cover or impervious surface datasets



Location of Street Trees in Grove Hall, Boston, MA
(Source: City of Boston GIS)



Land Cover GIS Data in Grove Hall, Boston, MA
(Source: Grove Hall Landscape Analysis, Anna Krzystyniak Sobiewska)



Street View on Stanwood St, Grove Hall, Boston, MA
(Source: Google Maps)

1.2 Identify Opportunities

Part of an Environmental Audit to determine the existing environmental hazards and opportunities for sustainability.

A. Identify and Inventory Existing Cooling Areas

- Begin with identifying areas and types of urban design that **already exist that contribute to cooling.**
  - **Existing tree canopy**, especially the canopy of legacy trees (achieved near-maximum size and age), **has a major impact on combatting urban heat island**
  - **Parks, green spaces, and public water features** often prevent heat island and reduce air temperature by several degrees
  - **Cooling centers, air-conditioned buildings, and shaded seating** are also critical to inventory
- Key evaluating questions include:
  - How can the resources that already exist to combat urban heat island be **expanded or protected**?
  - Are there **potential corridors or networks** that could be implemented **between existing cooler areas**?

Grove Hall Landscape Analysis

Grove Hall Overview | Land Use | Land Cover | Impervious Surface | Buildings | Parcels | Brownfields | Gas Leaks | Rooftops and Solar Energy Gene...

Boston Heat Resilience Study

> *Urban heat island effects are typically evaluated or defined as the difference between localized urban climatic conditions and the conditions further away from the urban centers such as within its suburbs and the rural outskirts.*

To produce the heat characteristic maps for the City of Boston, the study used a weeklong period in July 2019, which coincided with one of the hottest weeks in Boston that year. The data was processed into urban heat indices and delivered as georeferenced image layers, resampled to a 10m resolution for visualization purposes.

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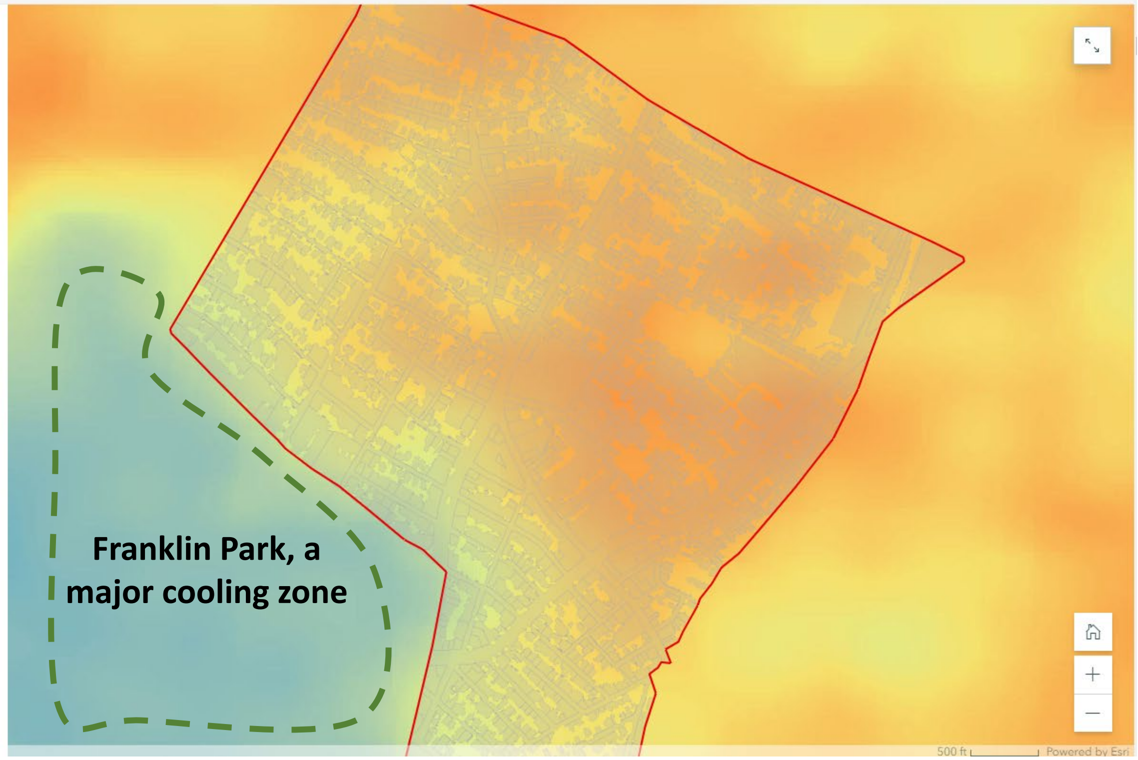
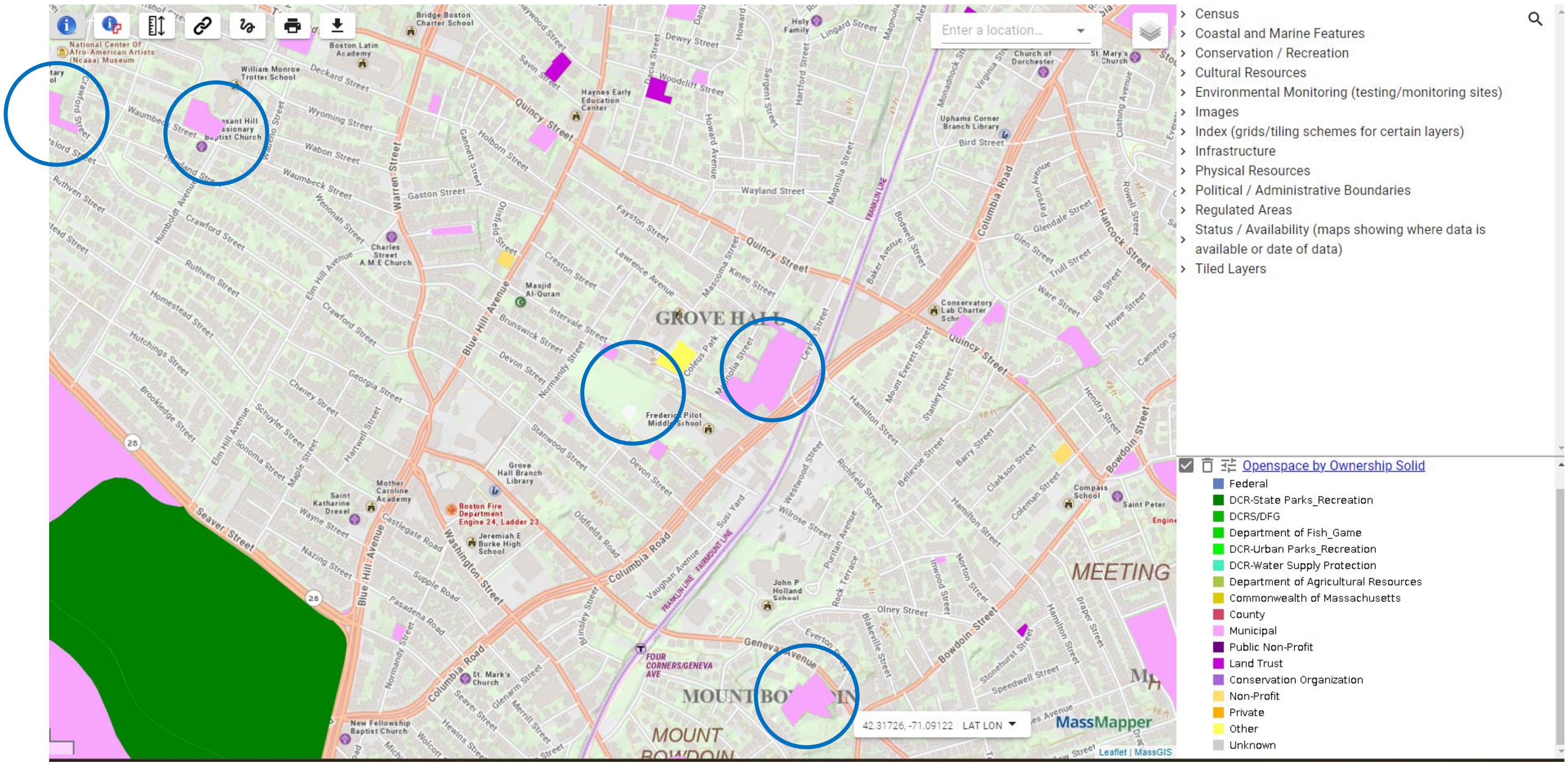
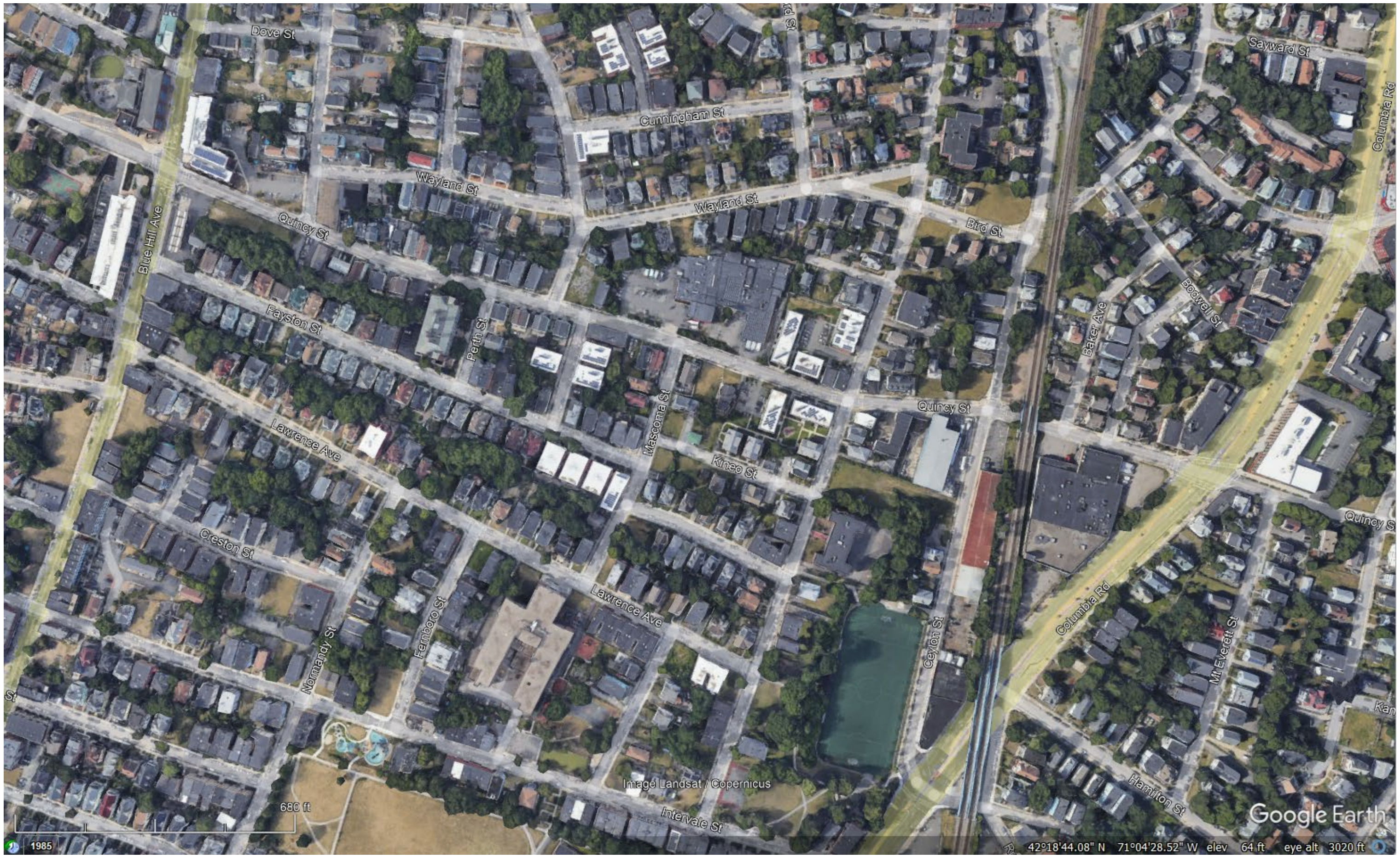
Modeled daytime air temperature at 3 pm.



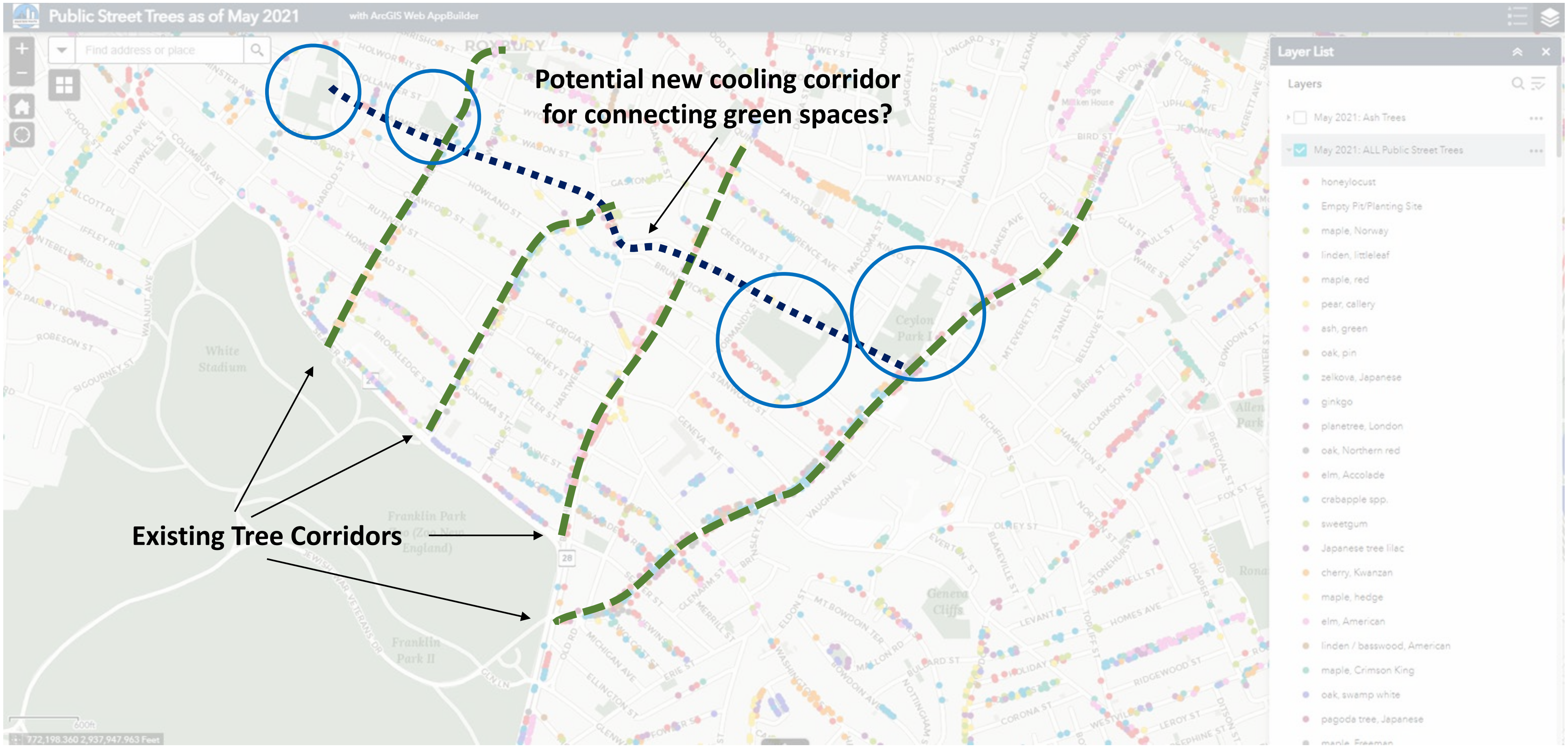
Daytime Air Temperature in Grove Hall, Boston, MA
(Source: Grove Hall Landscape Analysis, Anna Krzystyniak Sobiewska)



Open Spaces in Grove Hall, Boston, MA
(Source: MassGIS Data)



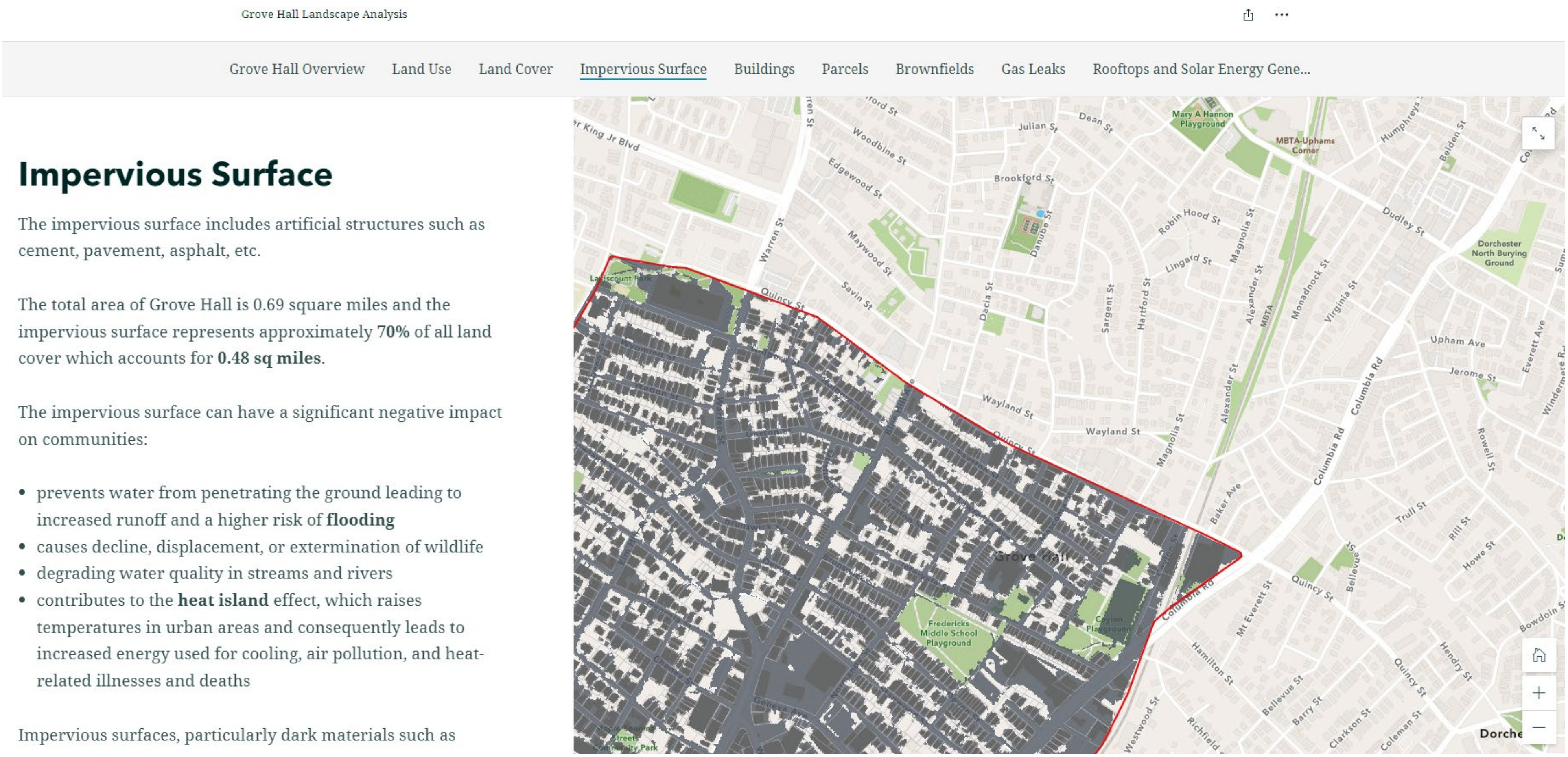
Aerial Imagery Revealing Pervious Surfaces, Grove Hall, Boston, MA
(Source: Google Earth)



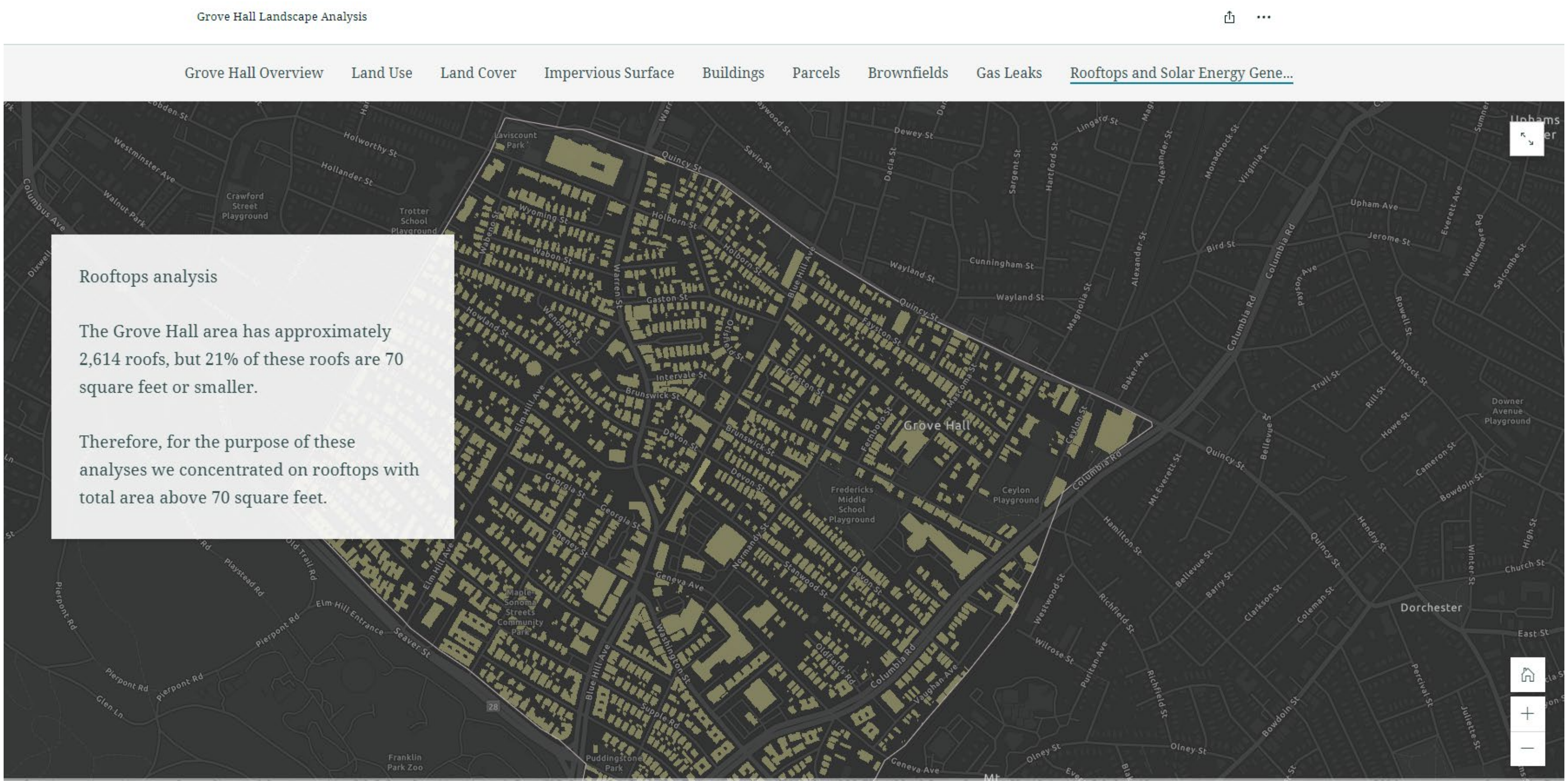
Location of Street Trees in Grove Hall, Boston, MA
(Source: City of Boston GIS)

B. Identify and Inventory Potential Impervious Implementation Sites

- **Larger, impervious surfaces** are ideal places to implement cooling strategies, because they are often major contributors to urban heat island
- Examples of impervious areas that can implement cooling strategies include:
  - Parking lots
  - Roofs
  - Major streets
  - Vacant lots
  - Large, vertical building faces
- Note the following for each impervious site:
  - Site use and size
  - If it is at street level or not
  - Aspect (which direction is it facing in relation to north)
  - Materials (e.g. concrete, granite, stone) and color (light or dark)
  - Slope and weight-bearing capacity (if a roof)



Impervious Surface Cover in Grove Hall, Boston, MA
(Source: Grove Hall Landscape Analysis, Anna Krzystyniak Sobiewska)



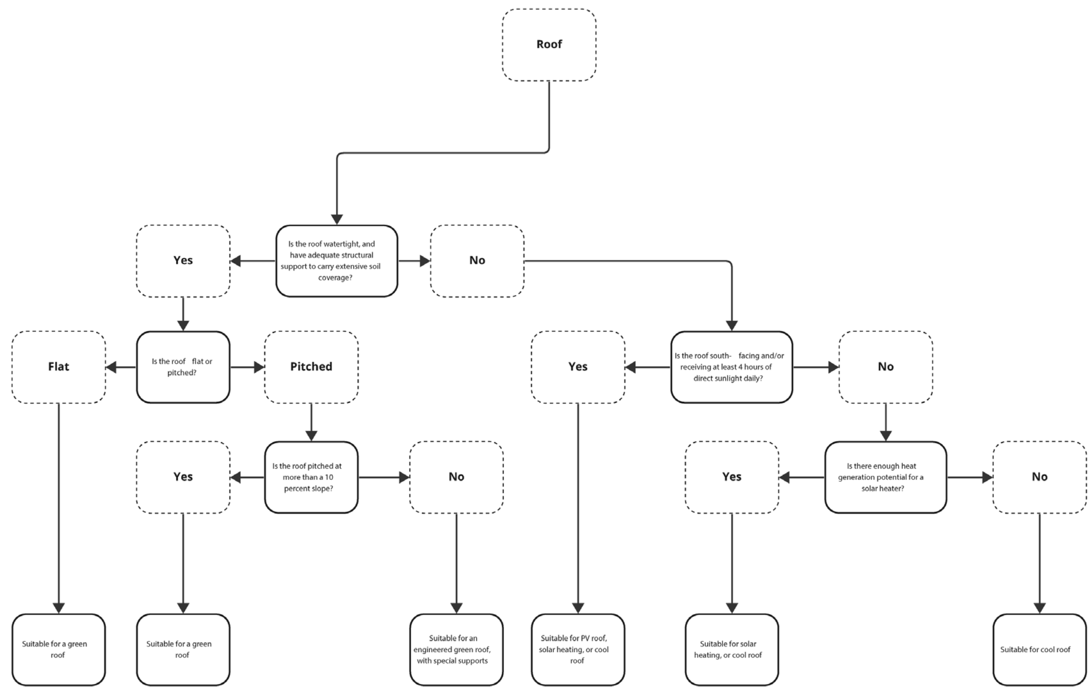
Building Footprints in Grove Hall, Boston, MA
(Source: Grove Hall Landscape Analysis, Anna Krzystyniak Sobiewska)

2 Site Feasibility Evaluation

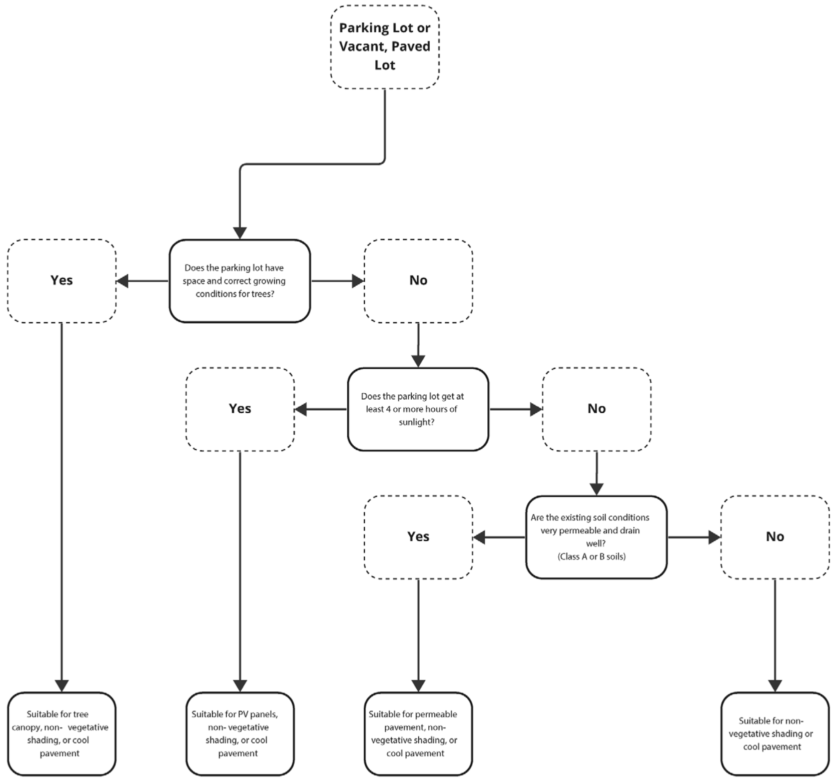
Feasibility Studies

A. Evaluate Feasibility of Site for Intervention

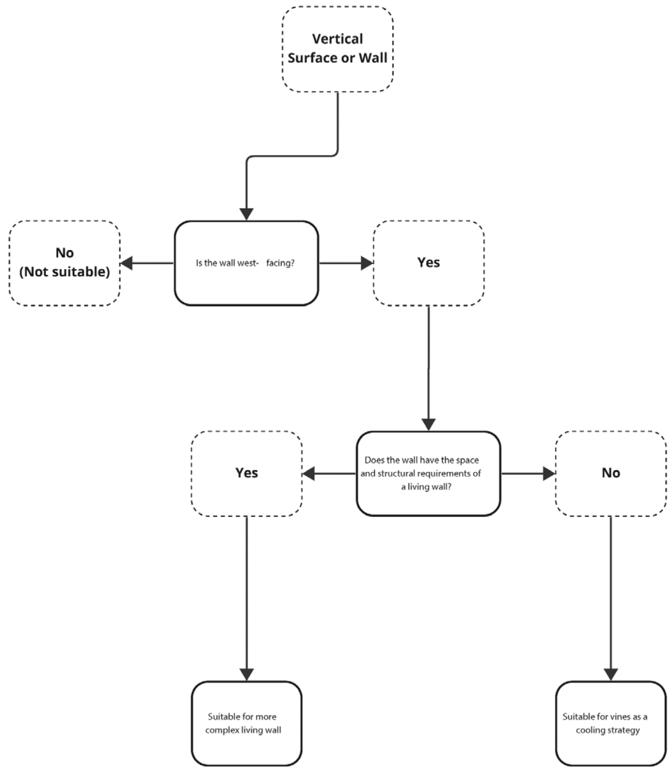
- All sites that are inventoried should be reviewed for feasibility, and for their potential for mitigating urban heat island
- Many sites may have multiple potential design interventions. In these situations, priorities and community preferences should be evaluated



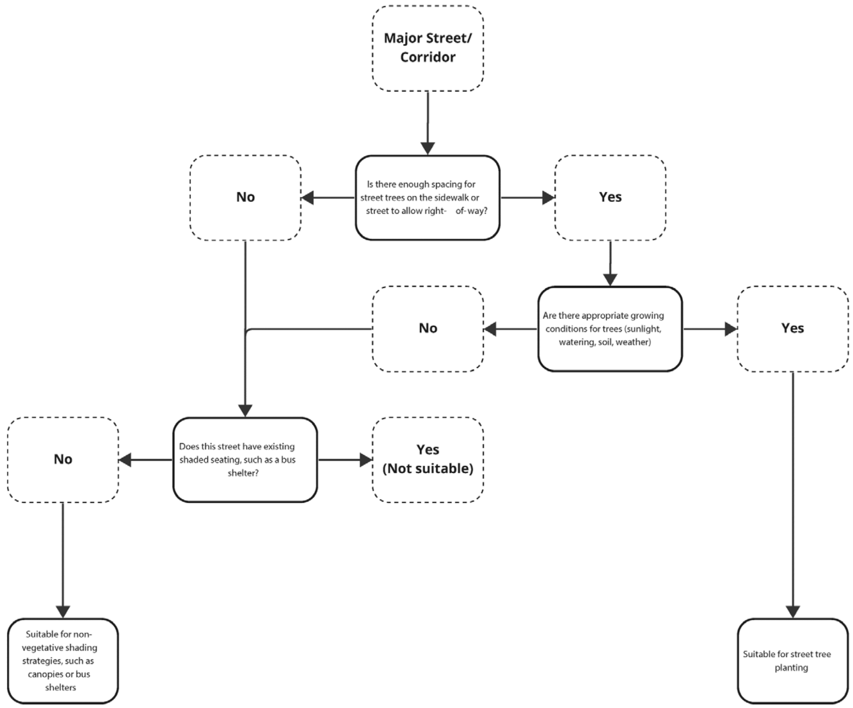
Flowchart for Evaluating Rooftop Heat Island Interventions



Flowchart for Evaluating Parking Lot Heat Island Interventions



Flowchart for Evaluating Building Wall Heat Island Interventions



Flowchart for Evaluating Major Street Heat Island Interventions

B. Use a scoring matrix to determine which projects to implement

- Use criterion such as:
  - Environmental impact,
  - Ease of implementation,
  - Governance,
  - Cost,
  - Funding potential,
  - Community ranking,
  - Environmental metrics such as clean energy generation, decarbonization, stormwater management, and heat island mitigation.

IV. Solution Evaluation Matrix

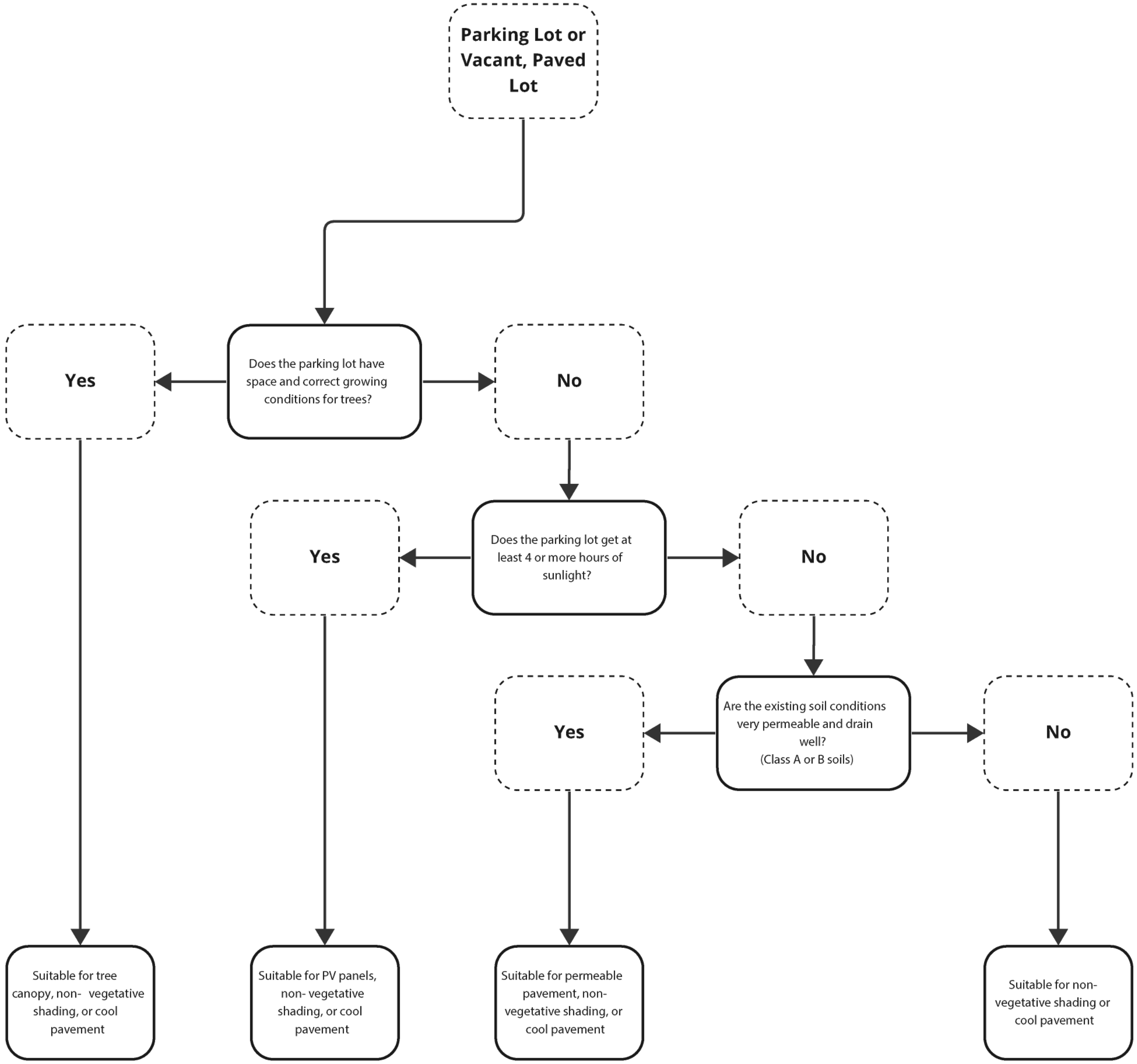
Intervention or Solution	Positive environmental impact 1 = least 5 = most	Ease of implementation 1 = difficult 5 = easiest	Governance 1 = least agency 5 = most agency	Cost 1 = high cost 5 = low cost	Funding potential 1 = least 5 = most	Ability to advance justice 1 = least impact 5 = most impact	Workplace development or entrepreneurship oppertunities 1 = least 5 = most	Community ranking 1 = lowest 5 = highest	Total Score
Site 1	*4*	*3*	*1*	*4*	*4*	*2*	*3*	*4*	***25***
Site 2	*5*	*2*	*3*	*2*	*4*	*3*	*4*	*3*	***26***
Site 3	*3*	*5*	*4*	*4*	*3*	*2*	*3*	*2*	***26***
Site 4	*5*	*4*	*4*	*3*	*5*	*4*	*3*	*5*	***33***
Site 5	*2*	*4*	*3*	*2*	*2*	*5*	*2*	*3*	***23***

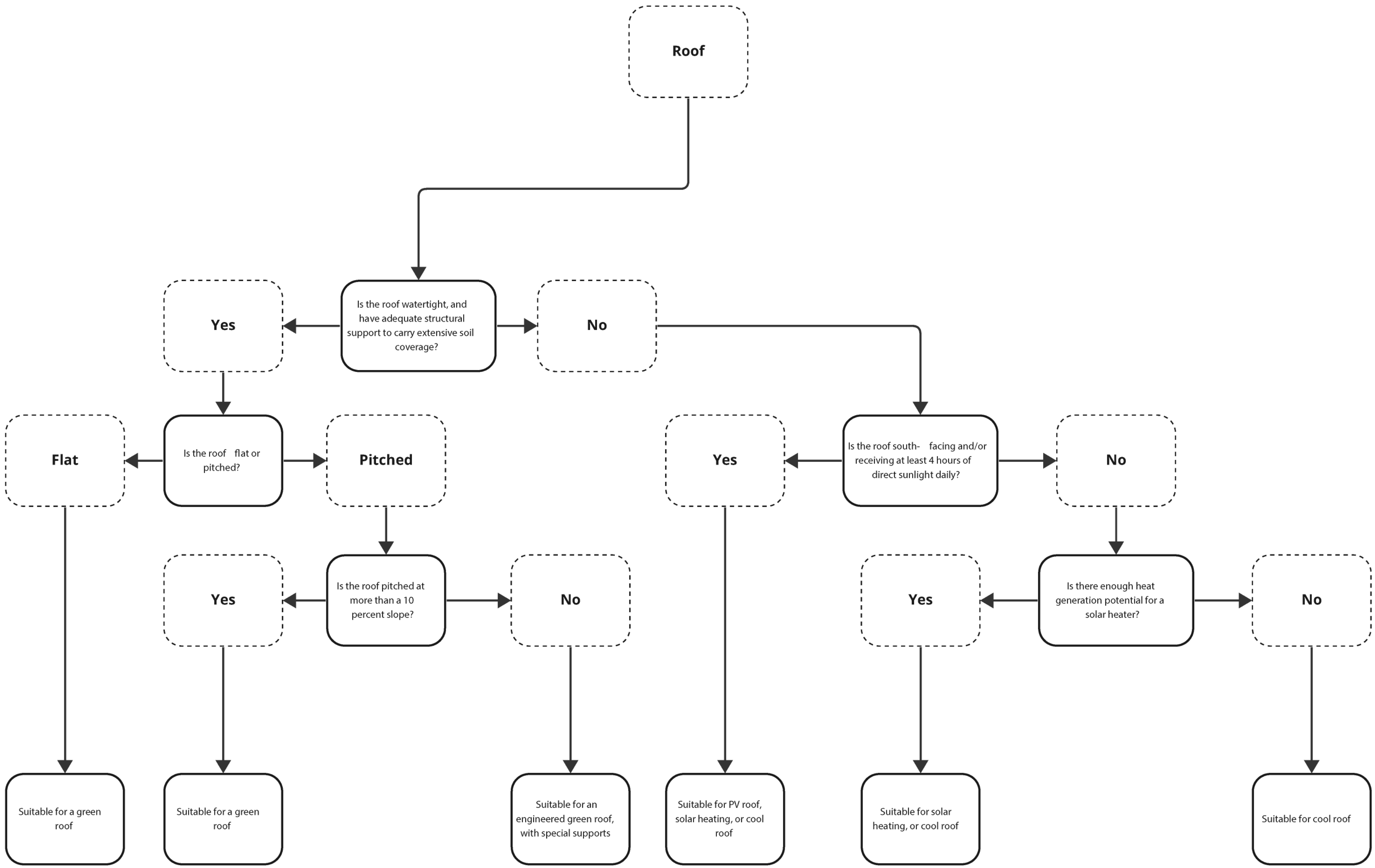
Scoring Matrix for Potential Interventions

References

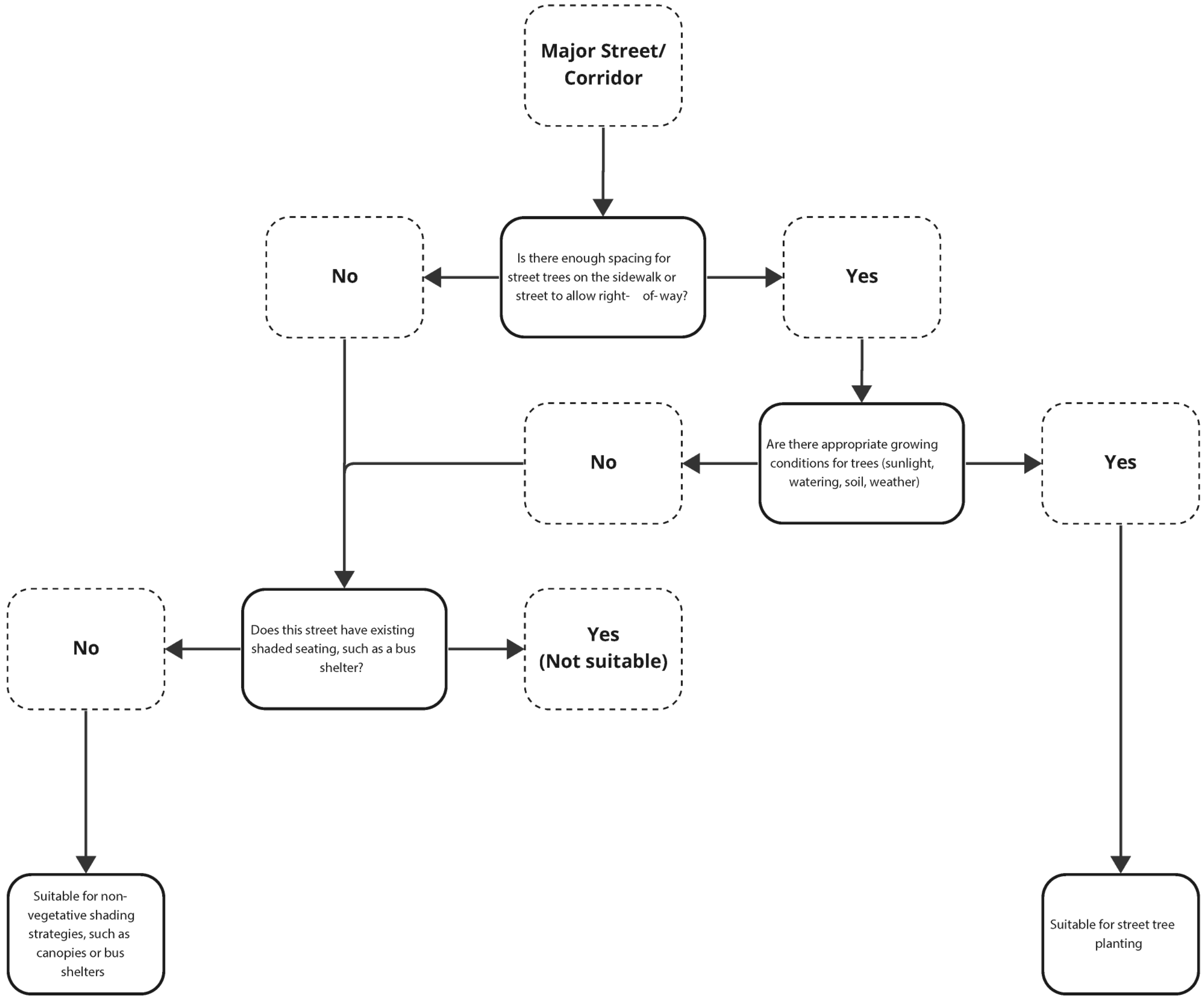
Krzystyniak Sobiewska, A. (2023, February 12). Grove Hall Landscape Analysis. *Grove Hall Landscape Analysis*. https://storymaps.arcgis.com/stories/a391ab26379641babc66f7e76c61bff9

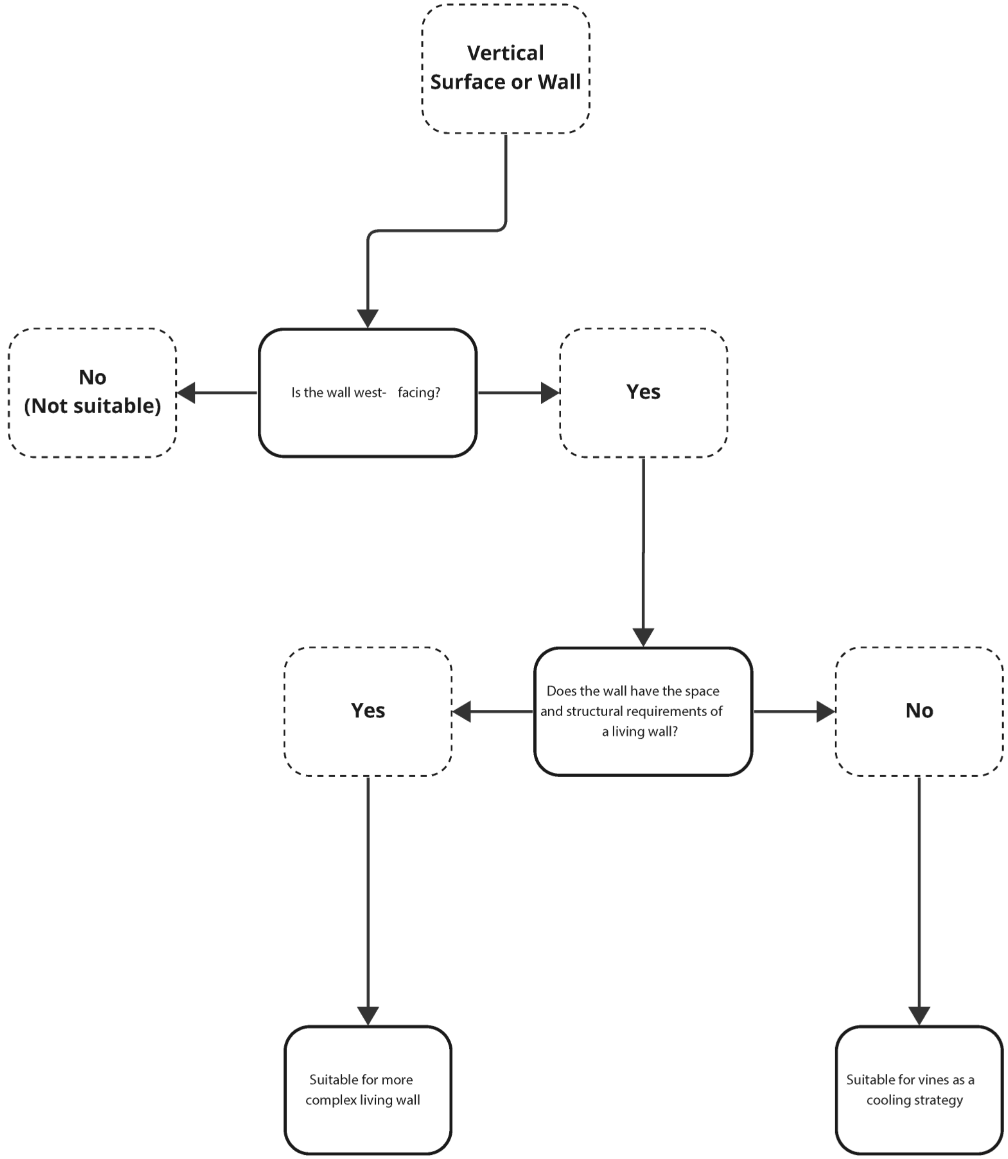
U.S. Environmental Protection Agency. (2023, August 1). Measuring Heat Islands. *Heat Islands*. https://www.epa.gov/heatislands/measuring-heat-islands#identifying


Parking Lot or Vacant, Paved Lot
Does the parking lot have space and correct growing conditions for trees?
Yes
No
Does the parking lot get at least 4 or more hours of sunlight?
Yes
No
Are the existing soil conditions very permeable and drain well? (Class A or B soils)
Yes
No
Suitable for tree canopy, non- vegetative shading, or cool pavement
Suitable for PV panels, non- vegetative shading, or cool pavement
Suitable for permeable pavement, non-vegetative shading, or cool pavement
Suitable for non-vegetative shading or cool pavement



Roof
Is the roof watertight, and have adequate structural support to carry extensive soil coverage?
Yes
No
Is the roof flat or pitched?
Flat
Pitched
Is the roof pitched at more than a 10 percent slope?
Yes
No
Suitable for a green roof
Suitable for a green roof
Suitable for an engineered green roof, with special supports
Is the roof south- facing and/or receiving at least 4 hours of direct sunlight daily?
Yes
No
Suitable for PV roof, solar heating, or cool roof
Is there enough heat generation potential for a solar heater?
Yes
No
Suitable for solar heating, or cool roof
Suitable for cool roof


Major Street/ Corridor
Is there enough spacing for street trees on the sidewalk or street to allow right- of- way?
No
Yes
Are there appropriate growing conditions for trees (sunlight, watering, soil, weather)
No
Yes
Does this street have existing shaded seating, such as a bus shelter?
No
Yes (Not suitable)
Suitable for non-vegetative shading strategies, such as canopies or bus shelters
Suitable for street tree planting



Vertical Surface or Wall
Is the wall west- facing?
No (Not suitable)
Yes
Does the wall have the space and structural requirements of a living wall?
Yes
No
Suitable for more complex living wall
Suitable for vines as a cooling strategy

A Methodology for Assessing Solar and Wind Power Generation Potential, and Project Implementation Sites

Chadwick Bowlin
Greater Grove Hall Main Streets

(In progress, 8/7/23)

1.2 Identify Opportunities

Part of an Environmental Audit to determine the existing environmental hazards and opportunities for sustainability.

A. Determine if Solar and Wind Energy Should be Prioritized

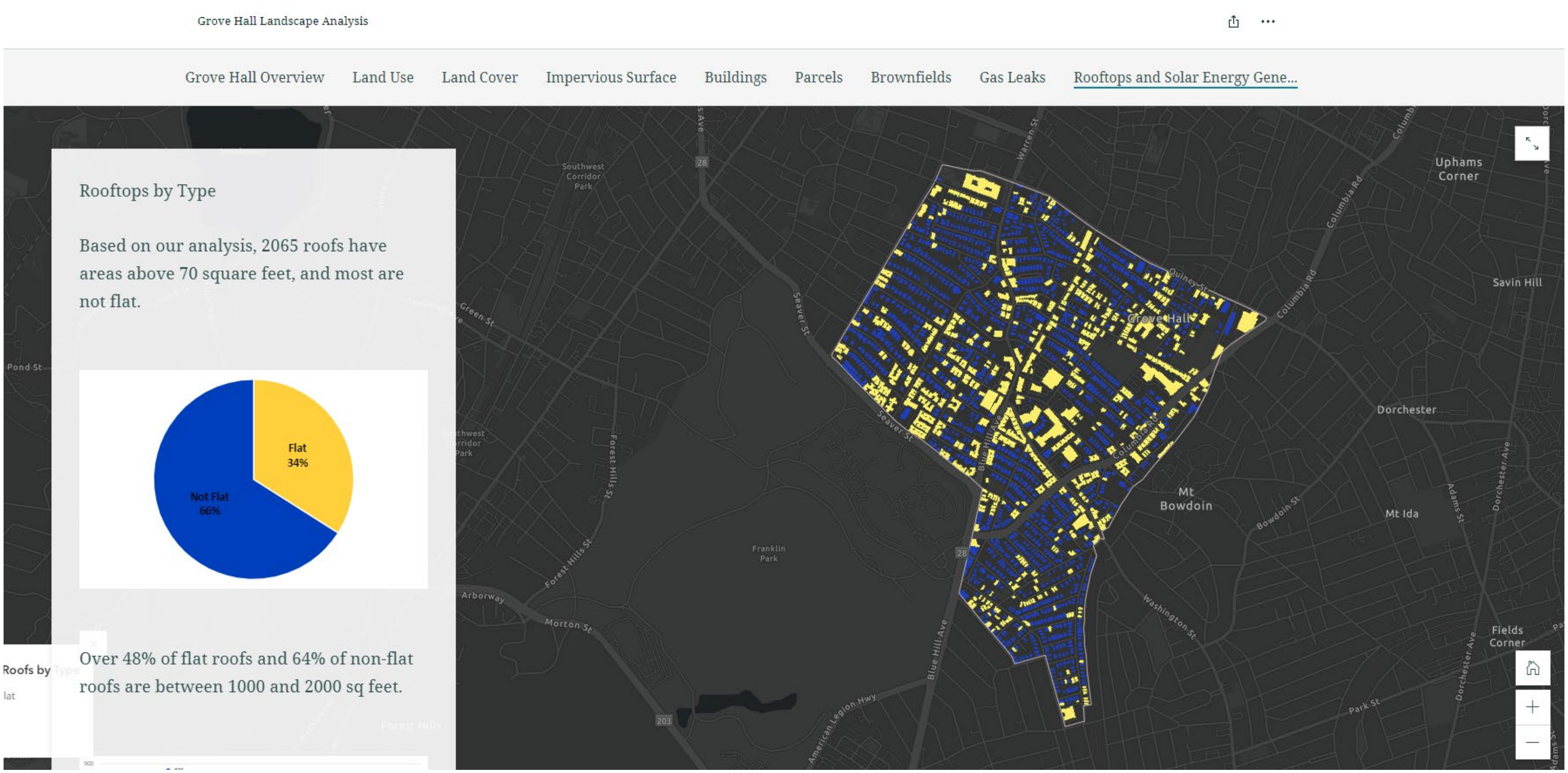
- Solar panels, solar heating, and wind turbines, like all interventions, may create a trade-off between other green development interventions. Additionally, not all jurisdictions allow installation of solar or wind energy technologies.
- Considerations for solar energy may include:
  - Are there better uses of space for places where solar can be implemented? (e.g. green roofs, bioswales)
  - What other energy sources can be used during the night, winter, or cloudier days?
  - Are there zoning laws and regulations preventing solar energy generation?
- Considerations for wind energy may include:
  - Is there an environmental cost to the use of wind turbines in this area?
  - What other energy sources can be used during times with less or no wind?
  - Are there zoning laws and regulations against urban wind turbine installation?

B. Evaluate Solar and Wind Energy Feasibility Through Data Analysis

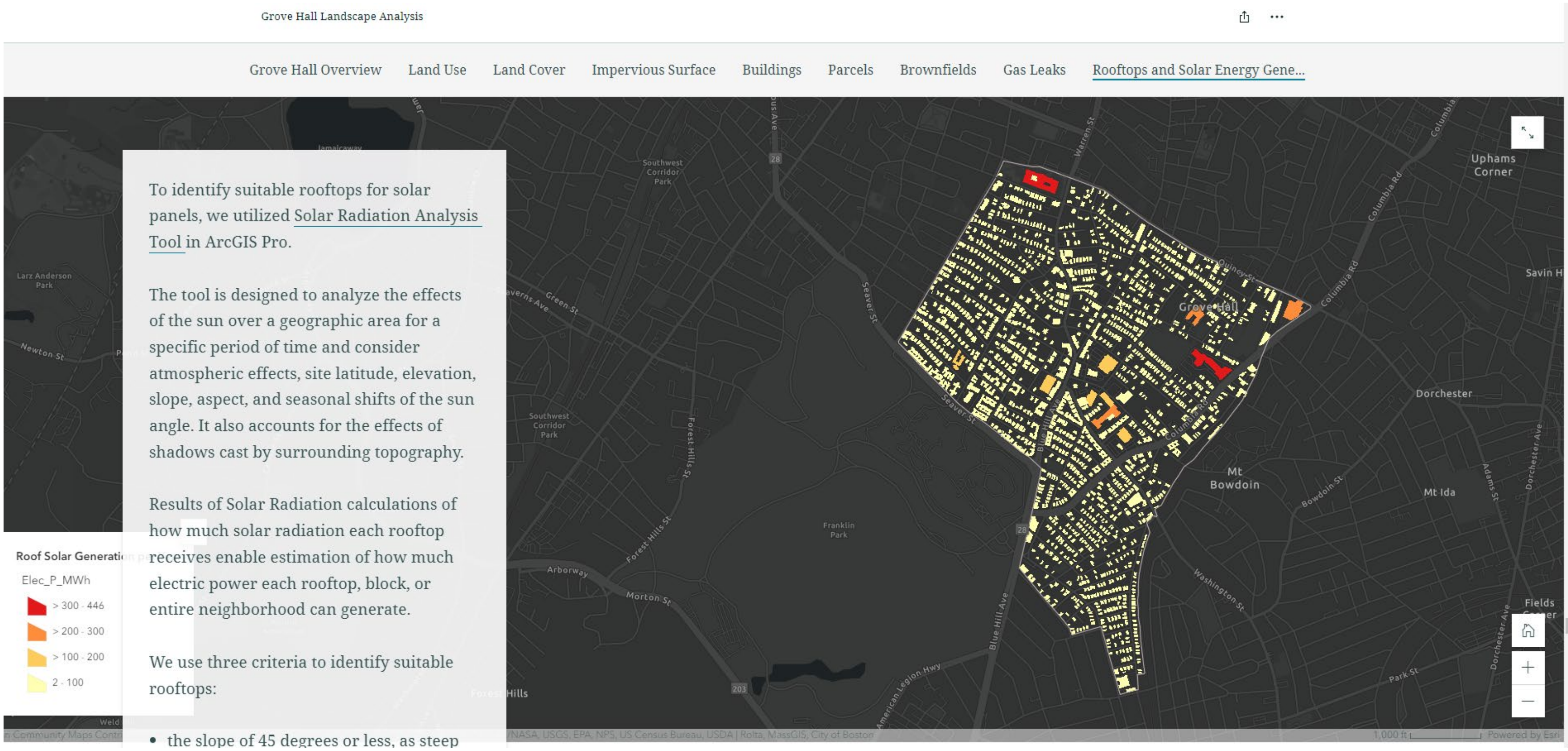
- If photovoltaic panels (solar panels) are the desire option, consider the following workflow using a GIS Software*:
  1. **Roof Analysis****: Analyze the direction, size, and number of floors of the buildings in the area of interest.
     - Buildings that are optimal for rooftop solar are not oriented north, have a roof with a 45-degree angle or less, and have ample space for panels
  2. **Solar Radiation Analysis**: Run the Solar Radiation Analysis Tool in ArcGIS, to determine how much energy can be generated on the buildings
     - Consider factors such as the energy demand of buildings and how much solar energy is converted to electricity
  3. **Feasibility:** Through process of elimination, create a list of optimal sites and their solar energy potential

* Adopted from "Grove Hall Landscape Analysis" by Anna Krzystyniak Sobiewska

** Other potential sites, such as parking lots, can also be analyzed for feasibility



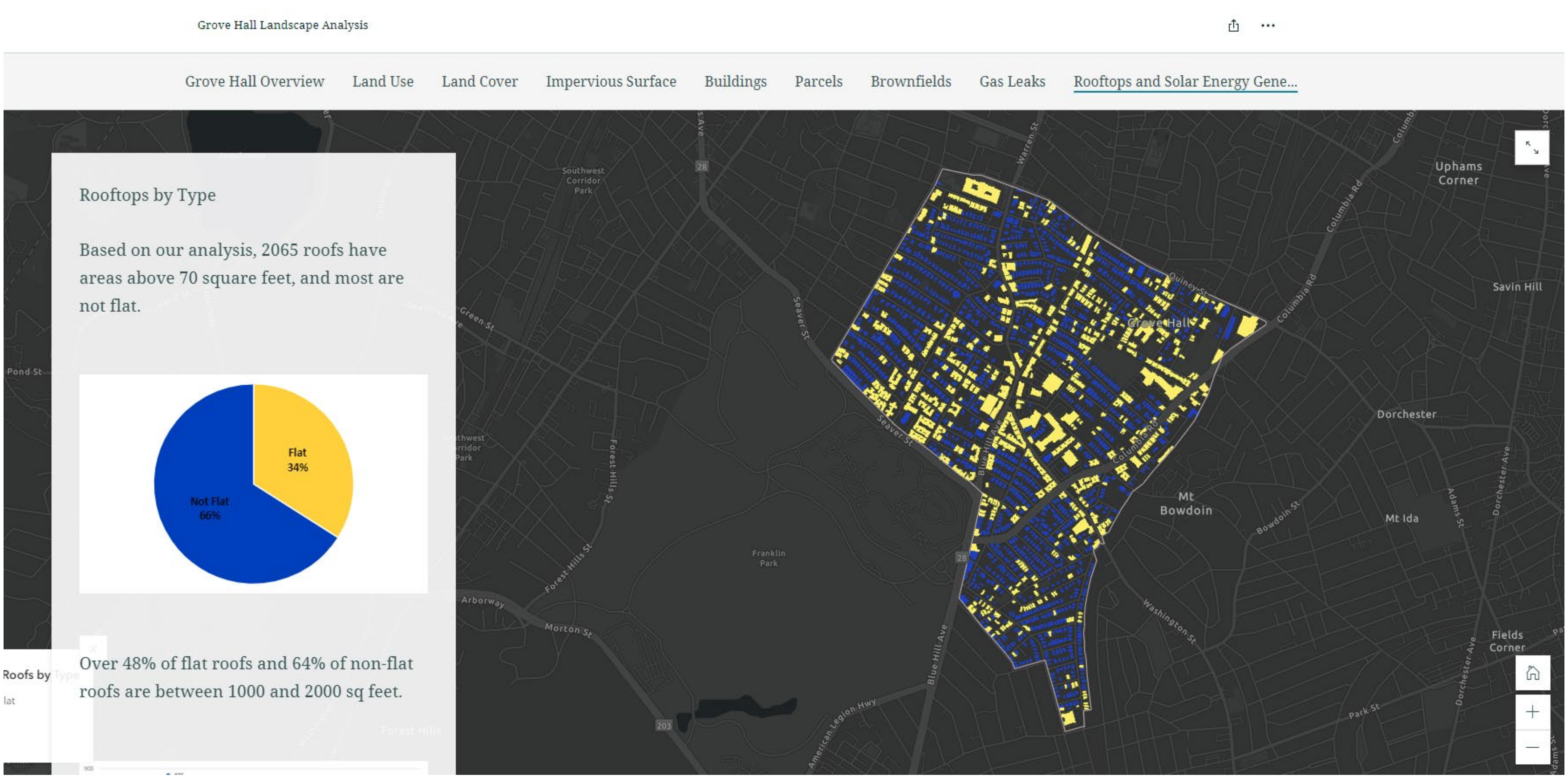
Roof Analysis in Grove Hall, Boston, MA
(Source: Grove Hall Landscape Analysis, Anna Krzystyniak Sobiewska)



Solar Radiation Analysis in Grove Hall, Boston, MA
(Source: Grove Hall Landscape Analysis, Anna Krzystyniak Sobiewska)

B. Evaluate Solar and Wind Energy Feasibility Through Data Analysis (Cont.)

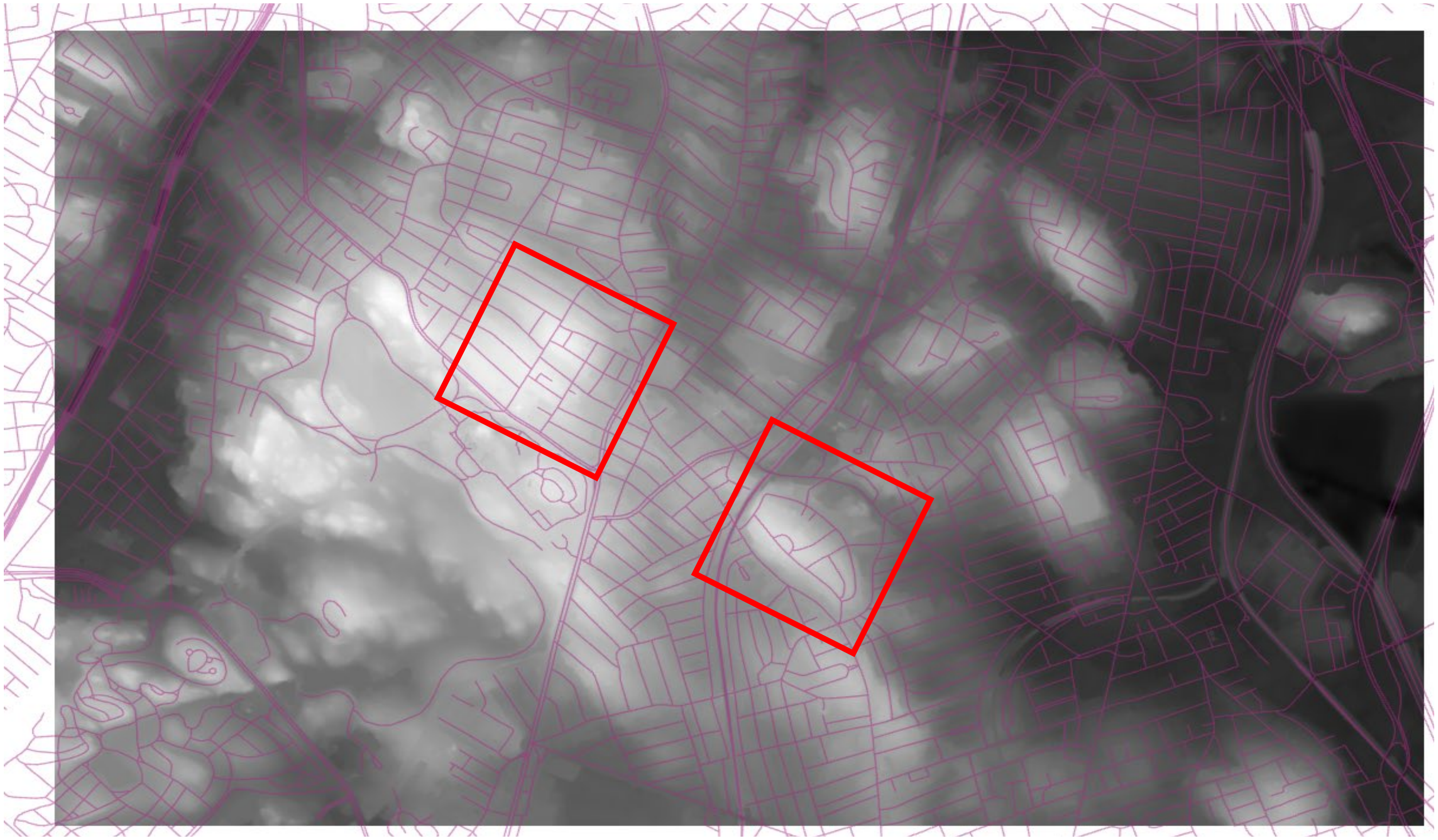
- Solar water heating requires less sun than a photovoltaic panel but requires roofs with more weight bearing capacity. Consider the following workflow to determine potential sites:
  1. **Roof Analysis**: Analyze the direction, size, and number of floors of the buildings in the area of interest.
     - Buildings that are optimal for rooftop solar are not oriented north, have a roof with a 45-degree angle or less, and have weight-bearing and space capacity for water heaters
  2. **Feasibility:** Through process of elimination, create a list of optimal sites and their solar heating potential



Roof Analysis in Grove Hall, Boston, MA
(Source: Grove Hall Landscape Analysis, Anna Krzystyniak Sobiewska)

B. Evaluate Solar and Wind Energy Feasibility Through Data Analysis (Cont.)

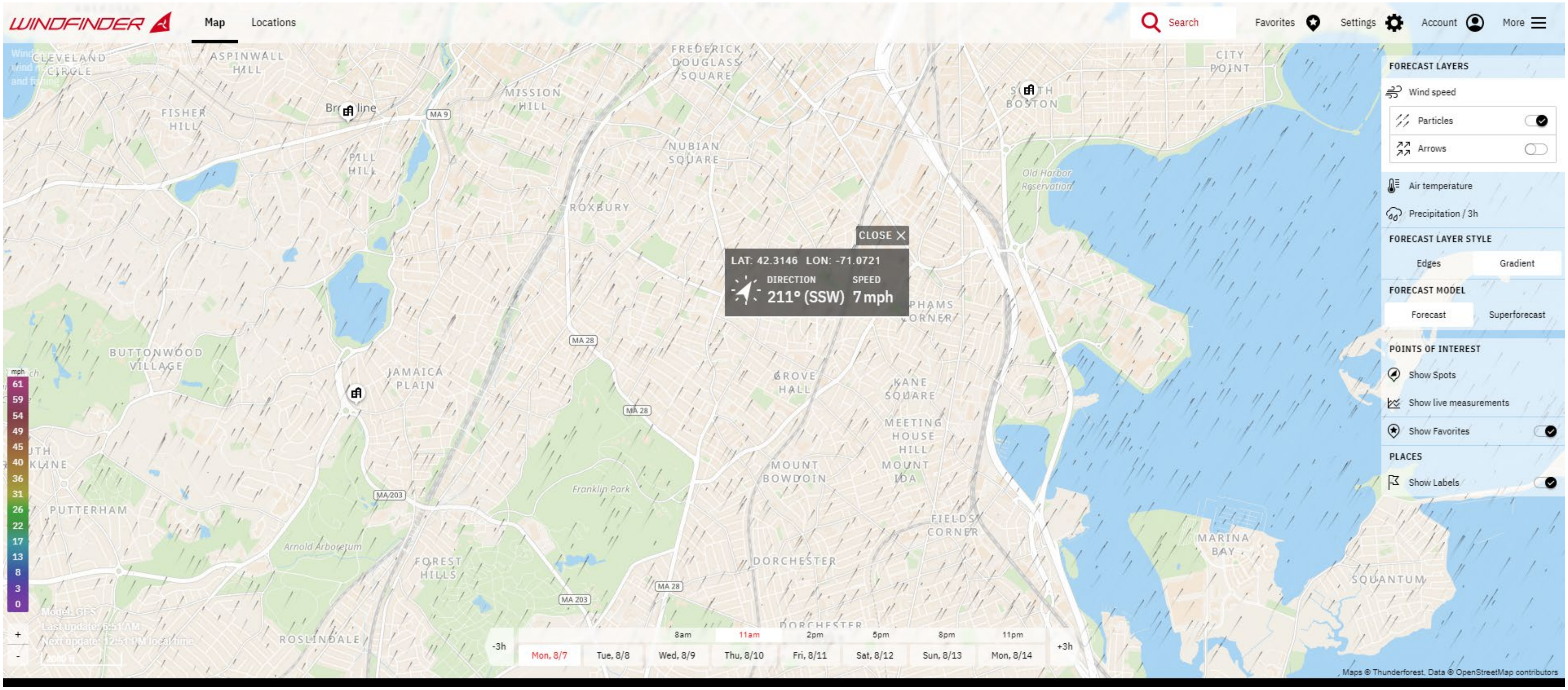
- Wind turbines can also be used for energy generation, and often require less horizontal space. The following workflow might be used to determine sites for wind turbines:
  1. **Spatial and Topographic Feasibility Analysis:** Wind turbines should be located **upwind of any buildings or other obstructions**, and **at least 30 feet above any object within 300 feet.** Additionally, they work best at the **highest points** in a neighborhood.
  2. **Wind Speed and Direction Analysis:** Wind speeds **of at least 9 mph** are required for small turbines. **Historic wind speed and direction data** from local weather monitoring stations can provide useful data on wind speed and direction trends.
  3. **Feasibility:** Through process of elimination, create a list of optimal sites and their wind energy potential
     - Consider factors such as the energy demand of buildings, and the feasible maximum size of turbines



Digital Elevation Model and Street Lines of Grove Hall, Boston, MA

(Dark grey represent lower elevation, and lighter greys represent higher elevation)

(Source: MassGIS)



Wind Speed and Direction at 11am in Grove Hall, Boston, MA
(Source: Windfinder.com)

2 Site Feasibility Evaluation

Feasibility Studies

A. Evaluate Feasibility of Site for Intervention

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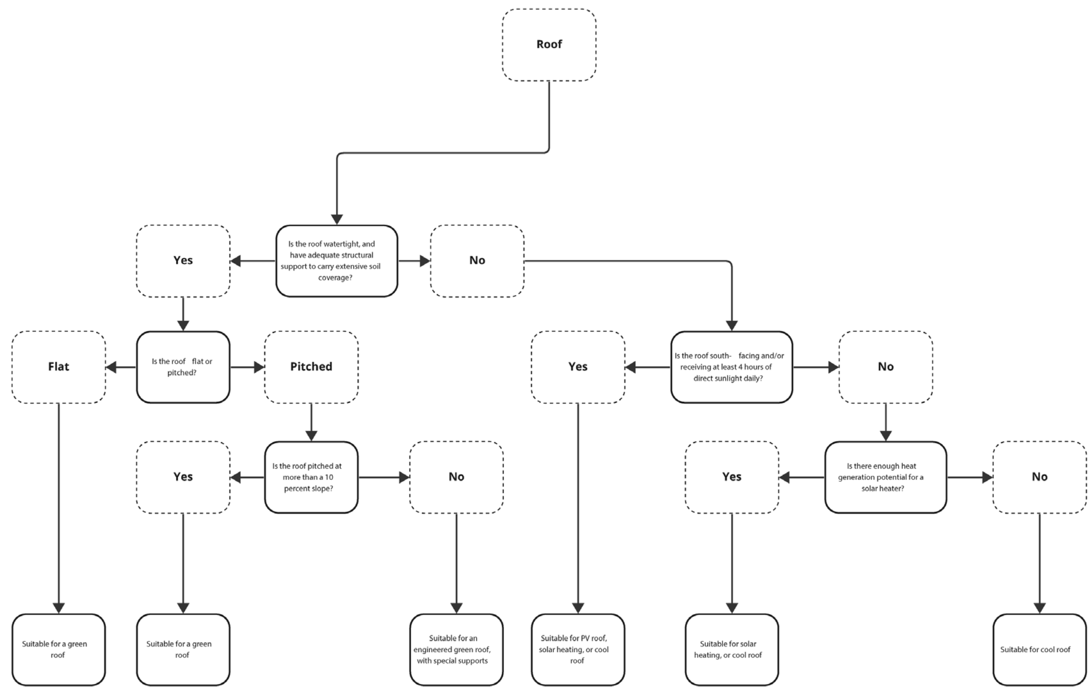
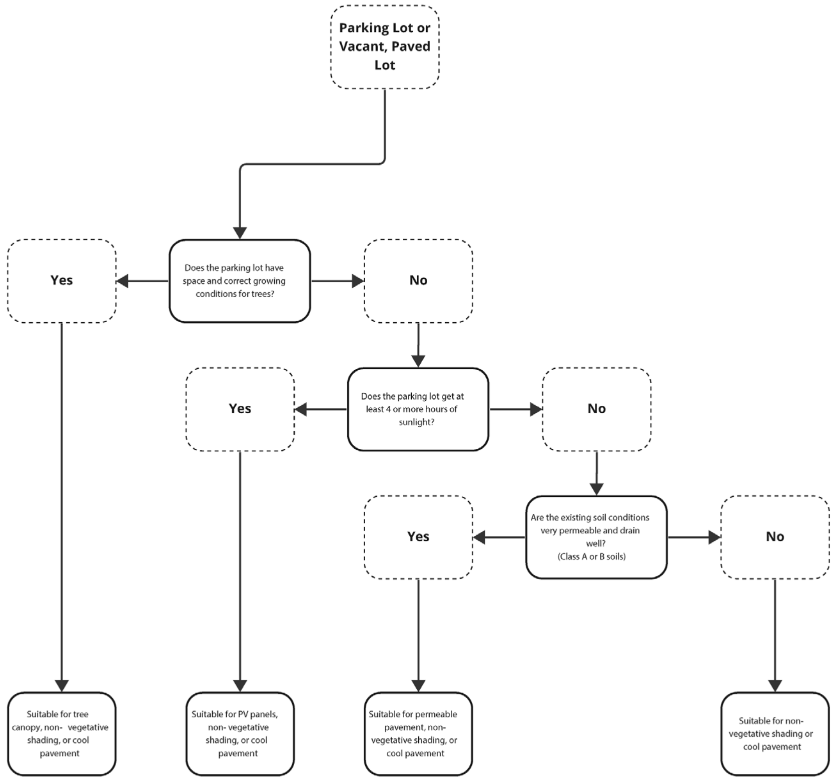
- Many sites may have multiple potential design interventions. In these situations, priorities and community preferences should be evaluated



Flowchart for Evaluating Rooftop Interventions



Flowchart for Evaluating Parking Lot Interventions

B. Use a scoring matrix to determine which projects to implement

- Use criterion such as:
  - Environmental impact,
  - Ease of implementation,
  - Governance,
  - Cost,
  - Funding potential,
  - Community ranking,
  - Environmental metrics such as clean energy generation, decarbonization, stormwater management, and heat island mitigation.

IV. Solution Evaluation Matrix

Intervention or Solution	Positive environmental impact 1 = least 5 = most	Ease of implementation 1 = difficult 5 = easiest	Governance 1 = least agency 5 = most agency	Cost 1 = high cost 5 = low cost	Funding potential 1 = least 5 = most	Ability to advance justice 1 = least impact 5 = most impact	Workplace development or entrepreneurship opportunities 1 = least 5 = most	Community ranking 1 = lowest 5 = highest	Total Score
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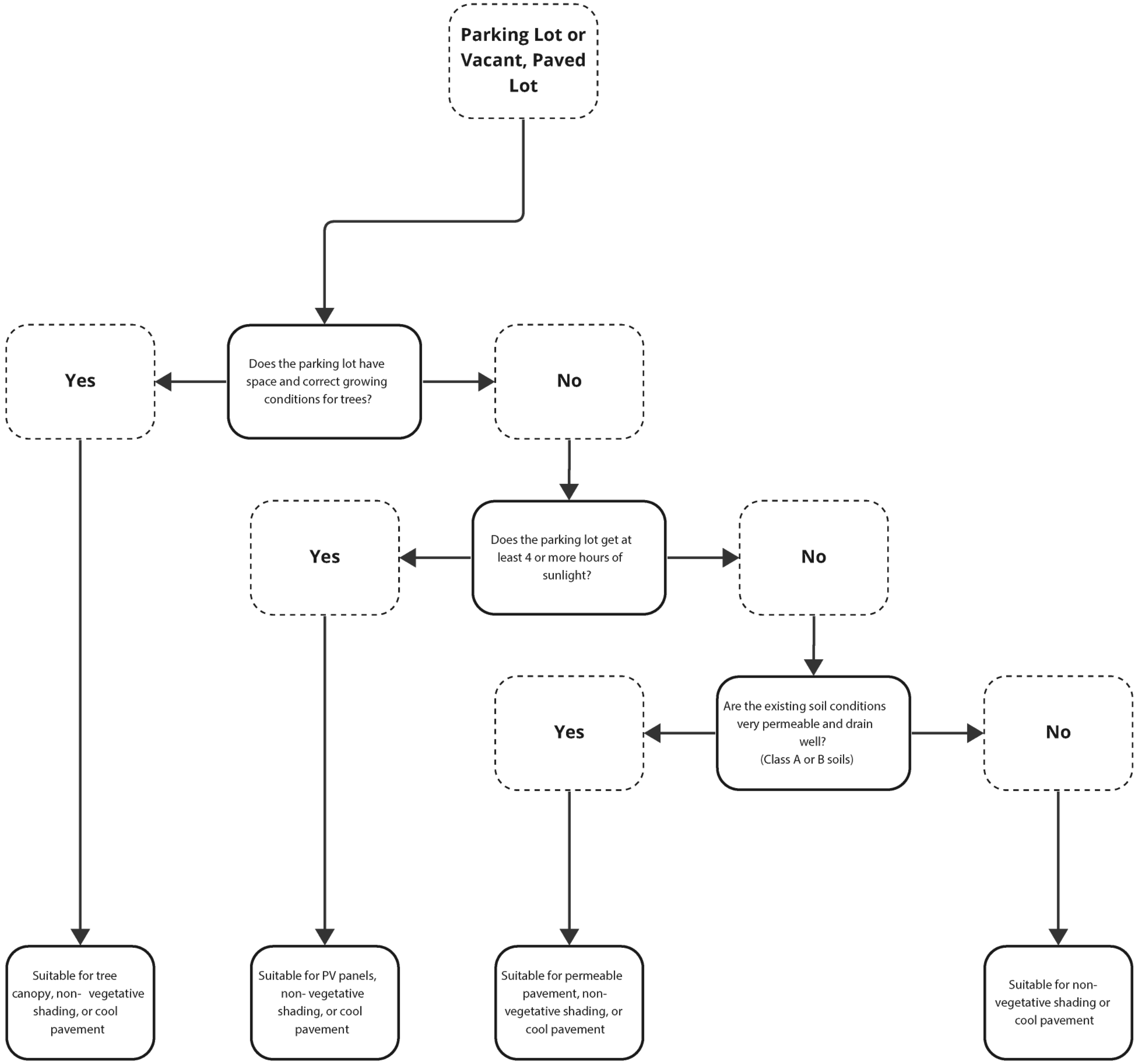
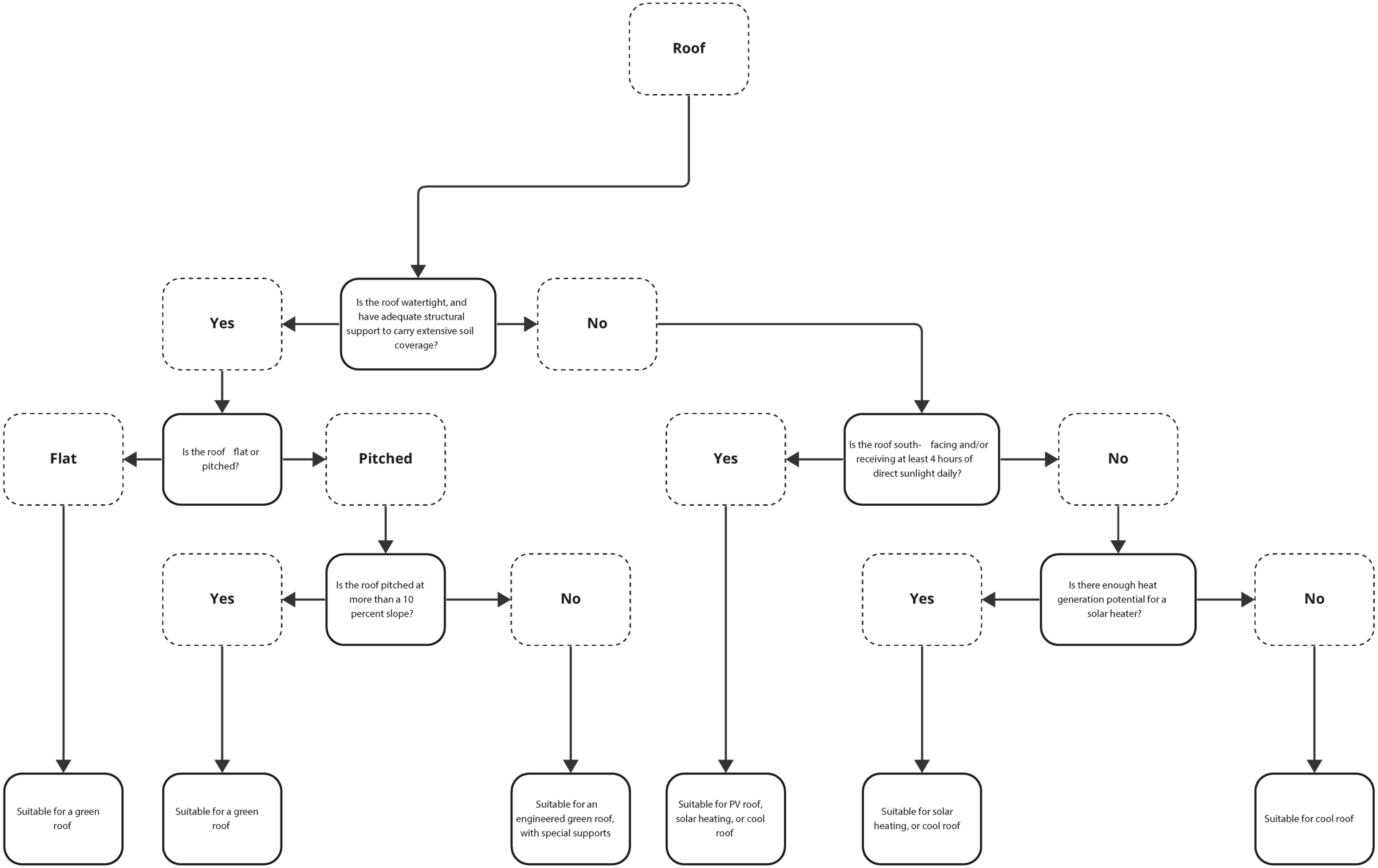
Site 3	*3*	*5*	*4*	*4*	*3*	*2*	*3*	*2*	***26***
Site 4	*5*	*4*	*4*	*3*	*5*	*4*	*3*	*5*	***33***
Site 5	*2*	*4*	*3*	*2*	*2*	*5*	*2*	*3*	***23***

Scoring Matrix for Potential Interventions


Parking Lot or Vacant, Paved Lot
Does the parking lot have space and correct growing conditions for trees?
Yes
No
Does the parking lot get at least 4 or more hours of sunlight?
Yes
No
Are the existing soil conditions very permeable and drain well? (Class A or B soils)
Yes
No
Suitable for tree canopy, non- vegetative shading, or cool pavement
Suitable for PV panels, non- vegetative shading, or cool pavement
Suitable for permeable pavement, non- vegetative shading, or cool pavement
Suitable for non- vegetative shading or cool pavement


Roof
Is the roof watertight, and have adequate structural support to carry extensive soil coverage?
Yes
No
Is the roof flat or pitched?
Flat
Pitched
Is the roof pitched at more than a 10 percent slope?
Yes
No
Is the roof south- facing and/or receiving at least 4 hours of direct sunlight daily?
Yes
No
Is there enough heat generation potential for a solar heater?
Yes
No
Suitable for a green roof
Suitable for a green roof
Suitable for an engineered green roof, with special supports
Suitable for PV roof, solar heating, or cool roof
Suitable for solar heating, or cool roof
Suitable for cool roof

Photovoltatic Panels (Solar Panels)

Summary

A solar panel, also known as a photovoltaic (PV) panel or module, is a device that converts sunlight into electricity through the photovoltaic effect. Solar panels are a key technology in the field of solar energy, enabling the conversion of sunlight into clean and renewable electricity. They are widely used in residential, commercial, and utility-scale applications to generate electricity for a wide range of purposes, including powering homes, businesses, and even supplying electricity to the grid.

On buildings, solar panels are often connected to the electrical grid. Excess electricity generated by the solar panels can be fed back into the grid, earning credits or compensation through net metering or feed-in tariff programs. This allows buildings to draw electricity from the grid when solar generation is insufficient and export surplus electricity when solar generation exceeds demand.

Considerations

- **Widely available and low-maintenance sustainable energy generation**
- **Cost-saving, or even revenue-generating, from reduced reliance on grid energy**
- **Often have a very high upfront capital costs, even with rebate programs**
- **Panels do not generate electricity on cloudy days or at night, requiring alternative backup energy sources**

Solar Water Heaters

Summary

A solar water heater, also known as a solar thermal system or solar hot water system, is a device that utilizes sunlight to heat water for various purposes, such as domestic use, space heating, or industrial processes. It is a renewable and energy-efficient alternative to conventional water heating methods.

The solar water heater has a solar collector, which is usually mounted on the roof or in an area with optimal sun exposure. The collector absorbs solar radiation and converts it into heat. Within the collector, there are tubes or channels that contain a heat transfer fluid. The heat transfer fluid absorbs the heat from the collector and circulates it to the storage tank to heat water.

Considerations

- **Solar water heaters save money on gas or electric bills, and are cost-saving in the long-term**
- **Require minimal maintenance, and are designed to be durable and reliable**
- **Often have a very high upfront capital cost**
- **Requires a roof that can support the weight**
- **Heaters do not produce heat on cloudy days or at night, and may need a backup heating element**

Geothermal Heat Pumps

Summary

Geothermal heat pumps, also known as ground source heat pumps (GSHPs), are a highly efficient and sustainable heating and cooling technology that utilizes the consistent temperature of the earth to provide indoor climate control. They tap into the relatively stable ground or groundwater temperatures to transfer heat to or from a building.

Geothermal heat pumps rely on a ground loop system, which consists of a series of pipes buried underground or submerged in a water source. During heating, a heat pump extracts heat energy from the relatively warmer ground or water through the ground loop. In cooling mode, the heat pump absorbs heat from the indoor air or water and transfers it to the cooler ground or water through the ground loop.

Considerations

- **GSHPs are very energy-efficient, and have fewer mechanical components compared to standard HVAC systems, requiring less maintenance**
- **GSHPs have a very high initial capital cost, but ultimately result in cost-savings due to lower energy use**
- **Specialized technical knowledge and equipment is needed to properly install the piping**
- **GSHPs require extensive digging and drilling during underground installation**

Air Source Heat Pump

Summary

An air source heat pump (ASHP) is a heating and cooling system that extracts heat from the outdoor air and transfers it indoors or vice versa. It operates on the same principles as a refrigerator but in reverse. ASHPs are an energy-efficient alternative to traditional heating and cooling systems that rely on combustion or electric resistance heating.

In heating mode, the ASHP extracts heat from the outdoor air, even in cold temperatures. During cooling, the process is reversed. The heat pump extracts heat from the indoor air and releases it to the outdoor air, providing a cooling effect.

For homes without ducts, air-source heat pumps are also available in a ductless version called a mini-split heat pump.

Considerations

- **ASHPs can reduce electricity use for heating by approximately 50 percent**
- **Easily installed, and are widely available and used in all climates**
- **Can operate year-round, providing both heating and cooling benefits, unlike an AC and furnace**
- **More costly than standard HVAC systems, but provide long-term savings though energy efficiency**

Green Roofs

Summary

Green roofs, also known as vegetative or living roofs, are roof systems that are partially or completely covered with vegetation and growing medium. They provide a layer of living plants on top of a building, creating a green space that offers numerous environmental, aesthetic, and functional benefits.

The benefits of green roofs include stormwater management, improved air quality, biodiversity and habitat creation, energy efficiency, and aesthetics. Green roofs are increasingly popular in urban areas where open space is limited, and there is a growing emphasis on sustainable and environmentally friendly building practices.

Considerations

- **Reduces urban heat island and insulates roof from heat, reducing energy cost**
- **Has many additional benefits, including stormwater management , and ecological benefits**
- **Depending on the extensiveness of the green roof, buildings must have enough structural support to support the growth medium**
- **Can sometimes be costly to construct, especially slanted roofs**
- **Must be properly maintained, with service access for maintenance workers**

Passive Solar Design (Heating)

Summary

Passive solar design is an architectural approach that harnesses the natural elements of sunlight, heat, and ventilation to create comfortable and energy-efficient buildings. It involves strategic design decisions and building techniques to maximize solar gain, minimize heat loss, and promote natural airflow.

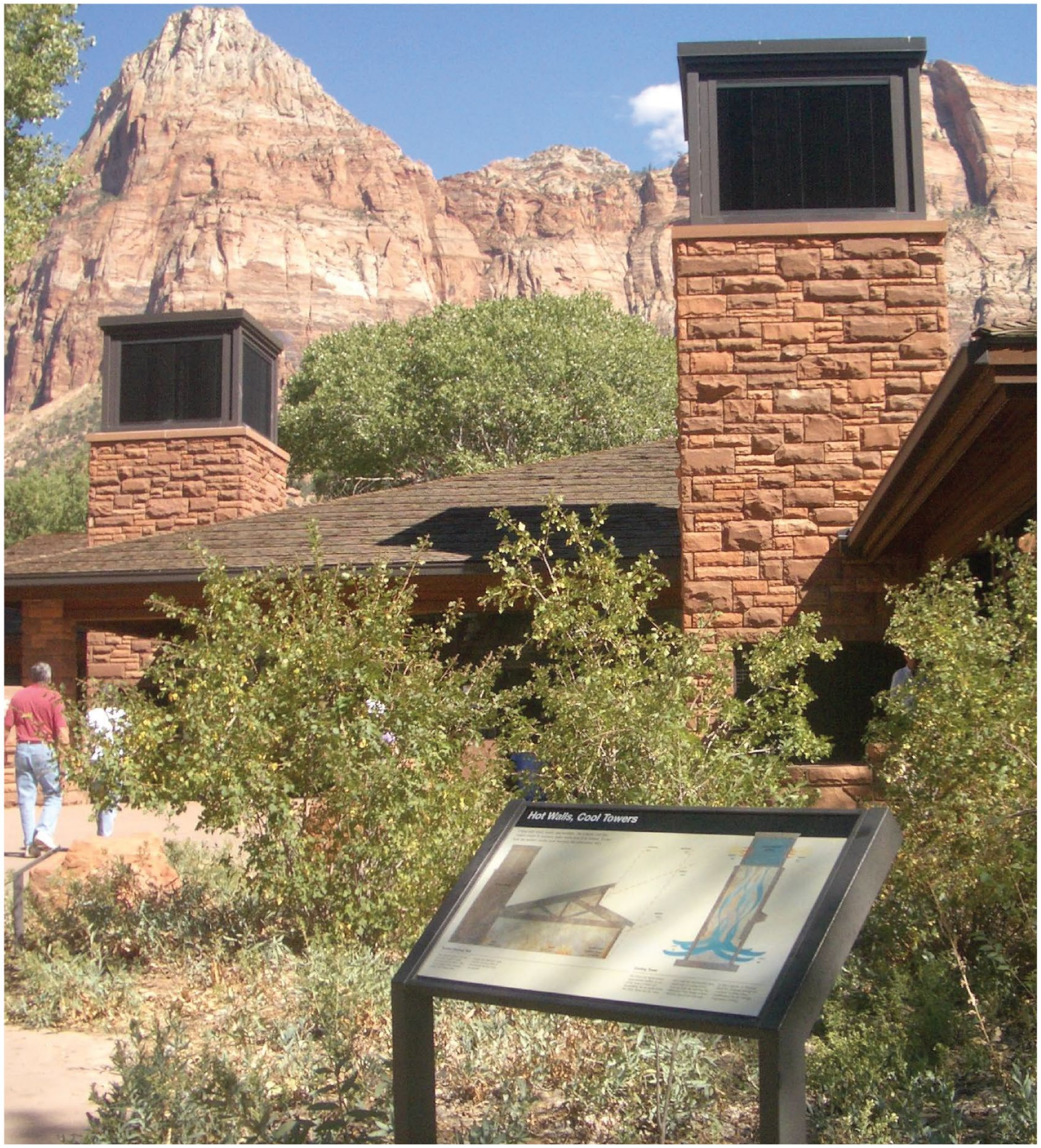
Key principals of passive solar include solar orientation, the aperture/collector (window that absorbs sunlight), thermal mass (material that can hold and store heat), distribution of air and heat, and controls (elements that regulate sunlight).

The goal of passive solar heating systems is to capture the sun's heat within the building's elements and to release that heat during periods when the sun is absent, while also maintaining a comfortable room temperature. Indirect gain refers to a system that uses the living space itself as a heating element, while indirect gain is a system that transfers heat to the living space through conduction.

Considerations

- **Passive buildings need no mechanical heating, and thus use no energy for heating**
- **Passive buildings often needs full exposure to sunlight, and thus be unobstructed**
- **Climate has a major impact on the feasibility and design of passive buildings**

Passive Solar Design (Cooling)



Summary

In a passive solar design, passive cooling systems are design strategies and techniques used to naturally cool buildings without the need for mechanical air conditioning or refrigeration. These systems take advantage of natural elements, such as airflow, shading, and thermal mass, to reduce heat gain and maintain comfortable indoor temperatures.

Natural ventilation strategies, such as cross-ventilation, thermal mass (to absorb excess daytime heat), the strategic use of shading, evaporative cooling (adding water to surfaces to cool them), nightime 'purging' of heat overnight, good insulation from daytime heat, solar chimneys (towers that cool by causing a natural updraft), reflective surfaces, and cooling landscape features outside, all contribute to cooling buildings without mechanical air conditioning.

Considerations

- **Passive buildings need no mechanical air conditioning, and thus use no energy for cooling**
- **Passive buildings often needs full exposure to sunlight, and thus be unobstructed**
- **Climate has a major impact on the feasibility and design of passive buildings**

Permeable Surfaces

Summary

Permeable pavement, also known as porous pavement or pervious pavement, is a type of surface material that is designed to allow water to permeate into the underlying soil. Examples include porous asphalt, permeable concrete, permable pavers, resin-bound aggregates, and grid systems.

In addition to reducing stormwater runoff, improving water quality, and improved safety from decreased risk of slipping, permable pavement can reduce urban heat island. This is because they allow water to infiltrate below, and can have vegetation grow beneath and between pavers, which both give an evaporative cooling effect. Materials with gaps in them, such as porous asphalt, are able to hold more heat, because they have more air pockets. Finally, permeable pavement has less thermal mass, which reduces the heat released at night.

Considerations

- **Major stormwater management benefits, such as reduced burden on stormwater system**
- **Rainwater cannot be collected on pervious pavement**
- **Can be more expensive to install than concrete, especially aggregates**
- **Requires occasional maintenance to continue to function well**
- **Requires monitoring to ensure the surface is flat, especially when used near trees**

Heated Sidewalks

Summary

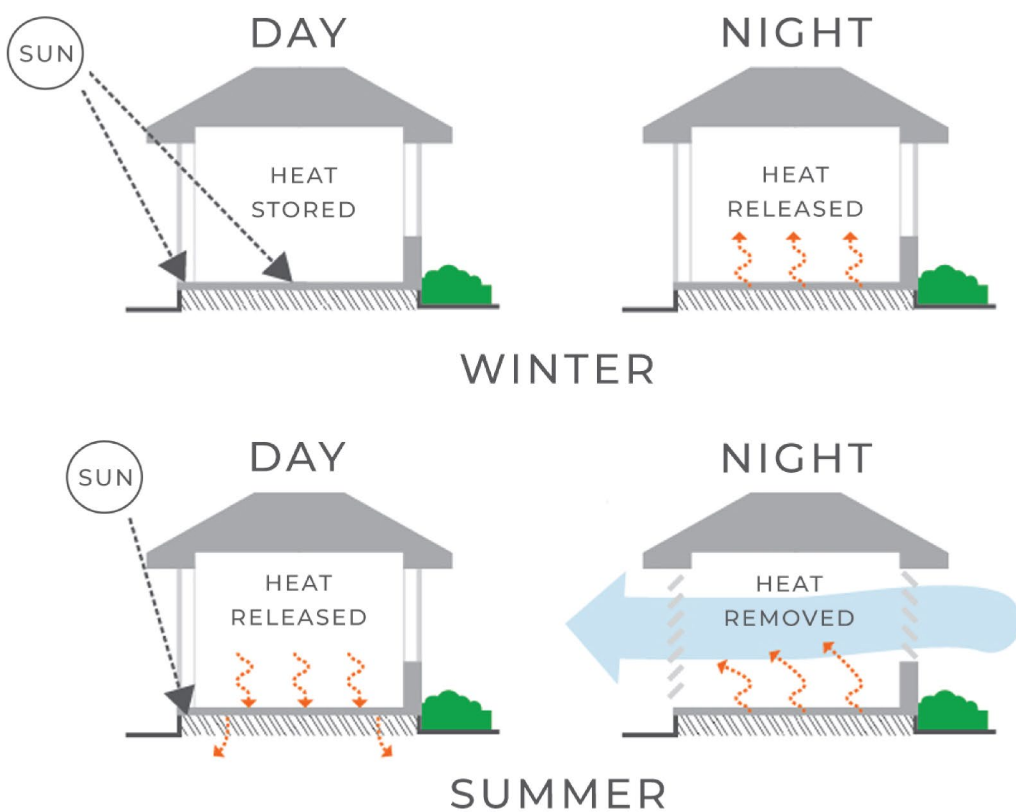
Heated sidewalks, also known as snow-melting systems or heated pavement, are a type of infrastructure that uses electric or hydronic heating elements to prevent ice and snow buildup on sidewalks and other outdoor pathways. The primary purpose of heated sidewalks is to enhance pedestrian safety by providing clear and ice-free walkways, especially during cold weather conditions.

Heated sidewalks prevent the formation of ice and snow, reducing the risk of slip and fall accidents, making pedestrian travel safer during winter months. They also improve accessibility for people with mobility impairments, including those using wheelchairs or mobility aids. Heated sidewalks also have reduced maintenance demands such as deicing or salting, last longer than non-heated sidewalks, and increase pedestrian activity year-round.

Considerations

- **Best time to install is from late spring to late fall**
- **Can have a high upfront cost, and need to be maintained regularly**
- **The systems require energy, and thus have a heating cost**
- **Often difficult to scale up due to cost and maintenance concerns**

Thermal Mass



Summary

Thermal mass refers to the ability of a material to absorb, store, and release heat energy. In the context of buildings and construction, thermal mass is a crucial concept in passive solar design and energy-efficient building strategies. It involves using materials with high heat storage capacity to stabilize indoor temperatures and reduce temperature fluctuations.

When a material has high thermal mass, it can absorb and store a significant amount of heat when exposed to a heat source, such as direct sunlight or indoor heating. The heat absorbed is stored within the material, and as the temperature drops or the heat source is removed, the stored heat is gradually released back into the surrounding environment. Common materials with high thermal mass include concrete, brick, stone, tile, rammed earth, and water. These materials have the ability to retain heat for extended periods, depending on their thickness and density.

Considerations

- **Every material has different thermal mass qualities, and the specific context of the use and location must be considered**
- **Thermal mass can heat, or cool, depending on the use and context**
- **Is a major component of other solutions**

Solar Chimney

Summary

A solar chimney, also known as a thermal chimney or solar updraft tower, is a passive ventilation system that harnesses solar energy to create natural airflow within buildings. It utilizes the greenhouse effect and the principle of thermal buoyancy to drive an upward flow of air, promoting ventilation and cooling.

The chimney is a vertical shaft or tower integrated into the building's design. It is usually positioned on the sunny side of the building, facing the sun to maximize solar exposure. As the air inside the solar chimney heats up, it becomes less dense and lighter than the cooler surrounding air, creating a natural convection current. Cooler air from the building's interior is drawn into the base of the chimney to replace the rising warm air. This process promotes natural ventilation and encourages the exchange of indoor air with fresh outdoor air.

Considerations

- **Solar chimneys are a passive (non-mechanical) strategy of cooling a space, which is energy-efficient and sustainable**
- **Can improve air quality and air flow**
- **Can be integrated into both new construction and existing buildings**
- **Often requires major building changes to existing buildings, and may not be feasible in all geographies**

Living Walls

Summary

A living wall, also known as a green wall or vertical garden, is a vertical structure covered with living plants. It is a form of green infrastructure that brings nature into built environments, providing a range of benefits for both aesthetics and functionality. Living walls can be installed both indoors and outdoors, and they come in various sizes and designs to suit different spaces and preferences.

Living walls can contribute to thermal regulation by providing shading and cooling effects on buildings' exteriors. This can help mitigate the urban heat island effect and reduce the need for mechanical cooling in some cases. Additional benefits include air quality improvement, sound absorbtion, aesthetics, increased biodiversity, and stress reduction.

Considerations

- **Can be done indoors and outdoors, and especially popular in larger spaces open to the public**
- **Can have a high upfront capital cost, especially larger walls**
- **Require a significant amount of maintenance, and often have a high failure rate due to poor growing conditions and maintenance**

Cool Roofs and Cool Pavement

Summary

Cool roofs and cool pavements are sustainable materials designed to reflect more sunlight and absorb less heat compared to traditional roofing and paving materials.

Cool roofs have high solar reflectance, which refers to their ability to reflect sunlight back into the atmosphere. They can reflect 50% to 90% of the solar radiation, while traditional dark-colored roofs may only reflect about 5% to 20%. By reflecting more sunlight and absorbing less heat, cool roofs help reduce the heat absorbed by buildings.

Similar to cool roofs, cool pavements also reduce the amount of heat absorbed by the pavement. By reflecting more sunlight and absorbing less heat, cool pavements reduce surface temperatures, making them more comfortable for pedestrians, cyclists, and drivers.

Considerations

- **Cool roofs can be implemented on many different roof types and angles**
- **Varying capital costs, depending on material, but decrease costs associated with cooling buildings**
- **Reflective material must be maintained for optimal performance**
- **Some studies argue that cooling pavement increase glare and actually reflect heat to pedestrians**

Increasing Access to Cooling Centers and AC Units

Summary

Summer days and heat waves can lead to extremely high temperatures, which can cause heat-related illnesses such as heat exhaustion and heatstroke. Certain groups, such as the elderly, young children, pregnant women, and individuals with pre-existing medical conditions, are especially susceptible to heat-related illnesses.

Cooling centers and AC provide a safe and comfortable environment for people to escape the extreme heat, reducing the risk of heat-related health problems. As climate change leads to more frequent and intense heatwaves, access to cooling centers and AC becomes even more crucial in protecting public health and safety.

Considerations

- **Cooling centers can be implemented in many public buildings, and should be distributed throughout cities and neighborhoods**
- **Subsidizing or giving rebates on AC units can save lives, and make living more comfortable, for residents who do not have air conditioning**
- **The location of cooling centers and availability of cooling resources must be communicated in an accessible way for all residents to be effective and impactful**

Tree Canopy Preservation and Tree Planting

Summary

Tree canopy plays a significant role in mitigating the urban heat island (UHI) effect caused by human activities, urban infrastructure, and the lack of vegetation in cities. Trees provide natural shade, absorb and reflect heat, and produce a microclimate that around them that cools the areas that surround them. They have additional benefits as well, such as absorbing water during storm events, and improving air quality.

This effect increases with size, which makes the preservation of existing large trees in streets and parks crucial in preventing urban heat island. Tree canopies are especially lacking in communities that have historically been redlined, or otherwise lacked investment. Communities can mitigate the effect of excessive heat by planting new trees, as well as protecting, preserving, and maintaining existing older trees from development.

Considerations

- **Trees must be planted with proper soil, water, sunlight, and spatial conditions to thrive. As many as 50 percent of all street trees planted survive longer than 20 years, most dying within the first 5 years.**
- **There is an often an opportunity cost between neighborhood development and tree preservation**
- **Trees require maintenance and water, especially in drought conditions or after being newly planted**

Increasing Green Spaces

Summary

A green space is an area of land that is primarily covered with vegetation, such as grass, trees, shrubs, and other types of plants. Green spaces are designed to provide natural, open, and green areas within urban or built environments. They serve a range of purposes, from recreational and aesthetic to environmental and ecological. Green spaces can take various forms, including parks, gardens, green corridors, and natural reserves

In addition to adding recreational value, improving air quality, and improving stormwater management, green spaces provide significant cooling benefits, due to the presence of vegetation and previous surface. Many studies show that the temperature within and outside of green spaces can be several degrees cooler than the surrounding area in an urban environment. They provide many of the same benefits that street trees provide, such as shade, absorbing and reflecting heat, and producing a cooler microclimate. Additionally, like cooling centers, parks provide a safe haven for vulnerable population to rest and cool down.

Considerations

- **Green spaces can vary in use, from parks to cemeteries, and still provide many benefits**
- **Green spaces have high capital and maintenance costs, and spaces are often difficult to find in dense urban environments**

Public Water Features

Summary

Public water features, such as fountains, splash pads, pools, lakes, ponds, and water bodies, can play a significant role in cooling cities, especially during hot weather and heatwaves. They offer several cooling mechanisms that help to mitigate the urban heat island effect and create more comfortable urban environments.

During hot weather, water bodies release water vapor into the air, which cools the immediate vicinity. This helps reduce ambient temperatures around the water feature, providing a cooling effect in nearby areas. They also provide access to activities, like swimming, that directly cool users. The effect increases when water features are placed in green spaces and in shaded areas.

Considerations

- **Fountains and other built water features require maintenance to perform hygienically and operate well**
- **Pools can be revenue-generating, despite high upfront capital and maintenance costs**
- **Some water features can provide recreation year-round, while others must be closed to prevent damage from freezing**
- **In water-scarce areas, water may not be as available for features that require potable water**

Public Shade Structures

Summary

Public shade structures play a critical role in addressing heat concerns in urban environments by providing shelter from the sun and reducing the impact of the urban heat island effect. These structures, such as shade sails, pergolas, canopies, and awnings, are strategically placed in public spaces to offer shaded areas for people to escape from direct sunlight

Shade structures can help mitigate the urban heat island effect by reducing the amount of heat absorbed and retained by buildings and paved surfaces. Shaded areas experience less heat buildup, contributing to overall cooler microclimates within urban spaces. Larger shade structures decrease heat demands in adjacent buildings, and decrease heating costs. Even smaller structures, such as shaded bus stops, make outdoor activities more comfortable, and provide areas for vulnerable populations to rest.

Considerations

- **Shade structures vary in size and cost, but generally require limited maintenance**
- **Provide additional benefits, such as rain shelter**
- **If designed incorrectly, can be structurally unsafe, or dangerous climbing opportunities**

Distributed Wind Energy

Summary

Wind energy is the most abundant renewable energy source in the United States. Distributed wind energy refers to the generation of wind power on a smaller scale, often at or near the point of use, such as urban or suburban areas. Small wind turbines, typically ranging from a few kilowatts to a few hundred kilowatts in capacity, can be installed on rooftops, parking lots, and other urban spaces. These turbines can harness wind energy and contribute to the local energy supply, reducing dependence on the grid.

However, there are challenges to consider when implementing distributed wind in cities. Urban areas are often densely populated, with limited available space for wind turbines. They can be visually and audibly disruptive in urban environments, have high maintenance costs, and be restricted by zoning laws and regulations.

Considerations

- **Increases resilience of cities, and can be combined with other forms of energy**
- **Must have average wind speeds of at least 9 mph to work, and placed in high locations**
- **Larger wind turbines are know to be harmful to wildlife, especially birds**
- **High maintenance costs, can be noisy to residents, and may be restricted by local law and regulations**

Subsection 3: Air and Atmosphere as Hazard and Opportunity

i. A Methodology for Evaluating Indoor Air Pollution and Potential Interventions
ii. Air and Atmosphere Solutions Bank

A Methodology for Evaluating Indoor Air Pollution and Potential Interventions

Chadwick Bowlin

Greater Grove Hall Main Streets

July 2023

1.1 Identify Hazards

Part of an Environmental Audit to determine the existing environmental hazards and opportunities for sustainability.

A. Identify Potential Sources of Poor Air Quality

“**‘Indoor air quality’ (IAQ)** refers to the quality of the air in a home, school, office, or other building environment. The potential impact of indoor air quality on human health nationally can be noteworthy for several reasons:

- Americans, on average, **spend approximately 90 percent of their time indoors**, where the concentrations of some pollutants are **often 2 to 5 times higher than typical outdoor concentrations**.
- **People who are often most susceptible to the adverse effects** of pollution (e.g., the very young, older adults, people with cardiovascular or respiratory disease) **tend to spend even more time indoors**.
- Indoor concentrations of some pollutants **have increased in recent decades** due to such factors as energy-efficient building construction (when it lacks sufficient mechanical ventilation to ensure adequate air exchange) and increased use of synthetic building materials, furnishings, personal care products, pesticides, and household cleaners.”

From “Report on the Environment – Air Quality”, EPA, 2023

A. Identify Potential Sources of Poor Air Quality (Cont.)

Most pollutants affecting indoor air quality come from sources inside buildings, although some originate outdoors.

- **Indoor sources** (sources within buildings themselves):
  - **Combustion sources** in indoor settings, including tobacco, wood and coal heating and cooking appliances, and fireplaces
  - **Cleaning supplies, paints, insecticides, and other commonly used products** introduce many different chemicals, including volatile organic compounds, directly into the indoor air.
  - **Building materials** are also potential sources, whether through **degrading materials** (e.g., asbestos fibers released from building insulation) or from **new materials** (e.g., chemical off-gassing from pressed wood products). Other substances in indoor air are of natural origin, such as **radon, mold, and pet dander.**

From “Report on the Environment – Air Quality”, EPA, 2023

A. Identify Potential Sources of Poor Air Quality (Cont.)

- **Outdoor sources:** Outdoor air pollutants can enter buildings through open doors, open windows, ventilation systems, and cracks in structures. For example, harmful smoke from chimneys can re-enter homes to pollute the air in the home and other homes in a neighborhood. Some pollutants come indoors through building foundations. For instance, radon forms in the ground as naturally occurring uranium in rocks and soils decays. The radon can then enter buildings through cracks or gaps in structures. In areas with contaminated ground water or soils, volatile chemicals can enter buildings through the same process. Volatile chemicals in water supplies can also enter indoor air when building occupants use the water (e.g., during showering, cooking). Finally, when people enter buildings, they can inadvertently bring in soils and dusts on their shoes and clothing from the outdoors, along with pollutants that adhere to those particles."

Other Factors Affecting Indoor Air Quality

- In addition, several other factors affect indoor air quality, including the air exchange rate, outdoor climate, weather conditions, and occupant behavior

From "Report on the Environment – Air Quality", EPA, 2023

A. Identify Potential Sources of Poor Air Quality (Cont.)

- **Outdoor sources:** Outdoor air pollutants can enter buildings through open doors, open windows, ventilation systems, and cracks in structures. For example, harmful smoke from chimneys can re-enter homes to pollute the air in the home and other homes in a neighborhood. Some pollutants come indoors through building foundations. For instance, radon forms in the ground as naturally occurring uranium in rocks and soils decays. The radon can then enter buildings through cracks or gaps in structures. In areas with contaminated ground water or soils, volatile chemicals can enter buildings through the same process. Volatile chemicals in water supplies can also enter indoor air when building occupants use the water (e.g., during showering, cooking). Finally, when people enter buildings, they can inadvertently bring in soils and dusts on their shoes and clothing from the outdoors, along with pollutants that adhere to those particles."

Other Factors Affecting Indoor Air Quality

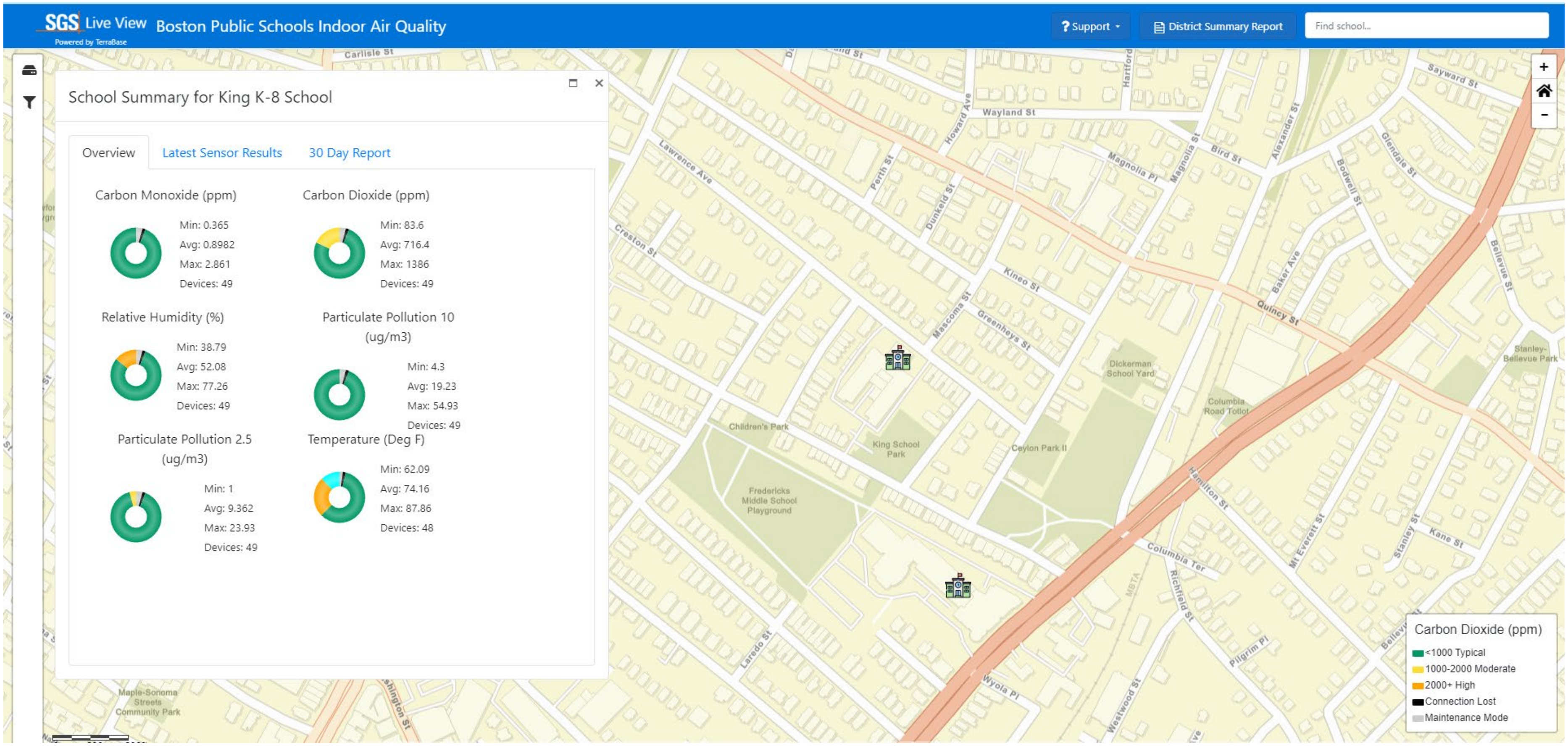
- In addition, several other factors affect indoor air quality, including the air exchange rate, outdoor climate, weather conditions, and occupant behavior

From "Report on the Environment – Air Quality", EPA, 2023

B. Identify if There is a Potential IAQ Issue

After identifying potential sources of poor indoor air quality, one can identify if there are high levels of pollutants. Some indicators of air quality issues include:

1. **Health Effects Due to Air Pollution**
   - Even before using equipment to test air quality, there are physical side effect of poor indoor air quality, such as:
     - Irritation of the eyes, nose, and throat.
     - Headaches, dizziness, and fatigue.
     - Long term: Respiratory diseases, heart disease, and cancer.
2. **Data from Indoor Air Quality Sensors**
   - Air quality sensors are an excellent tool to monitor air quality over time and determine air quality issues that would otherwise be invisible.
   - Additionally, their data can be used to determine types of pollutants, and compare them with safety thresholds
3. **Complaints/Reports, and Observation of Air Quality Hazards**
   - Often, residents who are exposed to a new air quality issue notice a change in their environments, such a construction site or smoke, which can indicate air quality issues.



King K-8 Live IAQ Sensor Data, Grove Hall, Boston, MA
(Source: Indoor Air Quality (IAQ) Sensor Dashboard, Boston Public Schools)

C. Determine if IAQ is Hazardous

- If not already completed, an **IAQ assessment should be conducted** in the building or buildings of concern
- The simplest way to determine if the IAQ of a building is hazardous is using the **EPA's NAAQS**
    - "The **Clean Air Act**, which was last amended in 1990, requires EPA to set National Ambient Air Quality Standards (40 CFR part 50) for six principal pollutants ("criteria" air pollutants) which can be harmful to public health and the environment." (EPA, 2023)
    - Although these do not include all potential pollutants, they are **legally backed** by the Clean Air Act, and are most common

Pollutant [links to historical tables of NAAQS reviews]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		primary and secondary	Rolling 3 month average	0.15 $\mu g/m^3$ [1]	Not to be exceeded
Nitrogen Dioxide (NO_2)		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb [2]	Annual Mean
Ozone (O_3)		primary and secondary	8 hours	0.070 ppm [3]	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 $\mu g/m^3$	annual mean, averaged over 3 years
		secondary	1 year	15.0 $\mu g/m^3$	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 $\mu g/m^3$	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		primary	1 hour	75 ppb [4]	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

NAAQS Table
(Source: EPA website)

C. Use Data to Determine Source of Hazardous IAQ

- **Check the list of 'potential sources of poor IAQ'** from Step A, **with air quality assessment data from Step C**, to determine sources of pollutants
- Many pollutants can be traced back to **specific sources of pollution**
  - For example, **combustion sources** "can release harmful combustion byproducts such as carbon monoxide and particulate matter directly into the indoor environment" (EPA 2023)
  - VOCs can often be traced to cleaning and other chemical use, or synthetic materials used in furniture, known as **'off-gassing**'

1.2 Identify Opportunities

Part of an Environmental Audit to determine the existing environmental hazards and opportunities for sustainability.

A. Prioritize, Identify and Inventory Major Buildings with Hazardous IAQ

- Since IAQ is a **building-specific issue**, evaluation and solutions must be done at the **building scale**.
- Conducting an indoor air quality assessment often takes time and resources. Thus**, there may need to prioritize** certain buildings that are occupied often, such as:
  - Schools
  - Libraries
  - Community Centers
  - Churches

B. Create an Approach to Improve IAQ

There are three basic strategies to improve indoor air quality:

1. Source Control

- Usually the most effective way to improve indoor air quality is to **eliminate individual sources of pollution or to reduce their emissions**.
- Some sources, like those that contain asbestos, can be sealed or enclosed; others, like gas stoves, can be adjusted to decrease the amount of emissions. In many cases, source control is also **a more cost-efficient approach to protecting indoor air quality** than increasing ventilation because **increasing ventilation can increase energy costs**.

B. Create an Approach to Improve IAQ (Cont.)

- Some sources of hazardous IAQ **can be substituted with non-hazardous, and more sustainable, counterparts**.
- For example, substituting **gas appliances for electric appliances** addressed a pollutant, and is **a green development opportunity**
  - Gas stoves **significantly increase the levels of NO2 in homes,** resulting in a variety of health effects
  - Electric appliances **do not use combustion**, and thus do not carry the health risk of increased NO2. They can **also be powered by renewable energy** sources, rather than gas.

B. Create an Approach to Improve IAQ (Cont.)

2. Improved Ventilation

- Another approach to lowering the concentrations of indoor air pollutants in your home is to **increase the amount of outdoor air coming indoors**.
- **Natural ventilation is a simple and sustainable** way of improving air quality
- Newer mechanical ventilation systems have **heat exchangers/pumps** that **increase energy efficiency and ventilation**

3. Air Cleaners

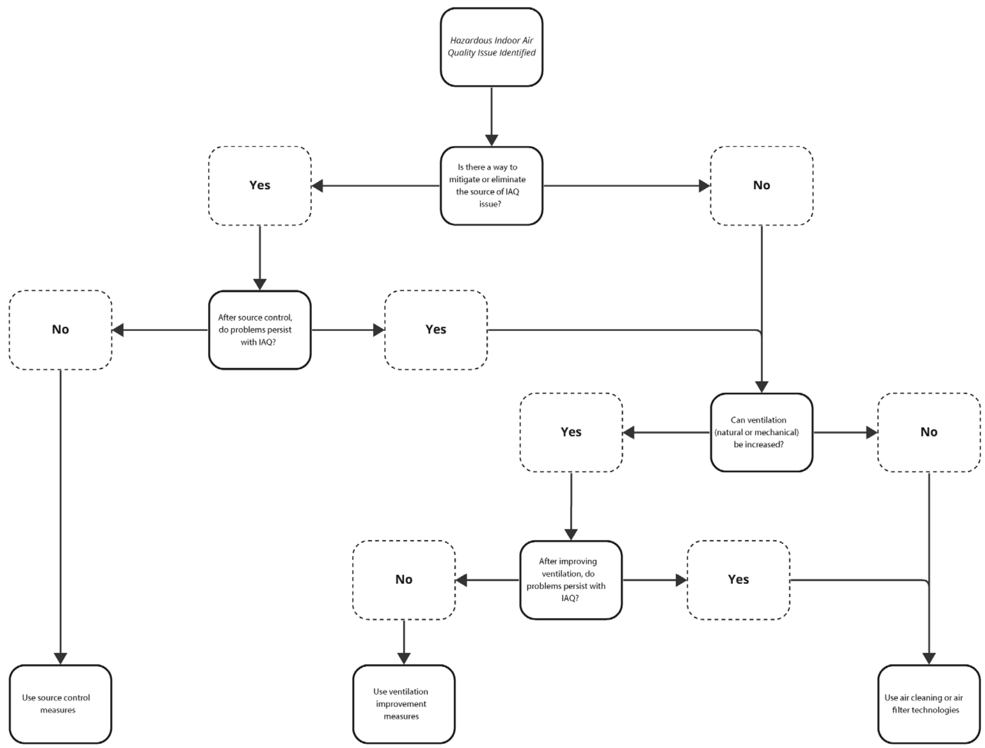
- There are many types and sizes of air cleaners on the market, ranging from relatively inexpensive table-top models to sophisticated and expensive whole-house systems.
- Some air cleaners are highly effective at particle removal, while others, including most table-top models, are much less so. Air cleaners are generally not designed to remove gaseous pollutants

2 Site Feasibility Evaluation

Feasibility Studies

A. Evaluate Type of Intervention

- All sites that are inventoried should be reviewed for feasibility
- Many sites may have multiple potential interventions. In these situations, priorities and community preferences should be evaluated



Flowchart for Evaluating Approach for Sites with Hazardous IAQ

B. Use a scoring matrix to determine which projects to implement

- Use criterion such as:
  - Environmental impact,
  - Ease of implementation,
  - Governance,
  - Cost,
  - Funding potential,
  - Community ranking,
  - Environmental metrics such as clean energy generation, decarbonization, stormwater management, and heat island mitigation.

IV. Solution Evaluation Matrix

Intervention or Solution	Positive environmental impact 1 = least 5 = most	Ease of implementation 1 = difficult 5 = easiest	Governance 1 = least agency 5 = most agency	Cost 1 = high cost 5 = low cost	Funding potential 1 = least 5 = most	Ability to advance justice 1 = least impact 5 = most impact	Workplace development or entrepreneurship oppertunities 1 = least 5 = most	Community ranking 1 = lowest 5 = highest	Total Score
Site 1	*4*	*3*	*1*	*4*	*4*	*2*	*3*	*4*	***25***
Site 2	*5*	*2*	*3*	*2*	*4*	*3*	*4*	*3*	***26***
Site 3	*3*	*5*	*4*	*4*	*3*	*2*	*3*	*2*	***26***
Site 4	*5*	*4*	*4*	*3*	*5*	*4*	*3*	*5*	***33***
Site 5	*2*	*4*	*3*	*2*	*2*	*5*	*2*	*3*	***23***

Scoring Matrix for Potential Interventions

References

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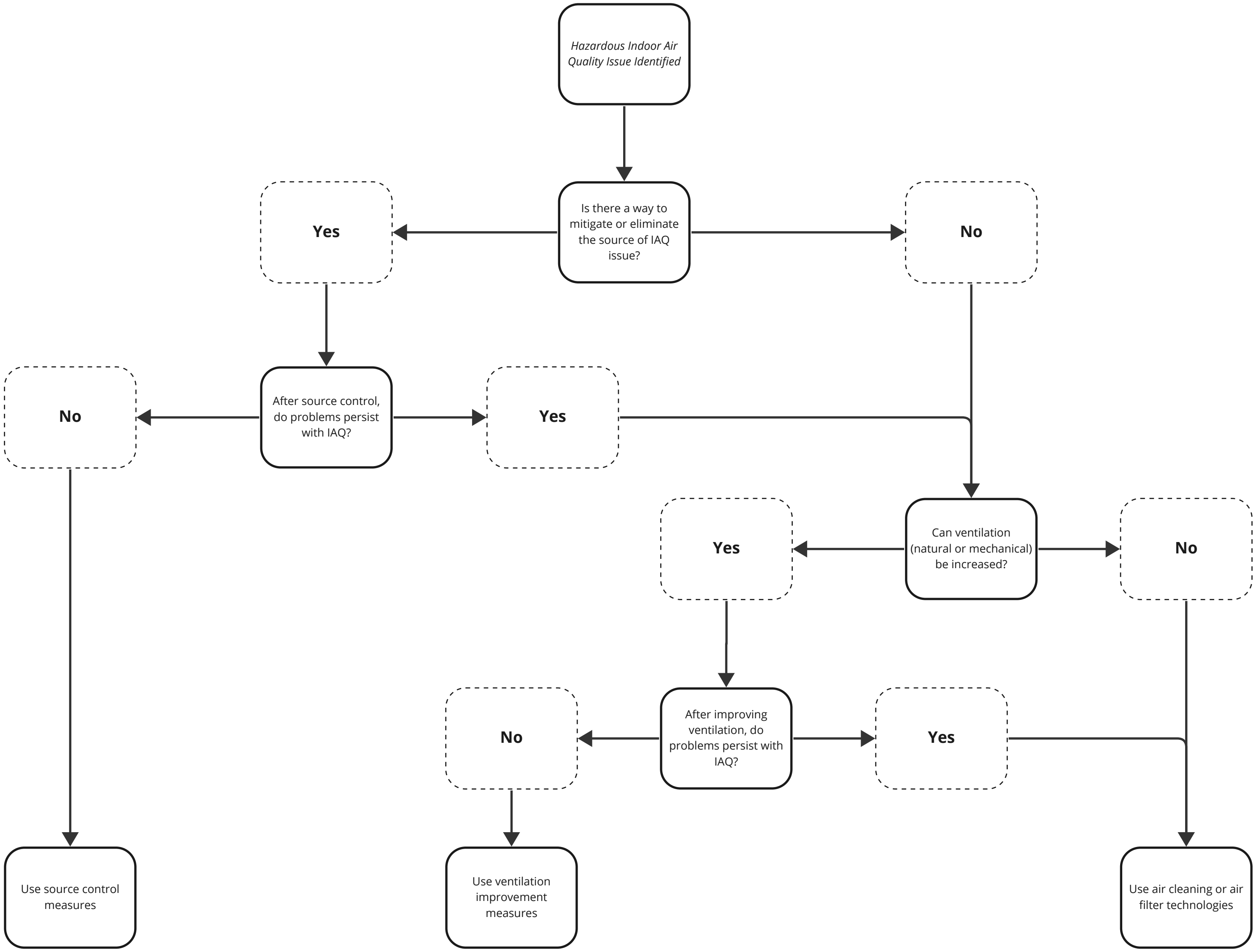


Hazardous Indoor Air Quality Issue Identified
Is there a way to mitigate or eliminate the source of IAQ issue?
Yes
No
After source control, do problems persist with IAQ?
No
Yes
Can ventilation (natural or mechanical) be increased?
Yes
No
After improving ventilation, do problems persist with IAQ?
No
Yes
Use source control measures
Use ventilation improvement measures
Use air cleaning or air filter technologies

Conversion from Gas to Electric Appliances

Summary

Switching from gas-powered appliances to electric appliances can offer significant environmental benefits, primarily due to the reduction in greenhouse gas emissions and the potential for utilizing renewable energy sources.

Gas appliances, such as gas stoves and water heaters, rely on the combustion of fossil fuels like natural gas. Additionally, gas combustion releases not only CO2 but also other pollutants, such as nitrogen oxides, sulfur dioxide, and particulate matter. These pollutants can degrade air quality and have adverse effects on human health. Electric appliances produce fewer or no direct emissions at the point of use, leading to improved local air quality.

Additional benefits include improved safety, and for electric stoves, better cooking experiences and easier cleaning.

Considerations

- **Electric appliances tend to have a lower upfront cost associated with them (specifically, water heaters and stoves)**
- **Electricity cost may be more expensive than cost of gas in some areas and at points of the year**
- **Despite being less expensive than gas, the cost of a new appliance is expensive nonetheless**
- **Renters often do not own their appliances**

Air Source Heat Pump

Summary

An air source heat pump (ASHP) is a heating and cooling system that extracts heat from the outdoor air and transfers it indoors or vice versa. It operates on the same principles as a refrigerator but in reverse. ASHPs are an energy-efficient alternative to traditional heating and cooling systems that rely on combustion or electric resistance heating.

In heating mode, the ASHP extracts heat from the outdoor air, even in cold temperatures. During cooling, the process is reversed. The heat pump extracts heat from the indoor air and releases it to the outdoor air, providing a cooling effect.

For homes without ducts, air-source heat pumps are also available in a ductless version called a mini-split heat pump.

Considerations

- **ASHPs can make ventilation of outdoor air more efficient**
- **ASHPs can reduce electricity use for heating by approximately 50 percent**
- **Easily installed, and are widely available and used in all climates**
- **Can operate year-round, providing both heating and cooling benefits, unlike an AC and furnace**
- **More costly than standard HVAC systems, but provide long-term savings though energy efficiency**

Increasing Green Spaces

Summary

A green space is an area of land that is primarily covered with vegetation, such as grass, trees, shrubs, and other types of plants. Green spaces are designed to provide natural, open, and green areas within urban or built environments. They serve a range of purposes, from recreational and aesthetic to environmental and ecological. Green spaces can take various forms, including parks, gardens, green corridors, and natural reserves

In addition to adding recreational value, providing cooling benefits, and improving stormwater management, green spaces have been show to improve air quality. Trees, parks, and other green infrastructure features can reduce particulate pollution by absorbing and filtering particulate matter. Additionally, vegetation can reduce smog, which causes respiratory problems, by reducing air temperatures, reducing power plant emissions associated with air conditioning, and removing air pollutants. Finally, green spaces filled with trees capture carbon in the air, which reduces carbon emissions.

Considerations

- **Green spaces can vary in use, from parks to cemeteries, and still provide many benefits**
- **Green spaces have high capital and maintenance costs, and spaces are often difficult to find in dense urban environments**

Tree Canopy Preservation and Tree Planting

Summary

Similarly to green spaces, trees and canopy cover provide cooling benefits, improve stormwater management, and more importantly, have been show to improve air quality. Trees, parks, and other green infrastructure features can reduce particulate pollution by absorbing and filtering particulate matter. Additionally, vegetation can reduce smog, which causes respiratory problems, by reducing air temperatures, reducing power plant emissions associated with air conditioning, and removing air pollutants. Finally, trees, especially large legacy trees, capture carbon in the air, which reduces carbon emissions.

This effect increases with size, which makes the preservation of existing large trees in streets and parks crucial in sequestering carbon and improving air quality. Tree canopies are especially lacking in communities that have historically been redlined, or otherwise lacked investment.

Considerations

- **Trees must be planted with proper soil, water, sunlight, and spatial conditions to thrive. As many as 50 percent of all street trees planted survive longer than 20 years, most dying within the first 5 years.**
- **There is an often an opportunity cost between neighborhood development and tree preservation**
- **Trees require maintenance and water, especially in drought conditions or after being newly planted**

Green Roofs

Summary

Green roofs, also known as vegetative or living roofs, are roof systems that are partially or completely covered with vegetation and growing medium. They provide a layer of living plants on top of a building, creating a green space that offers numerous environmental, aesthetic, and functional benefits.

The benefits of green roofs include stormwater management, improved air quality, biodiversity and habitat creation, energy efficiency, and aesthetics. Green roofs are increasingly popular in urban areas where open space is limited, and there is a growing emphasis on sustainable and environmentally friendly building practices.

Considerations

- **Reduces urban heat island and insulates roof from heat, reducing energy cost and carbon emissions**
- **Has many additional benefits, including stormwater management , and ecological benefits**
- **Can slightly improve air quality at roof level**
- **Depending on the extensiveness of the green roof, buildings must have enough structural support to support the growth medium**
- **Can sometimes be costly to construct, especially slanted roofs**
- **Must be properly maintained, with service access for maintenance workers**

Living Walls

Summary

A living wall, also known as a green wall or vertical garden, is a vertical structure covered with living plants. It is a form of green infrastructure that brings nature into built environments, providing a range of benefits for both aesthetics and functionality. Living walls can be installed both indoors and outdoors, and they come in various sizes and designs to suit different spaces and preferences.

Living walls can contribute to thermal regulation by providing shading and cooling effects on buildings' exteriors. They may have a small impact on improving air quality. Additional benefits include sound absorbtion, aesthetics, increased biodiversity, and stress reduction.

Considerations

- **Can be done indoors and outdoors, and especially popular in larger spaces open to the public**
- **Can have a high upfront capital cost, especially larger walls**
- **Require a significant amount of maintenance, and often have a high failure rate due to poor growing conditions and maintenance**
- **Does not have a significant impact on air quality compared to other strategies.**

Air Cleaners and Air Filters

Summary

Air cleaners and air filters are devices designed to improve indoor air quality by removing pollutants, particles, and contaminants from the air. They work by employing various mechanisms to capture and trap these undesirable substances, resulting in cleaner and healthier indoor air.

One of the primary functions of air filters and cleaners is to capture particles suspended in the air. These particles can include dust, pollen, pet dander, mold spores, and other allergens. By removing allergens, irritants, and pollutants from the air, air cleaners and filters can contribute to improved respiratory health for occupants, particularly those with sensitivities or respiratory conditions.

Considerations

- **Air cleaners and filters are a good solution for smaller spaces with particle-based air quality issues**
- **Do not filter gases, such as radon, carbon monoxide, or carbon dioxide**
- **The least effective way to clean the air, but it can be a good supplement to ventilation**
- **Requires ongoing cost of changing filters monthly to a few times a year**

Carbon Capture Technology

Summary

Carbon capture technology, also known as carbon capture and storage (CCS) or carbon capture and utilization (CCU), is a set of techniques and processes designed to capture carbon dioxide (CO_2) emissions from industrial processes or directly from the atmosphere and then either store or utilize the captured carbon for various purposes. The main goal of carbon capture technology is to mitigate the impact of greenhouse gas emissions on climate change by preventing CO_2 from entering the atmosphere.

In carbon capture and storage (CCS), the captured CO_2 is injected deep underground into geological formations such as depleted oil and gas reservoirs, saline aquifers, or other suitable storage sites. The CO_2 is stored securely underground to prevent it from re-entering the atmosphere. CO_2 can be used in various applications, such as the production of synthetic fuels, chemicals, building materials, or even as a feedstock for algae cultivation.

Considerations

- **Carbon capture can mitigate climate change, decarbonize industry, serve as a transition technology to a carbon-neutral future.**
- **CCS is still very expensive, difficult to scale for industry, and is still an ongoing field of research**
- **CCS gives a false sense of security, and does not embrace a zero carbon future with renewable energy**

Subsection 4: Roofs as Hazard and Opportunity

i. A Methodology for Evaluating Rooftops for Potential Sustainability Interventions
ii. Roof Solutions Bank

A Methodology for Evaluating Rooftops for Potential Sustainability Interventions

Chadwick Bowlin

Greater Grove Hall Main Streets

July 2023

Introduction – Types of Roof Interventions

Introduction

Roofs as Intervention Tools

- Roofs are an often-overlooked site of intervention when dealing with urban environmental hazards or opportunities
- In urban areas with limited space, rooftops can be a tool for intervention, as they do not take up ground space
- Sustainable roof designs have gained popularity due to an increased use of green roofs; however, there are several types of roof design that benefit the buildings and spaces around them
  - Although not mentioned in this methodology, there are several other benefits to these roof designs; for example, green roofs can have ecological benefits to urban wildlife

Roofs as Intervention Tools (Cont.)

- Roof types included in this methodology include:
  - Green Roofs (Including Brown Roofs)
  - Blue Roofs
  - White/Cooling Roofs
  - Rooftop Rainwater Harvesting
  - Rooftop Solar Panels

Summary of Major Benefits of Each Roof Type

	Stormwater Management	Conserving Water	Reduce excess heat due to UHI	Reduce energy costs	Energy/heat generation
Green Roofs	X		X	X	
Blue Roofs	X	X	X		
White Roofs			X	X	
Rooftop Rainwater Harvesting		X			
Rooftop Solar Panels and Solar Heaters					X

1.1-1.2 Identify Hazards and Opportunities

Part of an Environmental Audit to determine the existing environmental hazards and opportunities for sustainability.

A. Prioritize Environmental Issues

- It is critical to understand the unique environmental hazards and opportunities in the study area, and prioritize which rooftop interventions are most applicable
- The following slides elaborate on how to determine if an environmental hazard or opportunities exists, and steps to evaluate which rooftop intervention can be used

A.1 Identify Hazards and Opportunities - Stormwater

Identify hazards

1. Identify if area has a high flood probability through FEMA National Flood Hazard Layer or First Street Foundation Flood Model
2. Determine major contributions to flood risk

Identify opportunities

1. Identify capacity and problems with current stormwater management system
2. Determine priorities for stormwater management, and evaluate if rooftop solutions should be prioritized
3. Identify and inventory all eligible roofs

Choosing a solution

1. Evaluate green vs. blue roofs to determine which should be implemented

A.2 Identify Hazards and Opportunities - Water Conservation

Identify hazards

1. Identify if area is experiencing water scarcity, or can otherwise benefit from capturing stormwater

Identify opportunities

1. Determine priorities for water conservation, and evaluate if rooftop solutions should be prioritized over other options
2. Identify and inventory all eligible roofs

Choosing a solution

1. Evaluate rainwater harvesting vs. blue roofs to determine which should be implemented

A.3 Identify Hazards and Opportunities – UHI

Identify hazards

1. Design an approach for assessing your city's heat island
2. Conduct UHI assessment
3. Determine major contributions to urban heat island

Identify opportunities

1. Determine priorities for mitigating UHI, and evaluate if rooftop solutions should be prioritized over other options
2. Identify and inventory all eligible roofs

Choosing a solution

1. Evaluate green roofs vs. blue roofs to determine which should be implemented

A.4 Identify Hazards and Opportunities – Energy Cost Reduction

Identify hazards

1. Determine the energy needs and burden of the area

Identify opportunities

1. Determine priorities for decreasing energy costs, and evaluate if rooftop solutions should be prioritized over other options
2. Identify and inventory all eligible roofs

Choosing a solution

1. Evaluate green roofs vs. blue roofs to determine which should be implemented

A.5 Identify Hazards and Opportunities – Solar Energy/Heat Generation

Identify Hazards (There are no hazards)

Identify Opportunities

1. Determine if Solar Should be Prioritized over other forms of rooftop use
2. Evaluate Solar Feasibility Through Data Analysis
    1. For Panels: Roof Analysis, Solar Radiation Analysis
    2. For Water Heater: Roof Analysis
3. Identify and Inventory all Eligible Roofs

Choosing a Solution

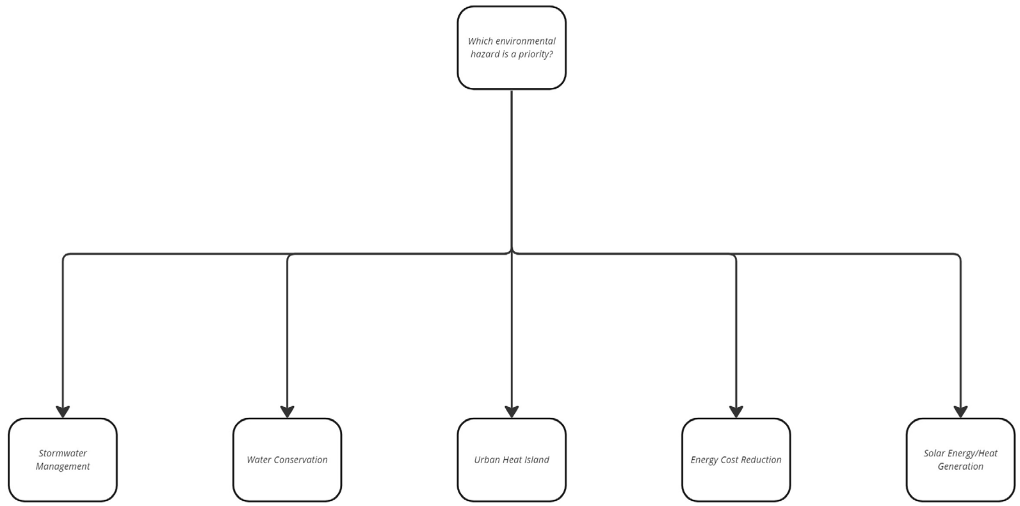
1. Evaluate solar panels vs solar heating to determine which should be implemented, if not both

2 Site Feasibility Evaluation

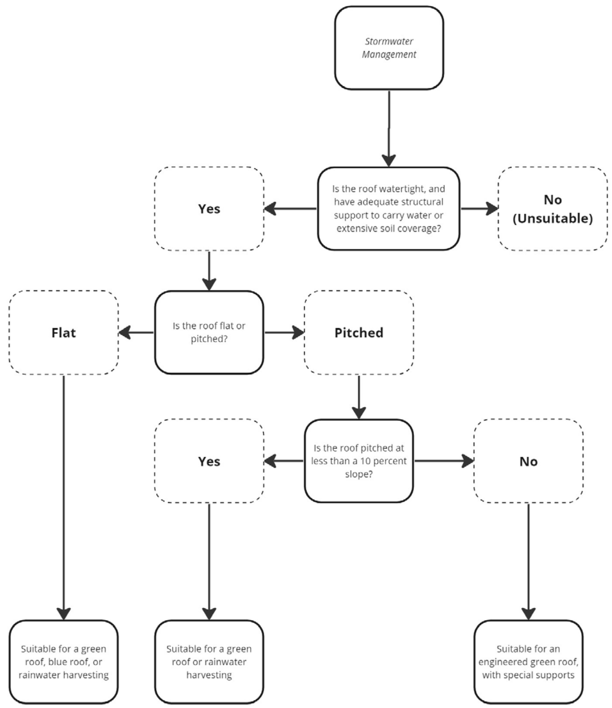
Feasibility Studies

A. Evaluate Type of Intervention

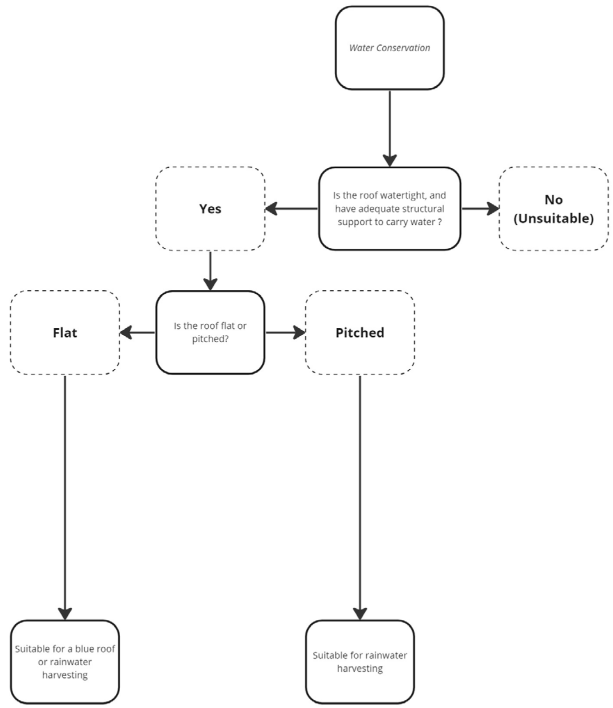
- All sites that are inventoried should be reviewed for feasibility
- Many sites may have multiple potential interventions. In these situations, priorities and community preferences should be evaluated



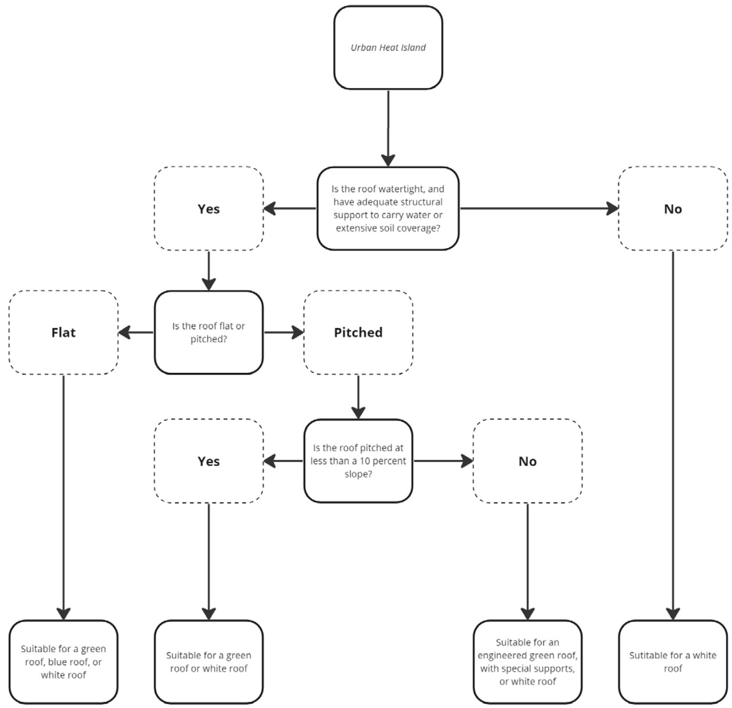
Flowchart for Choosing Objectives/Priorities with Rooftop Design Interventions



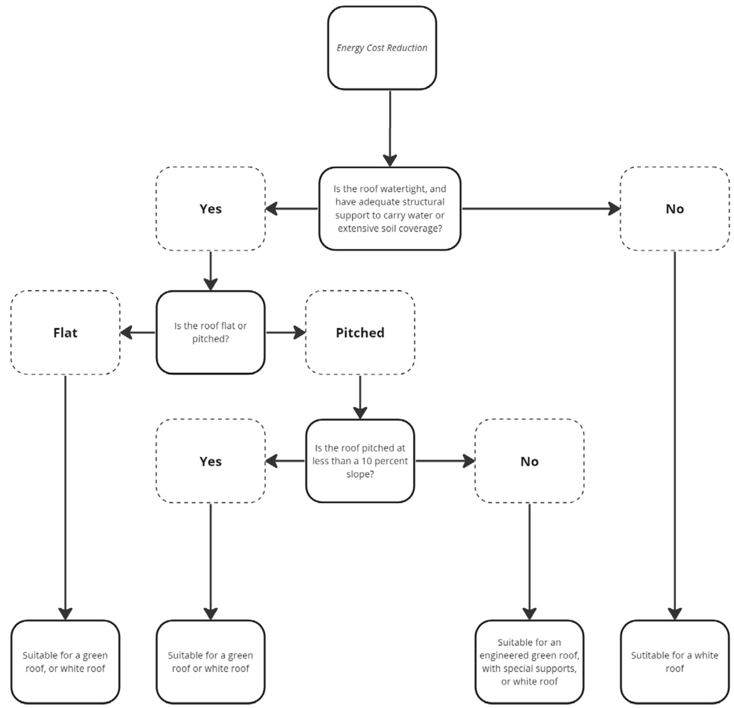
Flowchart for Evaluating Interventions for Stormwater Management



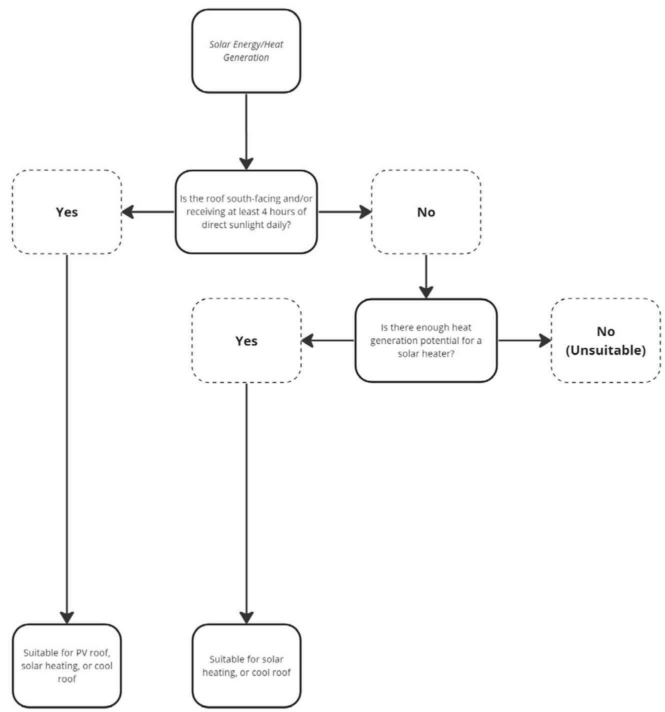
Flowchart for Evaluating Interventions for Water Conservation



Flowchart for Evaluating Interventions for Urban Heat Island Reduction



Flowchart for Evaluating Interventions for Energy Cost Reduction



Flowchart for Evaluating Interventions for Solar Energy/Heat Generation

B. Use a scoring matrix to determine which projects to implement

- Use criterion such as:
  - Environmental impact,
  - Ease of implementation,
  - Governance,
  - Cost,
  - Funding potential,
  - Community ranking,
  - Environmental metrics such as clean energy generation, decarbonization, stormwater management, and heat island mitigation.

IV. Solution Evaluation Matrix

Intervention or Solution	Positive environmental impact 1 = least 5 = most	Ease of implementation 1 = difficult 5 = easiest	Governance 1 = least agency 5 = most agency	Cost 1 = high cost 5 = low cost	Funding potential 1 = least 5 = most	Ability to advance justice 1 = least impact 5 = most impact	Workplace development or entrepreneurship oppertunities 1 = least 5 = most	Community ranking 1 = lowest 5 = highest	Total Score
Site 1	*4*	*3*	*1*	*4*	*4*	*2*	*3*	*4*	***25***
Site 2	*5*	*2*	*3*	*2*	*4*	*3*	*4*	*3*	***26***
Site 3	*3*	*5*	*4*	*4*	*3*	*2*	*3*	*2*	***26***
Site 4	*5*	*4*	*4*	*3*	*5*	*4*	*3*	*5*	***33***
Site 5	*2*	*4*	*3*	*2*	*2*	*5*	*2*	*3*	***23***

Scoring Matrix for Potential Interventions

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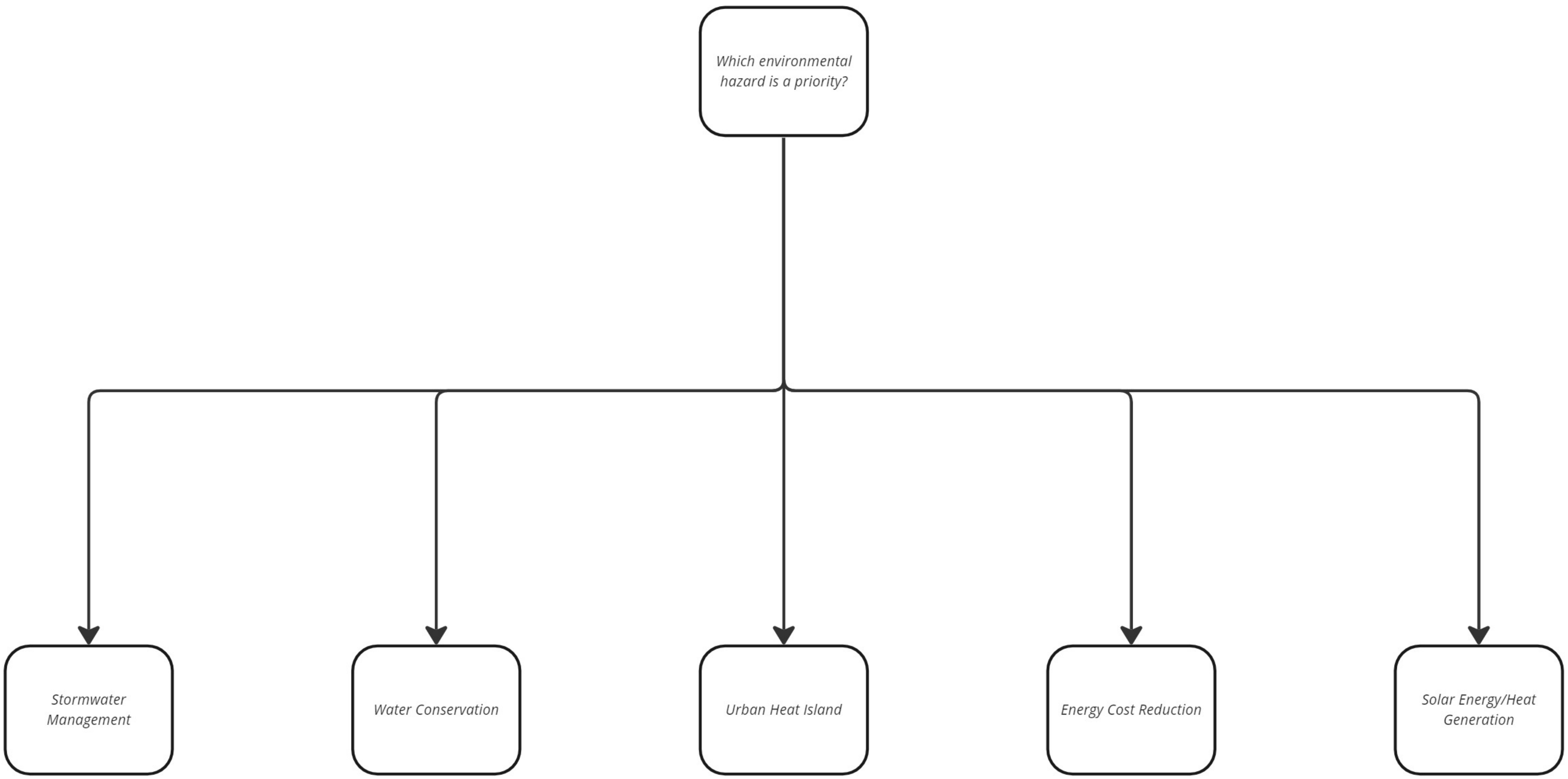
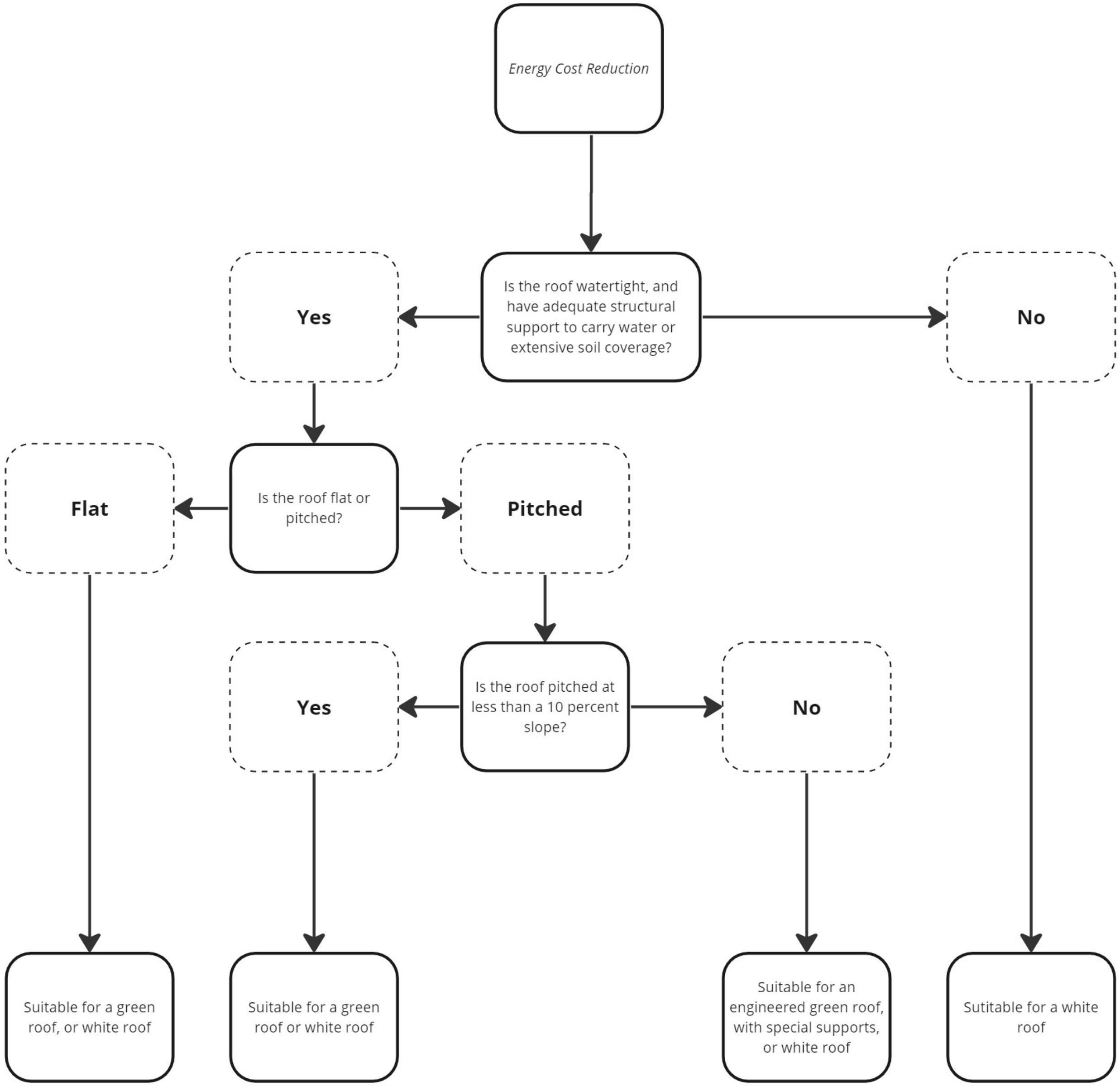
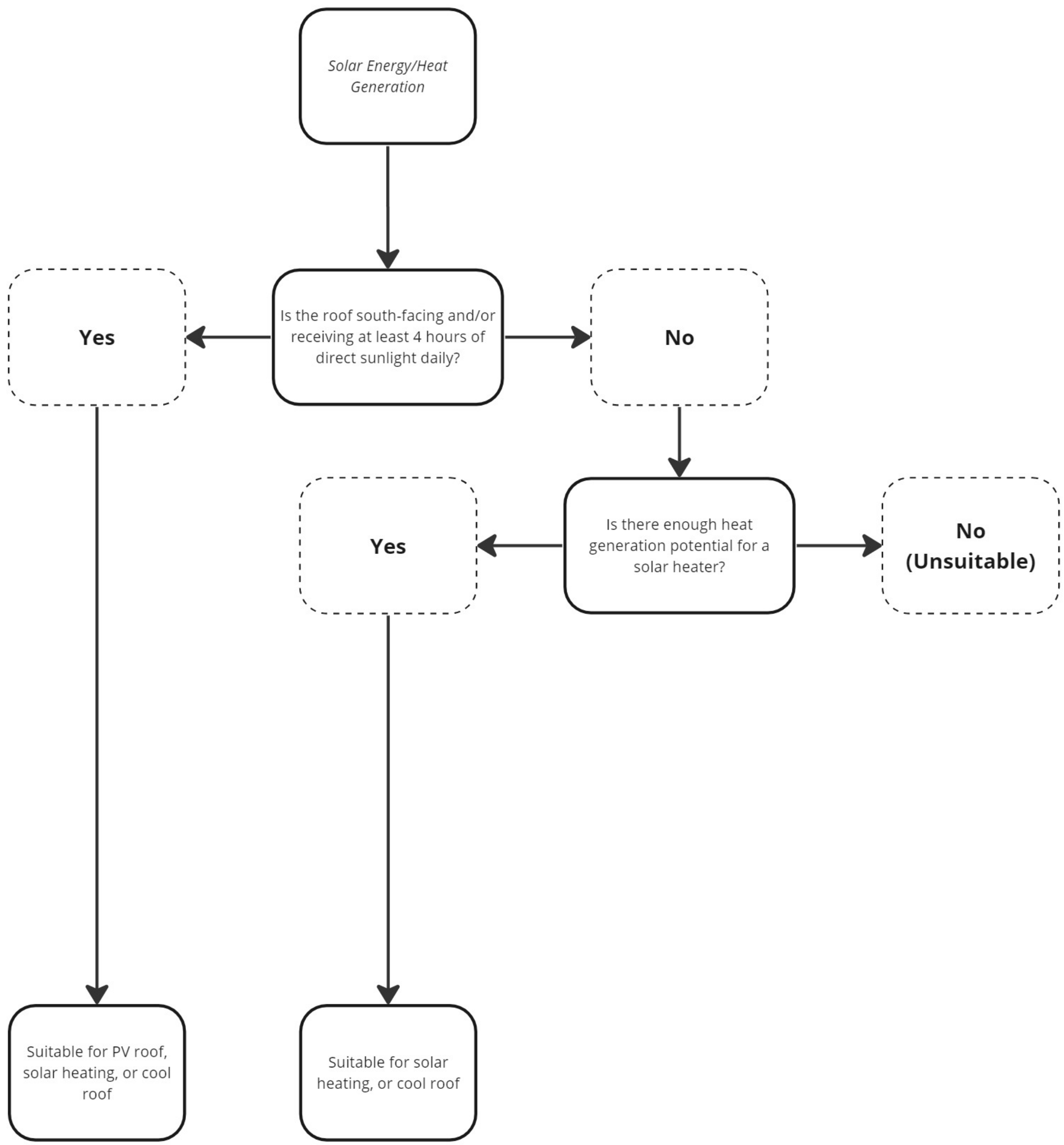
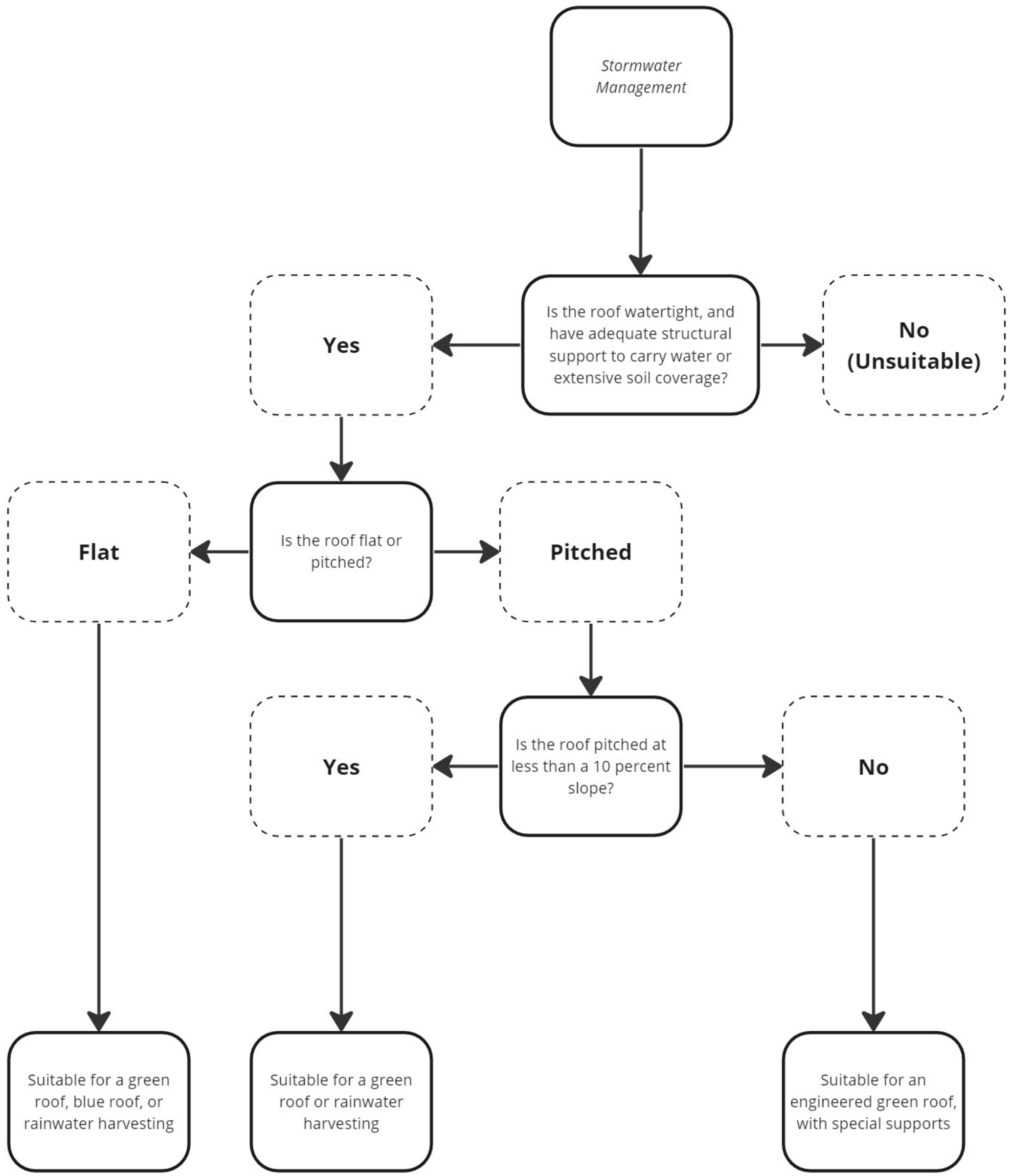

Which environmental hazard is a priority?
Stormwater Management
Water Conservation
Urban Heat Island
Energy Cost Reduction
Solar Energy/Heat Generation

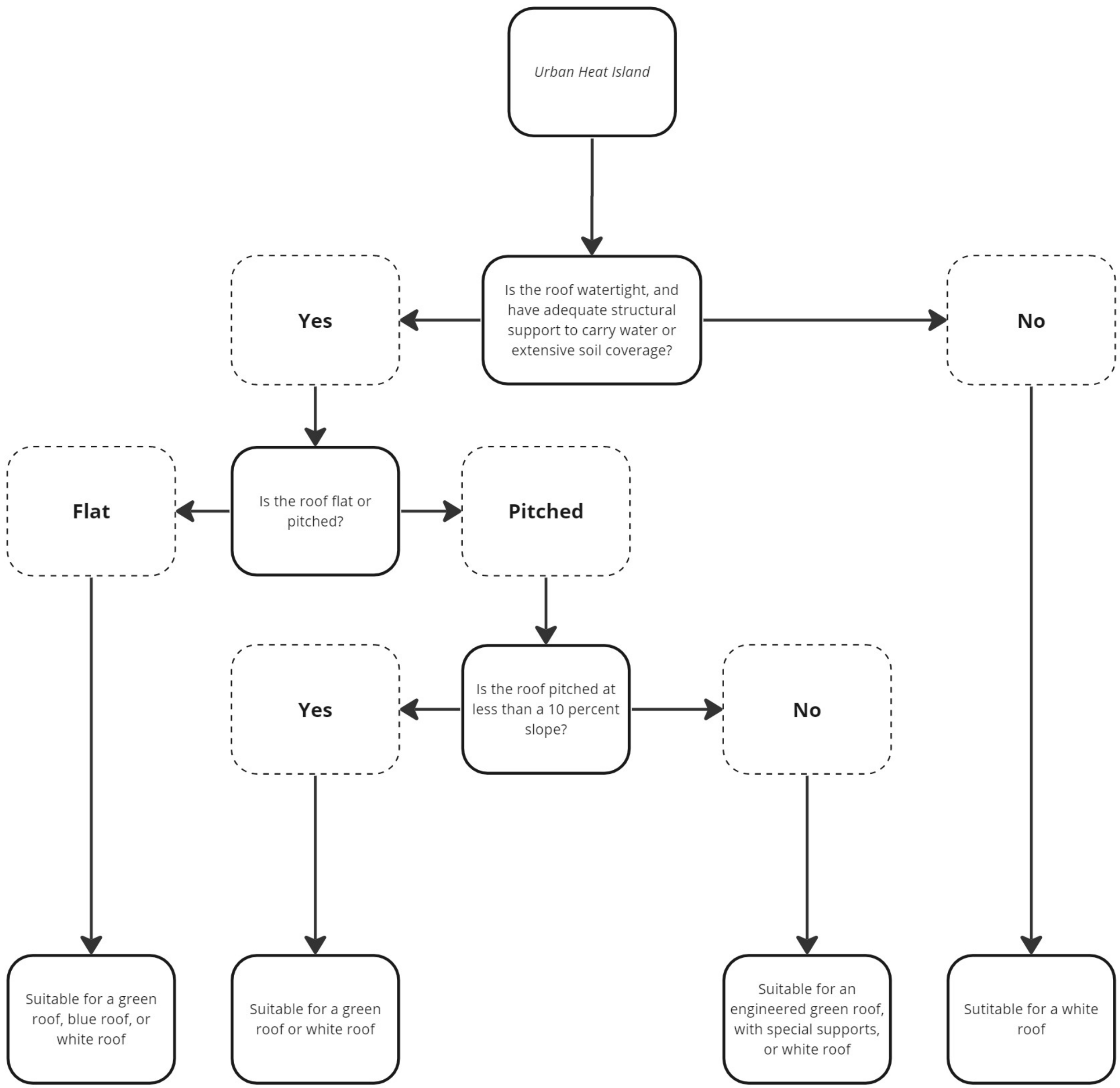

Energy Cost Reduction
Is the roof watertight, and have adequate structural support to carry water or extensive soil coverage?
Yes
No
Is the roof flat or pitched?
Flat
Pitched
Is the roof pitched at less than a 10 percent slope?
Yes
No
Suitable for a green roof, or white roof
Suitable for a green roof or white roof
Suitable for an engineered green roof, with special supports, or white roof
Sutitable for a white roof

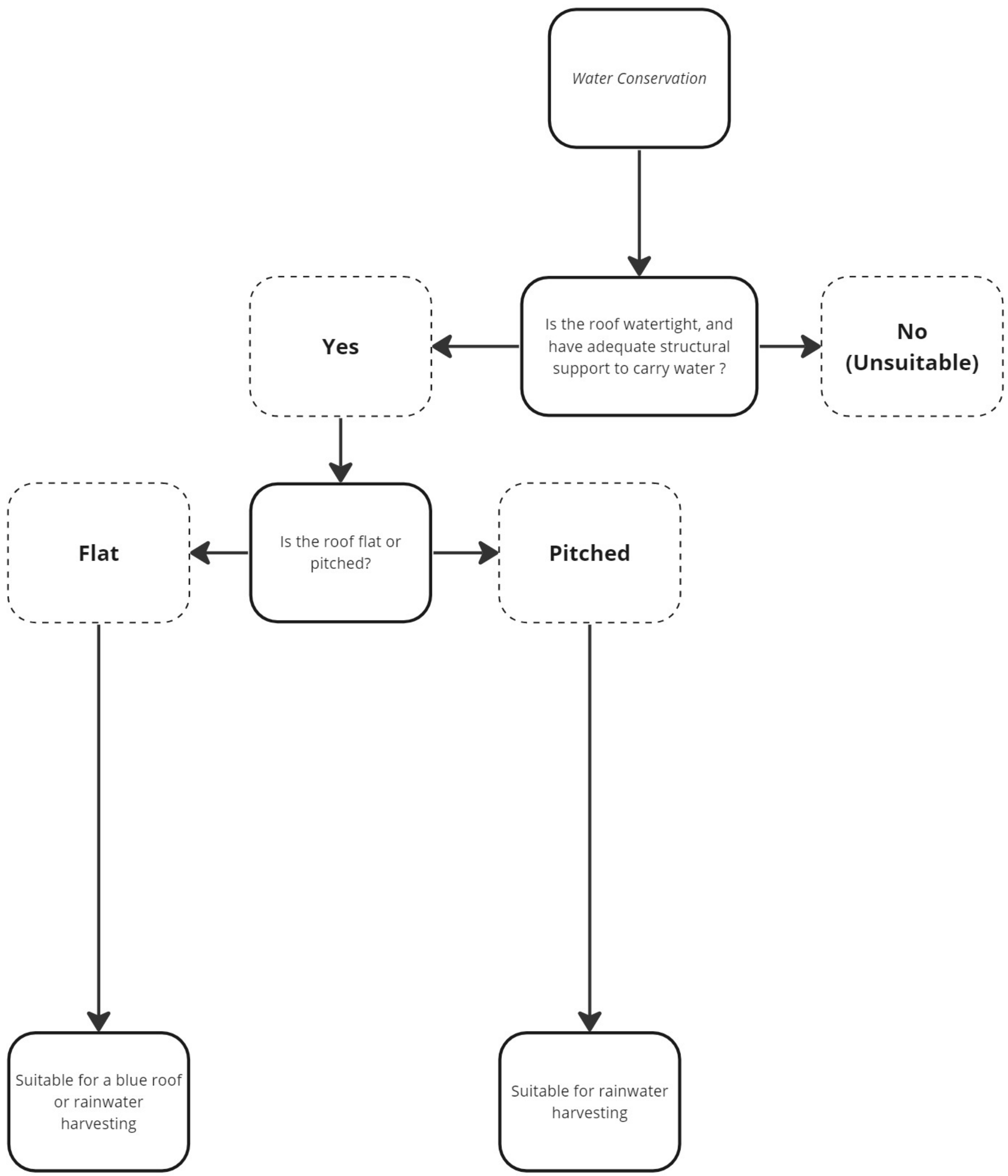


Solar Energy/Heat Generation
Is the roof south-facing and/or receiving at least 4 hours of direct sunlight daily?
Yes
No
Is there enough heat generation potential for a solar heater?
Yes
No (Unsuitable)
Suitable for PV roof, solar heating, or cool roof
Suitable for solar heating, or cool roof



Stormwater Management
Is the roof watertight, and have adequate structural support to carry water or extensive soil coverage?
Yes
No (Unsuitable)
Is the roof flat or pitched?
Flat
Pitched
Is the roof pitched at less than a 10 percent slope?
Yes
No
Suitable for a green roof, blue roof, or rainwater harvesting
Suitable for a green roof or rainwater harvesting
Suitable for an engineered green roof, with special supports


Urban Heat Island
Is the roof watertight, and have adequate structural support to carry water or extensive soil coverage?
Yes
No
Is the roof flat or pitched?
Flat
Pitched
Is the roof pitched at less than a 10 percent slope?
Yes
No
Suitable for a green roof, blue roof, or white roof
Suitable for a green roof or white roof
Suitable for an engineered green roof, with special supports, or white roof
Sutitable for a white roof


Water Conservation
Yes
Is the roof watertight, and have adequate structural support to carry water ?
No (Unsuitable)
Flat
Is the roof flat or pitched?
Pitched
Suitable for a blue roof or rainwater harvesting
Suitable for rainwater harvesting

Photovoltatic Panels (Solar Panels)

Summary

A solar panel, also known as a photovoltaic (PV) panel or module, is a device that converts sunlight into electricity through the photovoltaic effect. Solar panels are a key technology in the field of solar energy, enabling the conversion of sunlight into clean and renewable electricity. They are widely used in residential, commercial, and utility-scale applications to generate electricity for a wide range of purposes, including powering homes, businesses, and even supplying electricity to the grid.

On buildings, solar panels are often connected to the electrical grid. Excess electricity generated by the solar panels can be fed back into the grid, earning credits or compensation through net metering or feed-in tariff programs. This allows buildings to draw electricity from the grid when solar generation is insufficient and export surplus electricity when solar generation exceeds demand.

Considerations

- **Widely available and low-maintenance sustainable energy generation**
- **Cost-saving, or even revenue-generating, from reduced reliance on grid energy**
- **Often have a very high upfront capital costs, even with rebate programs**
- **Panels do not generate electricity on cloudy days or at night, requiring alternative backup energy sources**

Solar Water Heaters

Summary

A solar water heater, also known as a solar thermal system or solar hot water system, is a device that utilizes sunlight to heat water for various purposes, such as domestic use, space heating, or industrial processes. It is a renewable and energy-efficient alternative to conventional water heating methods.

The solar water heater has a solar collector, which is usually mounted on the roof or in an area with optimal sun exposure. The collector absorbs solar radiation and converts it into heat. Within the collector, there are tubes or channels that contain a heat transfer fluid. The heat transfer fluid absorbs the heat from the collector and circulates it to the storage tank to heat water.

Considerations

- **Solar water heaters save money on gas or electric bills, and are cost-saving in the long-term**
- **Require minimal maintenance, and are designed to be durable and reliable**
- **Often have a very high upfront capital cost**
- **Requires a roof that can support the weight**
- **Heaters do not produce heat on cloudy days or at night, and may need a backup heating element**

Green Roofs

Summary

Green roofs, also known as vegetative or living roofs, are roof systems that are partially or completely covered with vegetation and growing medium. They provide a layer of living plants on top of a building, creating a green space that offers numerous environmental, aesthetic, and functional benefits.

The benefits of green roofs include stormwater management, improved air quality, biodiversity and habitat creation, energy efficiency, and aesthetics. Green roofs are increasingly popular in urban areas where open space is limited, and there is a growing emphasis on sustainable and environmentally friendly building practices.

Considerations

- **Decreases stormwater runoff by catching rainwater above ground**
- **Has many additional benefits, including reducing urban heat island, and ecological benefits.**
- **Depending on the extensiveness of the green roof, buildings must have enough structural support to support the growth medium**
- **Can sometimes be costly to construct, especially slanted roofs**
- **Must be properly maintained, with service access for maintenance workers**

Cool Roofs and Cool Pavement

Summary

Cool roofs and cool pavements are sustainable materials designed to reflect more sunlight and absorb less heat compared to traditional roofing and paving materials.

Cool roofs have high solar reflectance, which refers to their ability to reflect sunlight back into the atmosphere. They can reflect 50% to 90% of the solar radiation, while traditional dark-colored roofs may only reflect about 5% to 20%. By reflecting more sunlight and absorbing less heat, cool roofs help reduce the heat absorbed by buildings.

Similar to cool roofs, cool pavements also reduce the amount of heat absorbed by the pavement. By reflecting more sunlight and absorbing less heat, cool pavements reduce surface temperatures, making them more comfortable for pedestrians, cyclists, and drivers.

Considerations

- **Cool roofs can be implemented on many different roof types and angles**
- **Varying capital costs, depending on material, but decrease costs associated with cooling buildings**
- **Reflective material must be maintained for optimal performance**
- **Some studies argue that cooling pavement increase glare and actually reflect heat to pedestrians**

Blue Roofs

Summary

A blue roof is a type of rooftop infrastructure designed to manage stormwater runoff in urban areas. It is a technique used to mitigate the negative impacts of urbanization on water systems by reducing the volume and rate of stormwater runoff, as well as improving water quality.

Blue roofs help to alleviate these issues by temporarily storing rainwater on rooftops and slowly releasing it back into the drainage system or allowing it to evaporate over time. This process reduces the peak flow rate during heavy rain events and helps prevent overwhelming the stormwater infrastructure.

Detention blue roofs are designed to store and slowly release rainwater. They use various mechanisms such as specially designed outlets, flow restrictors, or control devices to regulate the discharge rate. Retention blue roofs are designed to hold water for longer periods, allowing it to slowly evaporate or be absorbed by plants on the roof.

Considerations

- **Blue roofs reduce stormwater runoff and slow the flow of runoff**
- **Must have a flat roof, and a roof that can handle the weight of water**
- **Can be expensive to implement, and must be maintained regularly to ensure longevity**

Rainwater Harvesting (Residential)

Summary

Rainwater harvesting is the process of collecting and storing rainwater for later use. In resiential settings, it most often involves capturing rainfall from rooftops and channeling it into storage tanks or cisterns. This harvested rainwater can then be used for various non-potable purposes, such as irrigation, watering plants, washing clothes, and flushing toilets. Non-potable water is not suitable for drinking but may still be used for other purposes.

The basic components of a rainwater harvesting system typically include a collection surface, such as a roof, a gutter or a series of pipes to direct the flow of rainwater, a filter to remove debris and impurities, a storage tank to hold the collected water, and a distribution system to supply water where it is needed.

Considerations

- **Can reduce stormwater runoff**
- **Especially well-suited for drier climates and drought-affected areas**
- **Reduces costs for potable water, which provides cost savings long-term**
- **Can be simple, cheap, and accessible to most homeowners**
- **Requires a water-tight, impervious roof surface**
- **May require permits or compliance with restrictions in order to collect rainwater in some states**

Rainwater Harvesting (Commercial)

Summary

Similarly to residential rainwater harvesting, commercial harvesting involves collecting and storing rainwater for later use. Commercial systems are designed to meet the water demands of larger buildings, facilities, or commercial operations. They have a higher capacity for water storage, and the scale can range from moderate-sized structures to large-scale commercial or industrial facilities.

Commercial operations may have more diverse and substantial water demands. They can use rainwater for non-potable applications, and, in some cases, for potable uses (after appropriate treatment). Additionally, commercial systems tend to be more complex. The design may involve multiple collection areas, like plazas and large roofs, larger storage tanks or cisterns, advanced filtration and treatment systems, and pumps to distribute water throughout the facility.

Considerations

- **Can reduce stormwater runoff significantly**
- **Requires large, impervious surfaces to collect water, which can range in scale and use**
- **High upfront capital cost, but reduces costs for potable water, which provides cost savings long-term**
- **Due to impact on water resources, may face more stringent regulations and permitting processes**

Brown Roofs

Summary

A brown roof refers to a type of sustainable roofing system that involves intentionally creating a biodiverse environment on the roof of a building. They are a type of green roof. Unlike traditional roofs, a brown roof is designed to mimic natural landscapes and provide habitats for various plant species, insects, and wildlife. The term "brown" in "brown roof" refers to the earthy and natural appearance that these roofs tend to have, resembling undeveloped or wild areas. As a subset of green roofs, benefits of a brown roof include stormwater management, improved air quality, biodiversity and habitat creation, energy efficiency, and aesthetics.

Considerations

- **In addition to other green roof benefits, emphasis on ecological systems**
- **Decreases stormwater runoff by catching rainwater above ground**
- **Has many additional benefits, including reducing urban heat island, and ecological benefits.**
- **Depending on the extensiveness of the green roof, buildings must have enough structural support to support the growth medium**
- **Can sometimes be costly to construct, especially slanted roofs**
- **Must be properly maintained, with service access for maintenance workers**

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Section 6 - Appendix and References

Section Contents

Subsection 1: The First Environmental Audit: Greater Grove Hall Main Streets' Case Study

i. Original Grove Hall Environmental Audit Case Study
ii. Addressing Environmental Justice in Grove Hall: Landscape Analysis to Identify Environmental Challenges and Mitigation Solutions
iii. Grove Hall Overview

Creating a Green Zone would help pilot ideas for

• The Greater Boston area

• Addressing near term environmental justice issues

• Laying the infrastructure for migration to the "highlands" as a result of rising sea levels.

• Urban seacoast cities such as New York, Miami, Philadelphia

Massachusetts ranks low on "Eco-friendly" behaviors

• According a data study from WalletHub, Massachusetts only ranks 17th on "Eco-friendly behaviors"

• "Eco-Friendly Behaviors" metrics include "Green per Capita", "Total Capacity of Solar PV Systems Installed per Household", "Share of Renewable Energy Consumption", "Green Transportation" and more.

Our goal is one planet living

One planet living is more than trying to mitigate climate change and the resulting impacts such as rising sea levels.

One planet living means we do not consume the planet's resources at a rate faster than the plant can produce them.

https://wallethub.com/edu/greenest-states/11987/

State	Eco Friendly Behavior's Rank
Oregon	1
California	2
Vermont	3
Minnesota	4
Maryland	5
Maine	6
Washington	7
New York	8
Connecticut	9
Colorado	10
New Jersey	11
Pennsylvania	12
Hawaii	13
Wisconsin	14
Nevada	15
Delaware	16
Massachusetts	17

Achieving one planet living

• By 2050, 89% of the U.S. population and 68% of the world population is projected to live in urban areas.

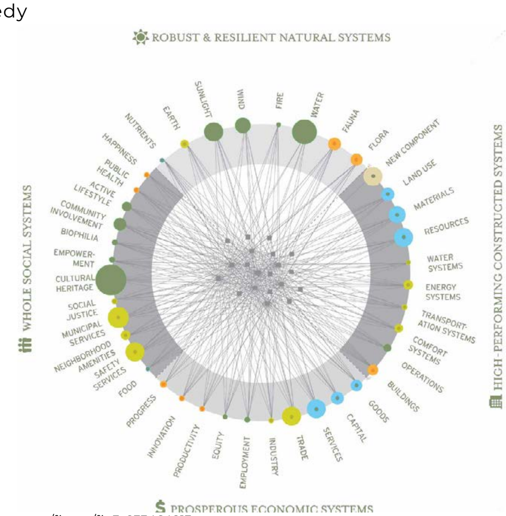
• Since most of the planet will be living in urban areas, we have to figure out how to make our urban areas more sustainable.

• Given the size and scale of the problem, it can't just be left to the few who have the luxury to think about problems 50 years from now, it has to include everyone.

The need to move with a sense of urgency

• "The best time to plant a tree was 20 years ago. The second-best time is now."
– Chinese Proverb

• "The great French Marshall Lyautey once asked his gardener to plant a tree. The gardner objected that the tree was slow growing and would not reach maturity for 100 years. Then Marshall replied: in that case, there is no time to lose, plant it this afternoon."
– John Kennedy



https://www.researchgate.net/figure/fig3_233464813

Boston will be heavily affected by rising sea levels

• According to NOAA sea level viewer, at 6ft, Boston stands the risk of having 60% of its area flooded and residences and business displaced.

• The Commonwealth stands the risk of having 309,220 individuals displaced from their homes and fleeing to the "highlands" in Grove Hall.

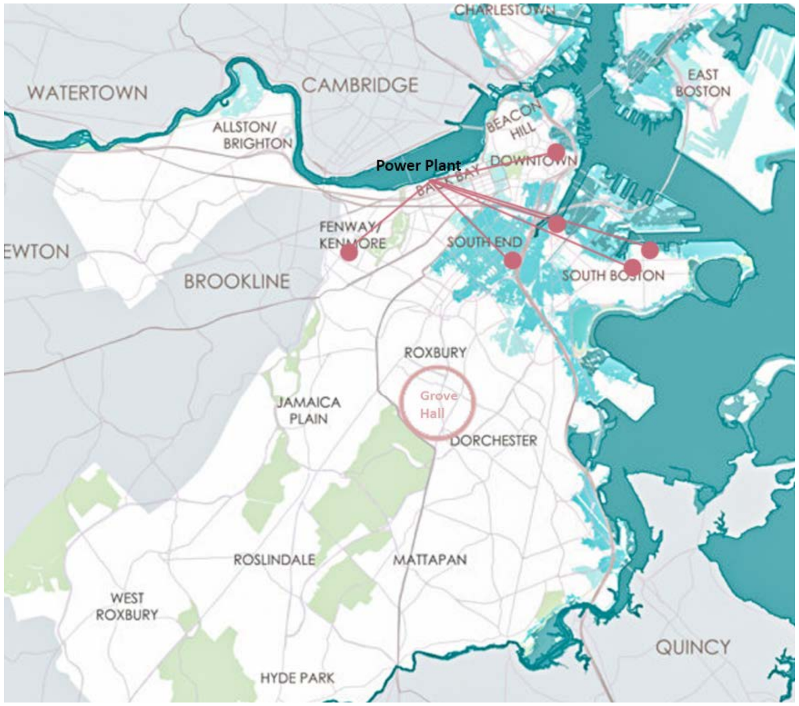
Map Source : Norman B. Leventhal Map Center Collection

Boston's transportation infrastructure will be severely affected

• With 6 ft sea level rise, major infrastructures such as the Interstate 93, Central Artery, Harbor tunnels, Logan International Airport will be damaged.

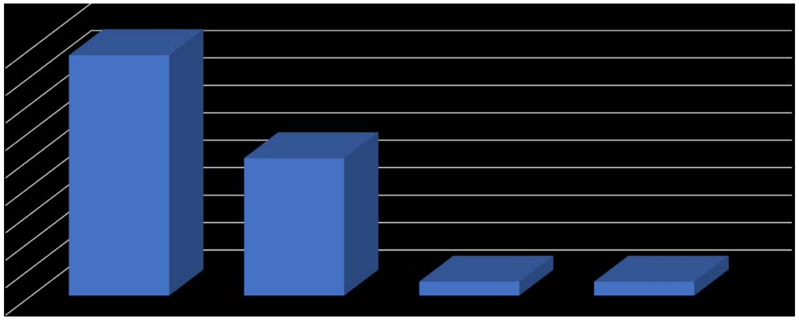
Boston's power plants will be severely impacted

With 6ft sea level rise, multiple power plants will be damaged.



Greater Grove Hall - The Highlands 100-200 Ft above Sea Level

Grove Hall elevation compared to other areas in Boston



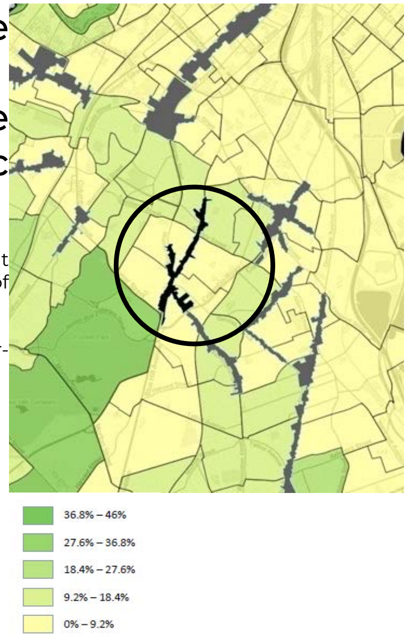
The Greater Grove Hall area: Lacks critical green infrastructure

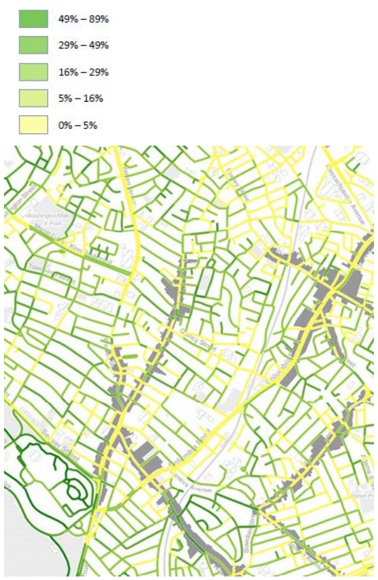
- Little to no tree canopy
- High percentage of impervious surfaces
- Severe heat island effects

The Greater Grove Hall area: Low amount of tree canopy in public areas

• The Greater Grove Hall area (in light green) represents the lowest amount of tree canopy at 4% - 10% in public areas.

• Greener color = more tree canopy coverage





The Greater Grove Hall area: Little tree canopy on main streets

• In the Greater Grove Hall area, main streets such as Blue Hill Ave., Warren St., Washington St. and Columbia Rd. have little tree coverage at 0-1%.

The Greater Grove Hall area: Overall, the area has little to no tree canopy

• Data diagrams and street view photos show how little tree canopy the area has.

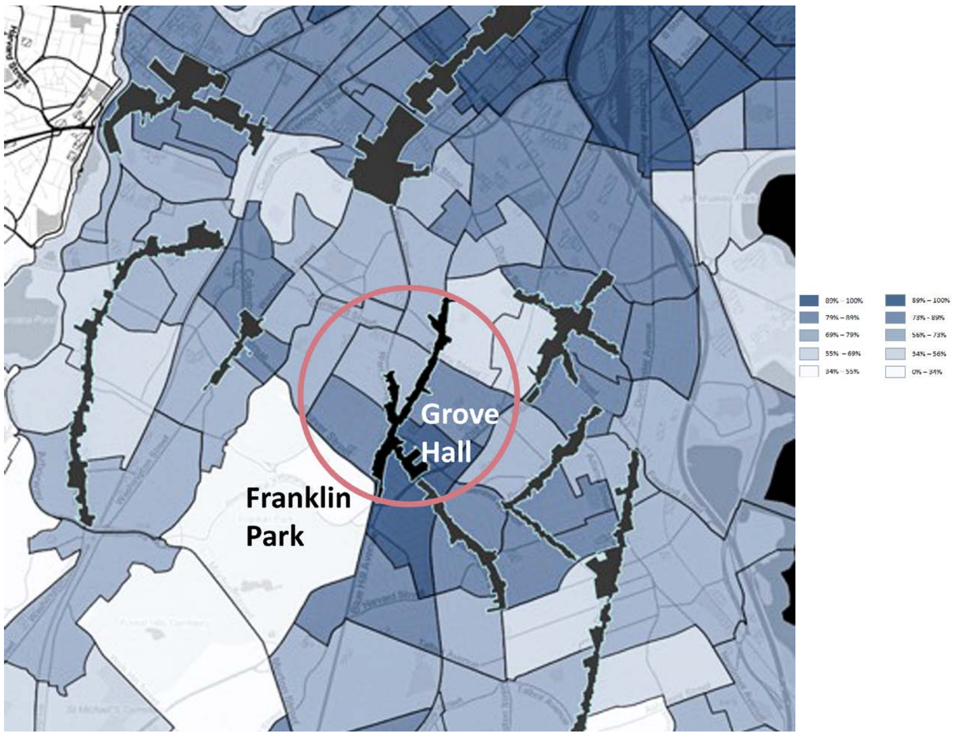
The Greater Grove Hall area: High amount of impervious surfaces

• Impervious surfaces: artificial structures such as cement pavement, asphalt, etc.

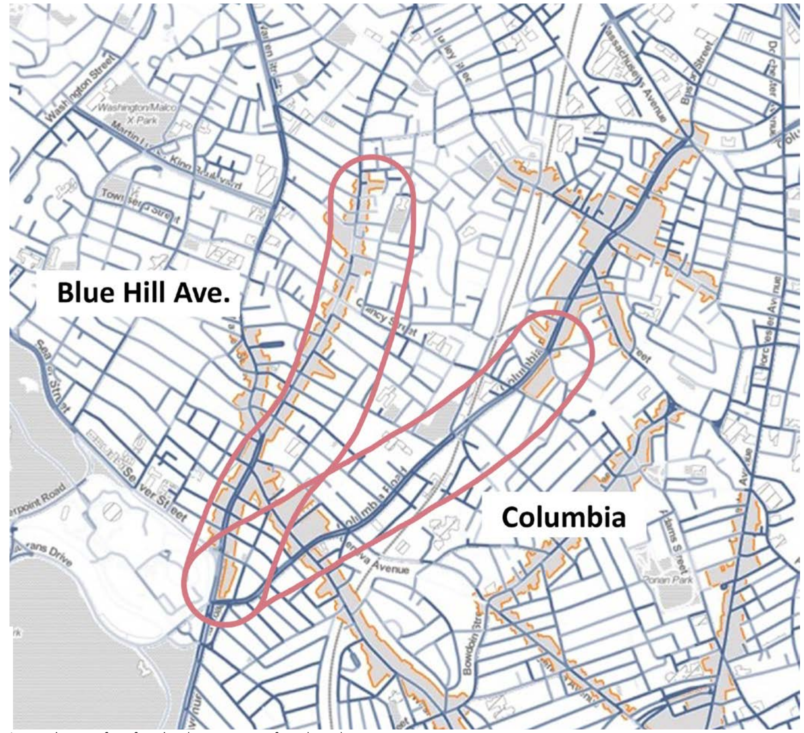
• The Greater Grove Hall area (in dark blue) represents a high amount of impervious surfaces at 74% - 91% .

• Darker color = less permeability

• This contributes to problems such as stormwater runoff and heat islands.



Impervious surface fraction (percentage of land surface area)



Impervious surface fraction (percentage of road area)

The Greater Grove Hall area: Impervious surfaces on main streets

Main streets such as Blue Hill Ave. and Columbia Rd. are highly impervious at 96% - 100%.

The Greater Grove Hall area: High amount of surface parking lots

• There are about 25 surface parking lots, publicly and privately owned, in the Greater Grove Hall area.

• These impervious surfaces contribute to the heat island effect, and stormwater runoff problems.

Surface parking lots

The Greater Grove Hall area: Low percentage of tree canopy and high amount of impervious surfaces result in urban heat island

The Greater Grove Hall area has less surface light reflection at 12% and absorbs more sunlight

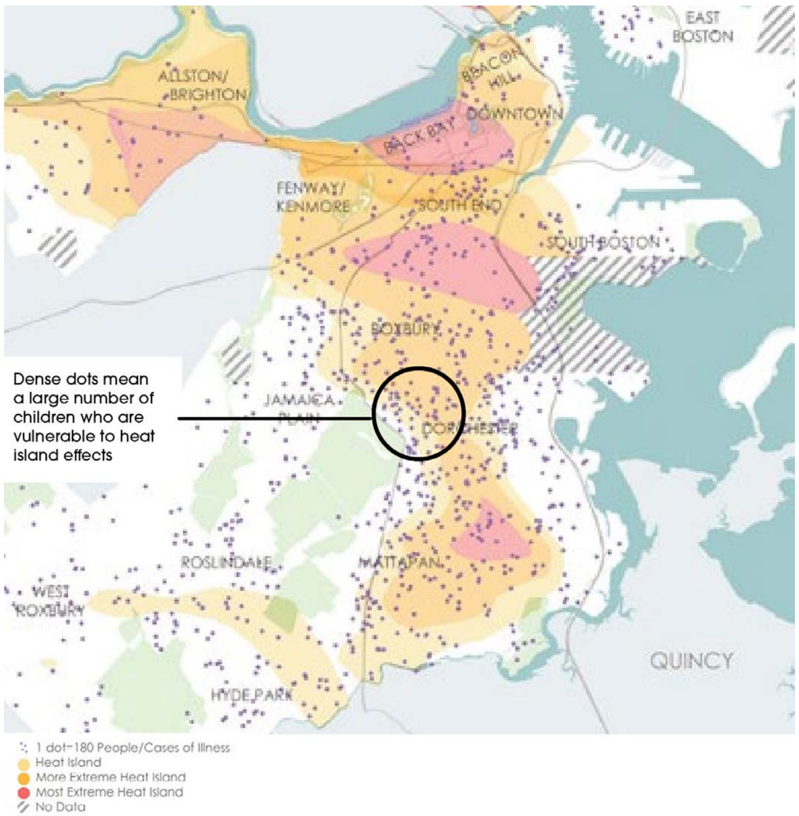
Darker color = lower light reflection

The Greater Grove Hall area has high land surface temperatures at 98 – 102 F

Darker color =higher temperature

The Greater Grove Hall area: Large vulnerable population, susceptible to heat island effects

• The Greater Grove Hall area has a lot of children (more than 10,800 people under 18 years old) vulnerable to severe heat island effect.



Source: Climate Ready Boston Vulnerability Assessment
https://www.boston.gov/sites/default/files/imce-uploads/2017-01/crb_-_focus_area_va.pdf

Urban heat Islands are catalysts for health problems

·Global temperature rise
·Loss of green cover
·Impervious paving
·Increased emissions
·Building materials that retain heat (brick, stone)

·Increases energy costs (e.g., for air conditioning)
·Increase air & water pollution levels
·Heat-related illness

·Neighborhoods and communities disproportionately affected
·Increased health problems (lung and respiratory infections)
·Reduced quality of life, increased cost of living
·Mortality

The Greater Grove Hall area: Suffers from health & safety related problems

• Physical inactivity

• Chronic health problems such as obesity

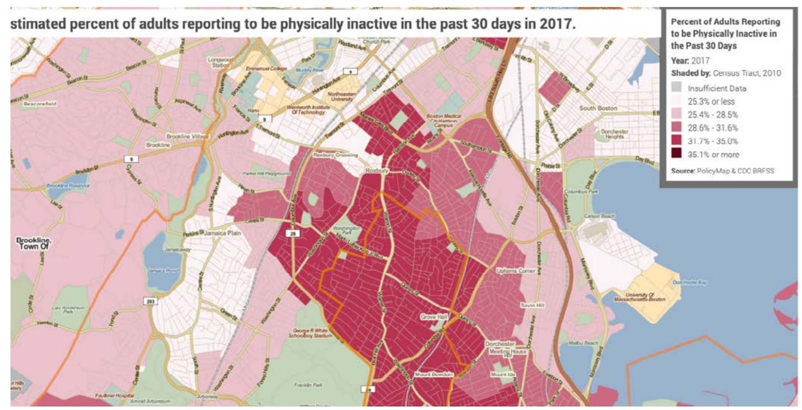
• High percentage of people experiencing poor mental health

• Large number of medical emergencies

Physical activity

A lot of the residents are defined as physically inactive.

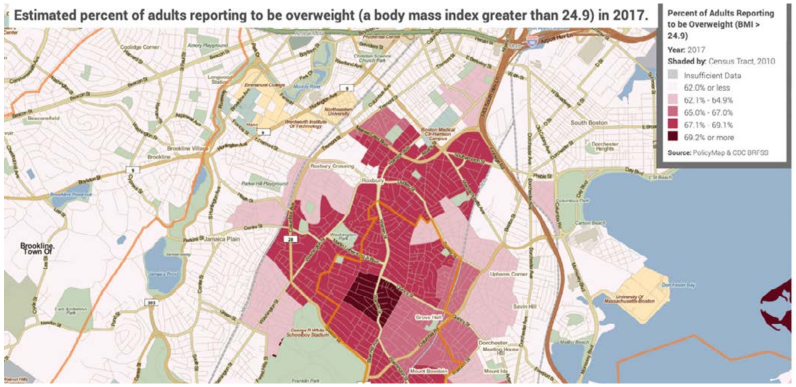
• Between 31.7% and 35% of the residents are physically inactive in the past 30 days in 2017.



Obesity

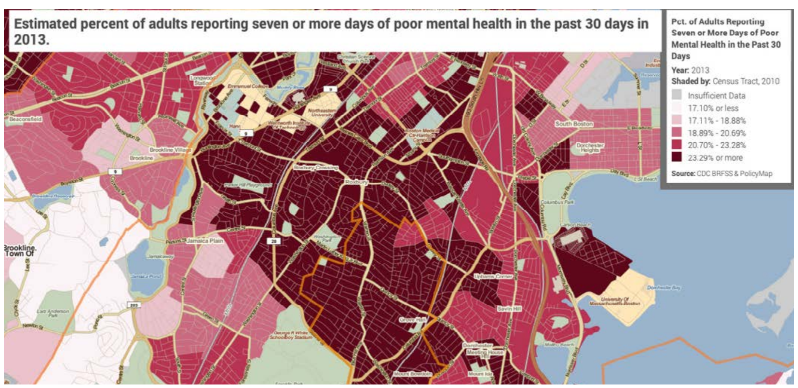
A lot of the residents are defined as overweight.

• Higher percentage of overweight population than the surrounding area.



Mental health

A lot of the residents are experiencing poor mental health
• More than 23.9% of the residents are reporting seven or more days of poor mental health in the past 30 days in 2013.



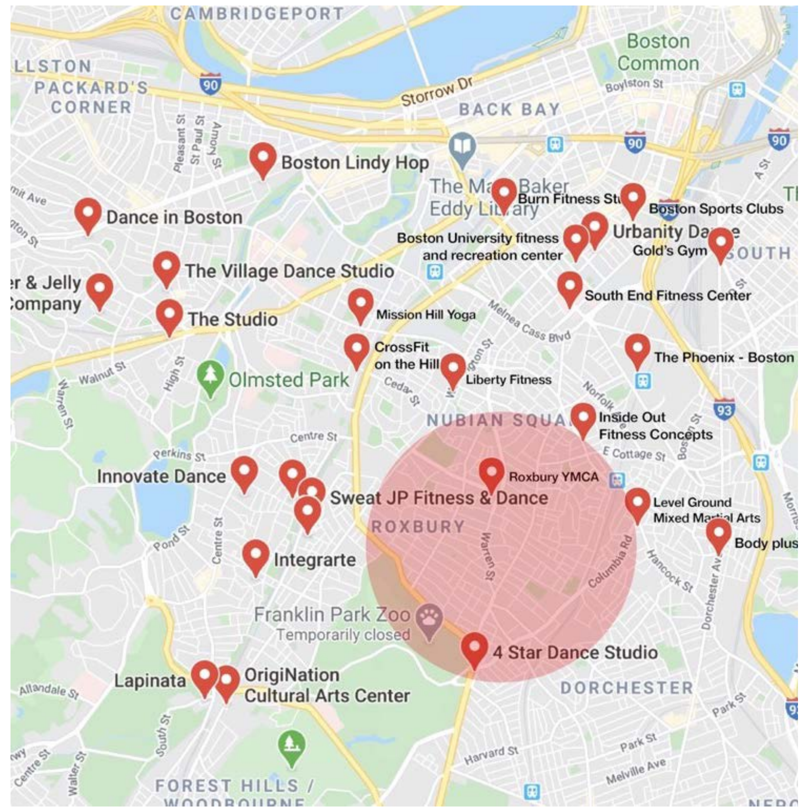
Fitness facilities

• There is a lack of fitness related business

• There are only two gym/fitness/yoga/dance/martial arts studio in the area:

- Roxbury YMCA

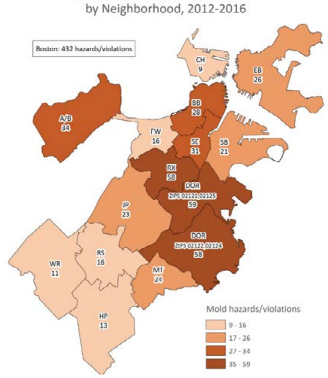
- 4 Star Dance Studio



The Greater Grove Hall area: Mold hazards

· North Dorchester and Roxbury have the highest number of mold hazards/ violations in Boston.

Figure 4.6 Mold Hazards/Violations by Neighborhood, 2012-2016

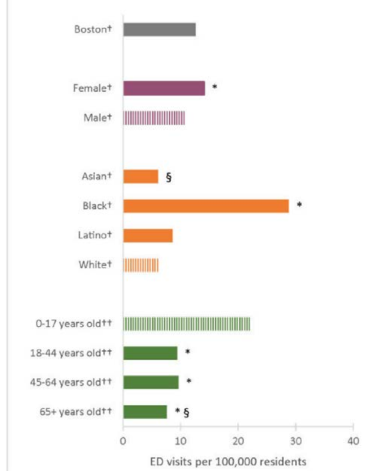


The Greater Grove Hall area: Carbon monoxide poisoning

· The Emergency Department visit rate for carbon monoxide poisoning was 4.6 times higher for Black residents (28.8) than for White residents (6.2).

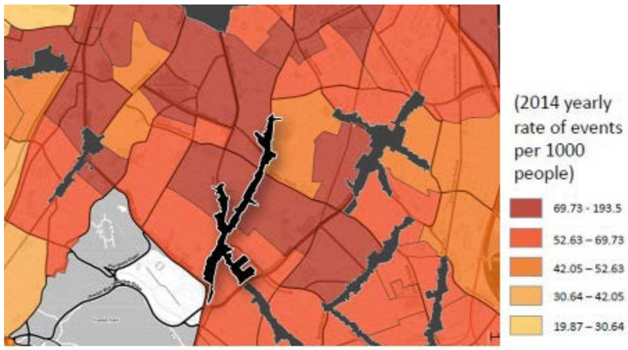
· 61.6% of the total residents in the Greater Grove Hall area are black.

Figure 4.19 Carbon Monoxide Poisoning Emergency Department Visits by Selected Indicators, 2012-2015

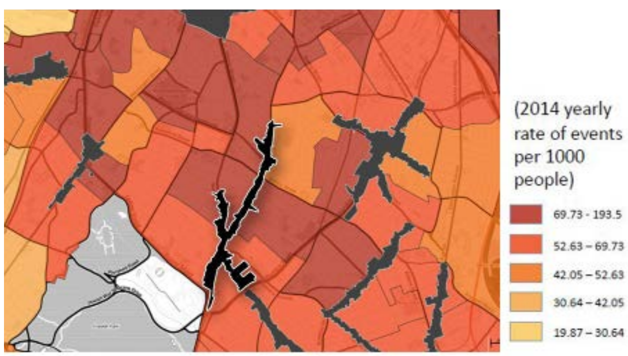


The Greater Grove Hall area: Large number of medical emergencies

• Medical Emergencies (top image):
- 65-80 cases per 1000 people in 2014
- Darker color = more prevalent medical emergencies



• Youth Health Emergencies (bottom image):
- 47-62 cases per 1000 people in 2014
- Darker color = more prevalent youth health emergencies
• The area has a higher rate of medical emergencies, especially surrounding youth health, than other areas.



Source: Boston Area Research Initiative

The Greater Grove Hall area: Public safety issues

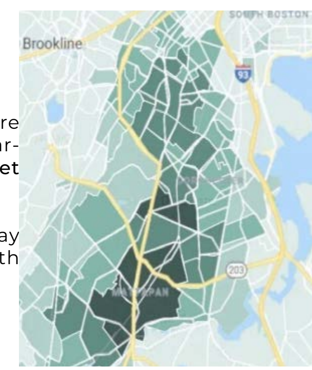
The Greater Grove Hall area: Suffers from environmental injustice

• The area suffers from poor air quality, causing increased asthma cases
• The area has a high number of vacant and distressed plots with lead contamination in the soil
• The area is exposed to a disproportionate amount of environmental hazards, making it socially vulnerable.

People of Color suffer higher health risks from traffic pollution

• Black residents of the metropolitan area are most concentrated around busy multi-lane arterials like **Columbus Avenue, Morton Street and Blue Hill Avenue**

• Airborne particulates from the SEExpressway are blown over the communities of color, with diurnal sea breezes



Higher asthma rates than the rest of Boston

Higher asthma hospitalization than the rest of Boston

The Greater Grove Hall area: Residents are disproportionately exposed to hazardous sites

· Daniel Faber, the director of the Northeastern University Environmental Justice

Research Collaborative concluded that:

"[I]f you live in a white community, then you have a 1.8 percent chance of living in the most environmentally hazardous communities in the state. However, if you live in a community of color, then there is a 70.6 percent chance that you live in one of the most hazardous towns."

The Greater Grove Hall area has the highest exposure to hazardous sites

Economic class and racial biases to exposure from hazardous sites

The leading area for brownfields in Boston

• There are three clusters of brownfields in Boston. Grove Hall has the most.

The Greater Grove Hall area: Lead contamination in the soil

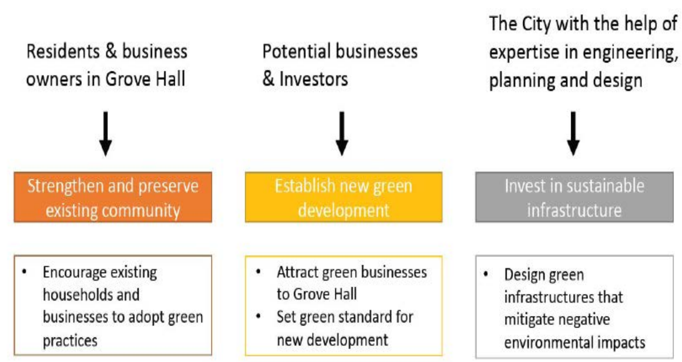
The leading site for brownfields in Boston

• There are three clusters of brownfields in Boston. Grove Hall has the most.a
• Grove Hall is the neighborhood with highest number of brownfields. There are 58 brownfields in Grove Hall.

• Grove Hall has a land area that is 3.33% of Boston but has 38.67% of all the brownfields.

The Greater Grove Hall area: Distressed properties

• According's the City's 2018 report, Roxbury and Dorchester have the highest number of distressed properties.



The Greater Grove Hall area: Distressed properties with no rehabilitation plan

• According's the City's 2018 report, Roxbury and Dorchester have the highest number

The Greater Grove Hall area: High vacancy rate

• The zip code 02121 has a high percentage of all addresses (including commercial and residential) that are vacant at 4.24% of distressed properties with no rehabilitation plan.

The Greater Grove Hall area: Meets the criteria of an Enviro metal Justice community

In Massachusetts, a community is identified as an Environmental Justice community if **any** of the following are true:

• Annual median household income is equal to or less than 65 percent of the statewide median ($62,072 in 2010, 65% is $40,346);

• Or 25% or more of the residents identify as a race other than white;

• Or 25% or more of households have no one over the age of 14 who speaks English only or very well - English Isolation

Grove Hall:
Black population: 61.6% Hispanic population: 30.6%

Grove Hall:
Median household income: $ 35,500

Grove Hall:
Speaks English less than very well: 21.2%

One of the poorest sections in the City of Boston

Median household income: 35500 (65900 - Boston)
Mean household income: 53600* (101300 - Boston)
Per capita income: 20200* (42000 - Boston)
Families below the poverty line: 30.8% (7.0% - Boston)
Unemployment rate: 13.8%* (7.2% - Boston)

The Greater Grove Hall area: One of the poorest sections in the City of Boston

Most of Boston's impoverished population is in Dorchester and Roxbury. of distressed properties with no rehabilitation plan.

One of the most culturally diverse neighborhoods in Boston

· Home to many Vietnamese, Haitian, Jamaican, Cape Verdean, Hispanic, African-American, Irish, and other populations

· However, African- Americans are the most numerous.

Source: Boston Redevelopment Authority Research Division
http://www.bostonplans.org/getattachmen t/f1ecaf8a-d529-40b6-a9bc- 8b4419587b86

The Greater Grove Hall area: High social vulnerability

· Grove Hall area has a high social vulnerability index (social vulnerab ity refers to the resilience of comm nities when confronted by external stresses on human health, stresses such as natural or human-caused d sasters, or disease outbreaks).

· More likely to face disproportionate impacts from both climate change and they are less likely to have access to the resources that buffer those impacts.

Creating an Urban Green Zone

· As a minority-majority city, Boston's climate change efforts must engage stakeholders of color.

· As minority groups in Boston and elsewhere face current threats of po erty, gentrification and displacement, they fail to perceive climate change as an urgent priority.

· A poll of African-American priorities ranked "Tackling Climate Change" 16th out of their 17 choices. Only a concerted effort of civic society, business and political leaders like the one that GGHMS is proposing (including co munity mobilization and incentives for businesses and residents) will pr duce the sustainable change we need in Boston.

Proposed Green Zone boundary

· Preliminary proposed boundary includes Grove Hall, part of Roxbury and part of North Dorchester.

· Criteria definition includes: Environmental Justice community, current state of green infrastructures, pollution, vacancy, demographics, topography, etc.

The most common elements that contribute

NEIGHBORHOOD DEVELOPMENT
Implementation of sustainable design strategies that contribute to a broad range of sustainability goals through good neighborhood design and development.

HEALTH
Implementation of sustainable design strategies that intend to improve the overall quality of life and fitness opportunities for both residents and users.

ENERGY: DISTRICT
Implementation of sustainable design strategies that reduce energy use through efficient district energy systems.

EDUCATION
Implementation of sustainable design strategies that support behaviors through education on green living for EcoDistrict residents and users, as well as the community at large.

ENERGY: BUILDING
Implementation of sustainable design strategies in the built environment that reduce the use of non-renewable, imported energy and associated greenhouse gas emissions.

HABITAT
Implementation of sustainable design strategies that promote biodiversity and responsible landscaping, even as development increases the intensity of the built environment.

TRANSPORTATION
Implementation of sustainable design strategies that reduce negative environmental impact of vehicle usage by maximizing the opportunity for walking, biking, ride-sharing, and transit use.

CULTURE
Implementation of sustainable design strategies that enrich social networks and the cultural environment.

STORMWATER & WATER
Implementation of sustainable design strategies that conserve and reuse potable water, and provide relief for stormwater runoff through natural drainage systems.

EQUITY
Implementation of sustainable design strategies that enable an EcoDistrict to benefit the broadest spectrum of people.

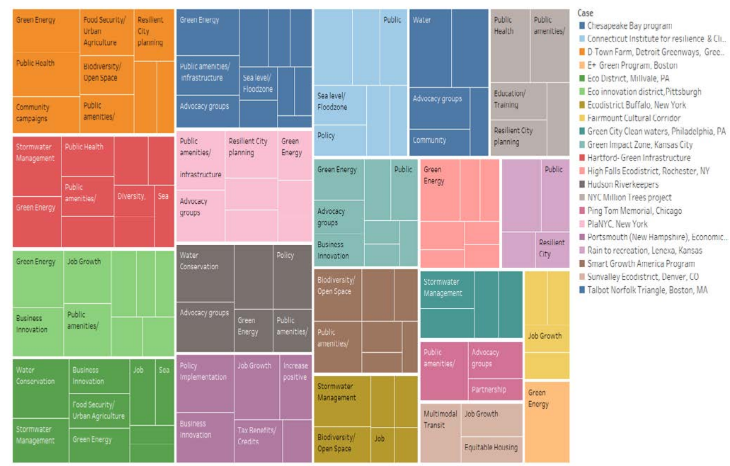
What should we do to achieve a Green Zone?

Residents & business owners in Grove Hall	Potential businesses & Investors	The City with the help of expertise in engineering, planning and design
↓	↓	↓
Strengthen and preserve existing community	Establish new green development	Invest in sustainable infrastructure

We studied 21 cases

Case studies and their focused ele-

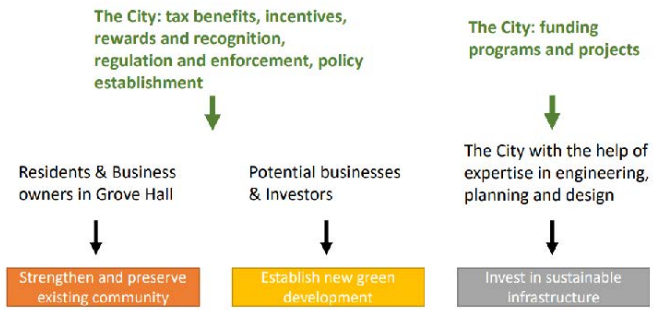
Sheet 2



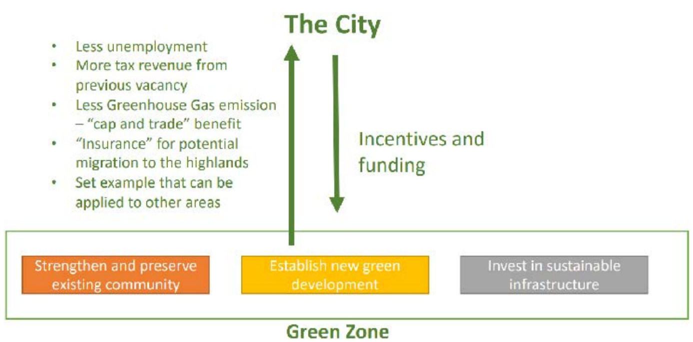
Who should take the actions?

Residents & business owners in Grove Hall	Potential businesses & Investors	The City with the help of expertise in engineering, planning and design
↓	↓	↓
Strengthen and preserve existing community	Establish new green development	Invest in sustainable infrastructure
• Encourage existing households and businesses to adopt green practices	• Attract green businesses to Grove Hall • Set green standard for new development	• Design green infrastructures that mitigate negative environmental impacts

Who should provide the incentives?



Return of the investment

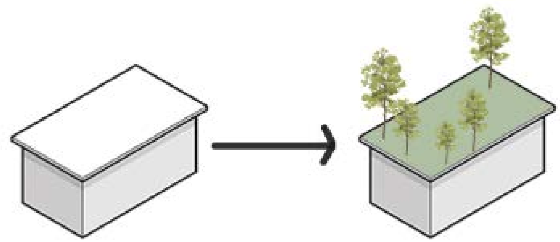


Interventions

We identified some opportunities for green interventions in the Grove Hall area that can transform the neighborhood into a resilient and just community.

- Turn flat roofs into green roofs or solar roofs
- Retrofit public housing, triple-deckers and other residential buildings
- Brownfield redevelopment
- Install permeable pavement
- Create rain gardens and bioswales
- Commercial recycling
- Green education
- Transportation options

Turn the flat roofs into green roofs



(May not be feasible due to building's structural capacity)
-Urban tree canopies decrease the urban heat island effect.

-The recommended average canopy cover is 40% for metropolitan areas east of the Mississippi and in the Pacific Northwest and 25% for metropo itan areas in the Southwest and West.

-Grove Hall area is currently at 4-10% tree canopy coverage in public areas.

-Stormwater runoff from the built environment is a principal contributor to water quality impairment of water bodies nationwide.

Sources:

-American Forests (2009) "Setting Urban Tree Canopy Goals."
-U.S. Department of Agriculture (USDA) (2010) Sustaining America's Urban Trees and Forests.
-National Research Council (2008) Urban Stormwater Management in the United States.

There are at least 1,250,000 ft2 potential green roof coverage in Grove Hall.

Green roofs can:
Reduce summer energy demands by more than 75 percent.
• Help reduce the urban heat Island effect.
• Reduce and slow stormwater runoff.
• Mitigate air pollution.

The average cost for a bare-bones green roof—including the design, permitting, and installation—will typically run between $18 and $22 per square foot.

• Incentives can include:
- Free consultation program
- Establish funding to subsidize homeowners/businesses projects
- Collaborate with designated design firm, planning team, and contractor to get
discounted rate.
- Tax rebate

Turn dark roofs into white reflective roofs

• Fresh asphalt reflects only 4% of sunlight compared to as much as 25% for natural grassland and up to 90% for a white surface such as fresh snow.

• The systematic replacement of dark surfaces with white could lower heat wave maximum temperatures by 2°C or 3.6 °F or more.

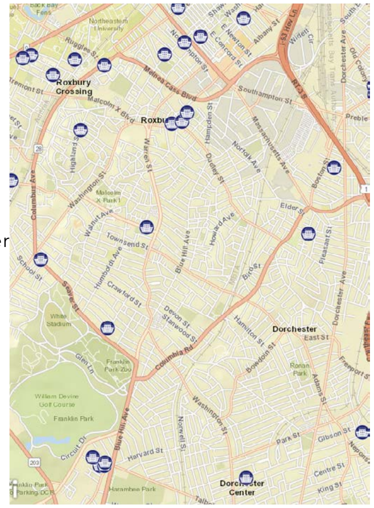
Retrofit public housing

• Seven public housing developments in the preliminary Green Zone boundary

• Interventions can include:

- Turn the flat roofs into green roofs, white roofs or install solar panels

- Better insulated windows and other measures to increase energy efficiency



Retrofit triple-deckers and other residential buildings

• It is estimated that approximately 15,000 three-deckers were built in Boston between 1880 and 1930, a third of them in Dorchester.

• Interventions can include:

- Incentives to encourage owners to turn the flat roofs into solar roofs or white reflective roofs (see previous slides)

- Start a pilot program that would pay a certain percentage of the costs of an eligible retrofit.

- Support for low-income tenants who would have to vacate their home during a retrofit.

Brownfield Redevelopment

• There are 58 brownfields in Greater Grove Hall

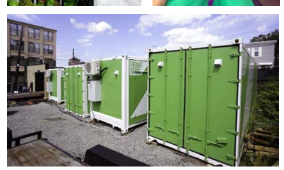
• Eight still require cleanup

• Only seven are redeveloped

• Brownfields account for 20.26 acres of vacant land, more than 18 football fields

Brownfields could be used for container farms:

• These are less expensive than most reclamation projects
• These would have other benefits such as:
- Food equality and security
- Create jobs
- Promote healthy living and education
- Foster therapeutic space



Brownfields could be used for playground with solar panels as canopy :

• Generate sustainable energy
• Serve the community with high youth population
• Provide youth education

Brownfields could be used for housing or retail :

• Revitalize the neighborhood
• Economic development
• Set new green design standard for the Green Zone

Install permeable pavement

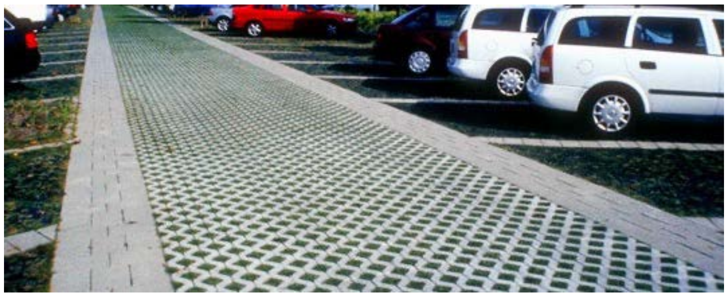
There are at least 31,000 ft in length or 580,000 ft2 sidewalk area on major streets that can be transformed into permeable pavement within preliminary Green Zone boundary.

Impervious main streets:

• Blue Hill Ave. – 6000 ft. 2 sides
• Warren St. – 7000 ft. 2 sides
• Columbia Rd. – 7200 ft. 2 sides
• Seaver St. – 4000 ft. 1 side
• Columbus Ave. – 6800 ft. 2 sides

• **Permeable pavement can:**
- Reduce water runoff
- Mitigate heat island effect
- Eliminate ice piling problem since water seeps through
- It can be made using recycled materials

• With different kinds of pavers, cost ranges from **$1.5** to **$10** per sqft. However, it requires less time to install and functions as a stormwater ma agement system with all the other benefits.



There are around 13,000 ft. or 200,000 ft2 of medians on major streets within preliminary Green Zone boundary.
• Blue Hill Ave. – 3000 ft.
• Warren St. – 2000 ft.
• Columbia Rd. – 4200 ft.
• Columbus Ave. – 2200 ft.
• MLK Blvd. – 1500 ft.

• Rain gardens and bioswales can:

-Reduce stormwater runoff: a 13-feet swale can reduce approximately 25 percent of total rainfall runoff.

-Reduced pollutants: Bioswales/bioretention ponds remove pollutants by filtering stormwater runoff through natural vegetation and soil-based systems.

Create rain gardens and bioswales


Current condition of major streets medians


Current condition of parking lots

-Reduce pressure on existing systems and the maintenance costs associated with centralized stormwater management systems.
- Mitigate heat island effect

Commercial recycling

• Majority of businesses in the Grove Hall area are small. They are not participating in any recycling program.

• Many small businesses have large cumulative effect. For example, there are **25** takeout restaurants/convenience stores in Greater Grove Hall Main Street area alone, throwing away a lot of food packages and takeout boxes unrecycled.

• **Interventions can include:**
- Determine specific recyclable wastes that the local businesses produce the most (for example, takeout boxes, hair care bottles, liquor bottles, etc.)

- Team up with local recycling hauler to provide free or discounted recycling pick up service

- Communicate and educate the small businesses about the be efits of participating in the recycling program, focusing on monetary benefit such as reduced waste management cost

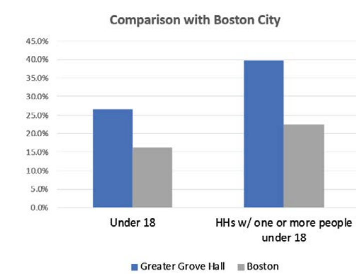
Green education

There is an opportunity to provide green education

There are a large number of children in Grove Hall

• Under 18: 26.6% (16.2% - Boston)

- Households with one or more people under 18 years: 39.8% (22.4% - Boston)



Raw data from ACS 5-year Estimates 2014-18

There is an opportunity to provide green education

There are **23** schools within the preliminary Green Zone boundary

There are several educational facilities such as the Boys & Girls Club, Roxbury YMCA, Freedom House, Grove Hall Library.

- **Green education should include:**
- Training on green living in schools. Teach sustainability as a course.

- Establish youth program for regularly organized activities such as tree planting, watering and caring, trash collecting and recycling, etc.

- School supplies, lunch boxes and other items that the schools provide should use reusable or recyclable materials.

- Perform energy audit for school buildings and retrofit them as needed.

Transportation options

Grove Hall area has a vehicle oriented commuting pattern. Although 39.3% of the housing units do not have a car, they prefer commuting with a car including carpool.

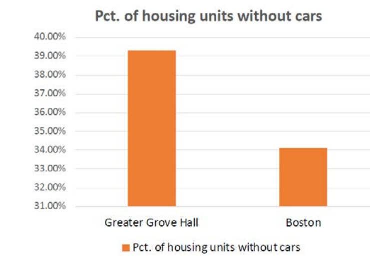
- Commuting method:
- By walk: 5.2% (14.7% - Boston)
- By public transportation: 40.4% (33.4% - Boston)
- By car (including carpool): 49.9% (44.7% - Boston)
- Mean travel time to work: 32.8 min.

Raw data from ACS 5-year Estimates 2014-18 and BTD

Major streets such as Blue Hill Ave. are very busy, causing air pollution and traffic accidents.

- 24-hour traffic count northbound 24,388 and southbound 25,601 at Blue Hill Ave. and Seaver St. intersection, Sept.27th, 2018.

- 10,000 Kilograms of CO_2 emission per day on Blue Hill Ave. (from Seaver St. to Julian St., about 1-mile distance)



- There are 39.3% of the housing units in Grove Hall that have no vehicle available for the entire unit, compared to 34.1% in Boston.

Transportation recommendation

- **To reduce congestion and improve mobility**, interventions can include:

- Create a better and safer environment for pedestrians (plant street trees with big canopy, re-design streetscape to create visual interest along the way, etc.)

- Strategically place more Blue Bike stations in Green Zone and create bike lanes on major streets

- Create rapid transit lines from major hubs in the Green Zone to other parts of Boston, connecting with rail stations

- Partner with Uber/Lyft to alleviate first/last mile problem (discounted rides within certain geographic areas, subsidized rides to/from public transportation stations, etc. https://nytransit.org/resources/transit-tncs/205-transit-tncs)

- Support bus rapid transit

Summary of potential interventions

• Potential interventions, including development and policy changes, are summarized and divided into the three categories mentioned earlier:

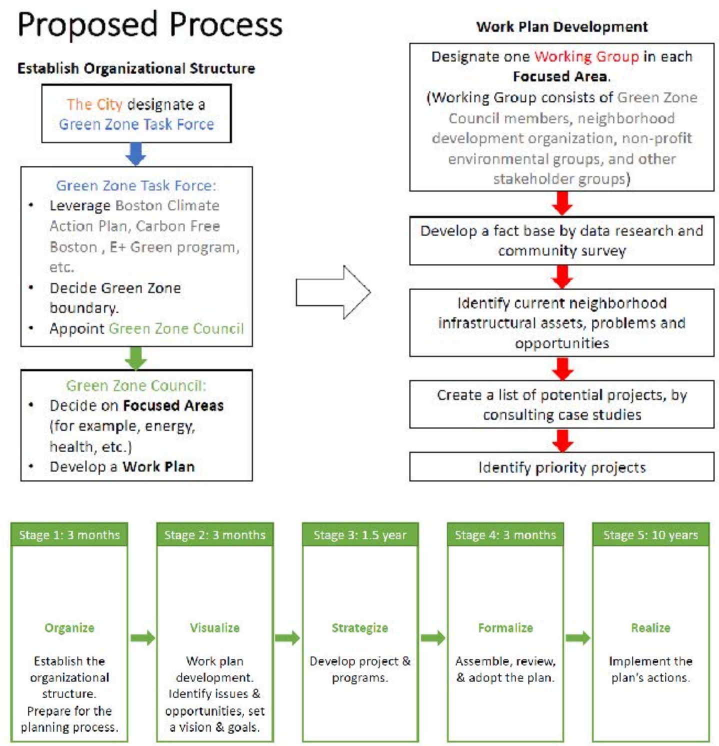
Possible interventions
• Retrofit existing flat-roofed structures with green roofs or solar roofs
• Retrofit public housing, private-owned triple-deckers and other residential
buildings to have better energy performance
• Delegate a subgroup in the Mass Save program to focus on assisting Grove Hall residents and businesses
• Set up incentives and programs to encourage local businesses to recycle
• Incorporate green education in schools
• Establish youth program for green awareness and activities such as tree planting, watering and caring, trash collecting and recycling, etc.

• Rental discount or tax benefit to attract green businesses such as:
• Local recycling hauler
• Repair and refurbishing
• Secondhand store
• Eco-friendly retail (organic food, handmade products, etc.)
• Farmers market
• Sustainable construction materials
• Eco-consulting
• Solar panel installation
• Environmental impact and carbon emissions education

• Set green standard for new development (e.g. LEED certified, etc.)
• Brownfield redevelopment
• Encourage start-ups and innovation effort in sustainability by providing flexible spaces, housing support, grants, etc.

• Fund and collaborate with engineers, landscape architects and planners to design green infrastructures that mitigate negative environmental impacts:
• Install permeable pavement
• Plant street trees
• Create rain gardens and bioswales

• Collaborate with BTD and experts in transportation design and development
to reduce congestion and improve mobility
• More pedestrian friendly streetscape
• Better bike facility and safer environment
• Rapid transit line
• Solve first/last mile problem



Referencing Pittsburgh's Eco-innovation District timeline

Next steps

1. Present to city departments, stakeholder organizations and subject matter experts to gain support and create the Task Force
2. Apply for grants for internal operation
3. Establish Task Force internal structure and leaders
4. Task Force review and modify goals, aspects and areas to address in the Green Zone plan (may involve community feedback)
5. Appoint Green Zone Council
6. Establish projects , priority projects and timelines (may involve community feedback)
7. Funding for projects
8. Adoption of projects and designing the projects
9. Community outreach before implementation
10. Implementation

What types of incentives were used to motivate residents, businesses, or others to get them to adopt green practices, invent new technologies?

For residents:

• Tax rebate when purchasing eco-friendly products.
• Provides funds to residents to weatherize/retrofit their homes. These funds are most accessible to
residents in the form of direct grants to provide the upfront monetary funds that are necessary for housing upgrades.
• Offer incentives for individuals who are able to reduce their electric intake for a year by percentages. For
example, if a household can reduce its electric intake by 10%, then it can factor into a tax decrease. For businesses:
• Lower interest rate for green businesses.
• Provide loans to businesses tied to greening practices (These loans can come in the form of building upgrades, store frontal management, or the inclusion of clean technology into their firms).
• Provide grants to universities and research firms for developing a specific green technology for the city.
• Providing tax breaks, such as no property taxes on buildings that meet Gold, a mid-to-high range standard, LEED requirements.

Appendix

How successful have these Green zones been in terms of creation, impl mentation of best practices, and reduction of environmental pollution or improvement of resiliency?
• Existing Green Zones and projects are mostly pre-mature and hard to evaluate. Most projects have a long timeline to be completely realized, and the vision is to plan ahead for 100 years.
• Resiliency cannot be measured until there comes a disaster and the measurement would be how well that community recover from the disaster.
• The successful part of those Green Zones can only be called "early wins".

What types of political and economic challenges did the green zones discover when trying to create one?
• Lesson learned from TNT Eco-district: "Despite the experience and dedication of the CSNDC staff, efforts remain under-staffed and underfunded with gains made too slowly, particularly compared with private sector d velopment efforts. Coordination with the City of Boston continues to change with incoming and outgoing political leadership. Grant funding is inconsistent and slow."
• Most Green Zones face challenge of funding issues to finish the original plan.

What policies, proposals or recommendations were suggested?
• Affordable housing or rental policies to mitigate gentrification displacement.
• Energy audits and retrofit existing structures to maximize energy efficiency.
• Green infrastructures including parks, rain gardens, bioswales, constructed wetlands, permeable pavement, etc.
• Increase connectivity/mobility by better transportation.
• Promote diversity and equity by workforce development programs, youth education, local business support
• Strengthen the community by preserving cultural/historic characters, promote community programs, invest in public art.
• Encourage start-ups and innovation effort in sustainability by providing flexible spaces, housing support, grants, etc.
• Smart city implementation.

What might it cost? What are the benefits?
• The cost depends on the number of projects and the nature of those projects (policy change vs. development projects). It is therefore hard to estimate the total cost of the Green Zone.
• Benefits for the City: Less unemployment, more tax revenue from previous vacancy, less Greenhouse Gas emission – "cap and trade" benefit, "Insurance" for potential migration to the highlands, set example that can be applied to other areas, etc.
• Benefits for the residents: better streetscape, more mobility, less pollution, less energy cost, employment, etc.
• Benefits for businesses: less energy cost, tax or other benefits if perform green practices, better reputation, more customers if the district is revitalized.

Can it be implemented in pieces or does it have to be
implemented all at once?
• It can be implemented in pieces. The whole process of creating a Green Zone is very long (at least 10 years from start to realization). One of the challenges is to have consistent staff and funding. Strategically it should be implemented piece by piece to break down the overwhelmingly large project.

Glossary

• Green Zone – Is a community transformed from a highly polluted, economically depressed neighborhood into a vibrant area with green business practices, a healthier environment and a stronger economic future.

• Eco-District – An eco-district is a defined urban area in which collaborative economic, community, and infrastructure redevelopment is explicitly designated to reduce negative and create positive environmental impacts. It links energy transportation, water, and land use in an integrated, efficient resource system.

• Smart Cities – A smart city is an urban area that uses different types of electronic Internet of things sensors to collect data. Insights gained from that data are used to manage assets, resources and services efficiently; in return, that data is used improve the operations across the city.

• A Resilience Zone is a special improvement district, precinct, neighborhood, or corridor designated in official planning documents for comprehensive risk management and upgrading so that it performs with resilience in the face of a variety of predictable and unpredictable extremes.

• Food Resiliency – capacity over time of a food system and its units at mu tiple levels, to provide sufficient, appropriate and accessible food to all, in the face of various and even unforeseen disturbances.

• Sustainability Zones - Certified Sustainability Zones (CSZs), a reference to municipalities or other political domains whose inhabitants (1) strive to live within their ecological means, (2) ensure the social and economic means to live, and (3) use state-of-the-art accounting tools to measure, manage and report their Triple Bottom Line performance.

• Smart growth is an urban planning and transportation theory that co centrates growth in compact walkable urban centers to avoid sprawl. It also advocates compact, transitoriented, walkable, bicycle-friendly land use, i cluding neighborhood schools, complete streets, and mixed-use development with a range of housing choices.

• Environmental Justice (EJ) – is based on the principle that all people have a right to be protected from environmental pollution and to live in and enjoy a clean and healthful environment. EJ is the equal protection and meaningful involvement of all people with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies and the equitable distribution of environmental benefits. (Mass. gov)

Northeastern University Capstone Project

Addressing Environmental Justice in Grove Hall:

Landscape Analysis to Identify Environmental Challenges and Mitigation Solutions

Client:

Grove Hall Main Streets

Gregory King

Capstone Team Members:

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Xuran Wu,

Yifan Zhang,

Zexian Wang

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Executive Summary

This report contains results of The Northeastern University Capstone Project research designed to support the development of a Green Zone in the Grove Hall Area. Green zones are defined as communities transformed from highly polluted, economically depressed neighborhoods into vibrant areas with green businesses, healthier environut, and solid economic futures. The transformation is an effect of green design interventions, including green businesses, practices, and technologies.

The main objective was to provide an inventory of existing infrastructure and physical assets, as well as environmental issues associated with the unique characteristics of the Grove Hall neighborhood. Furthermore, the team, in collaboration with the client's representative, identified six projects that will holistically address environmental issues and provide sustainable, environmentally friendly, feasible, and cost-effective solutions.

Using Geographic Information System (GIS) technology, the team of graduate students obtained data specific to the Grove Hall area, analyzed it, and provided results in the format of Story Map, an interactive web mapping application. Additionally, comprehensive research led to identifying specific solutions proved to mitigate environmental problems similar to Grove Hall.

We discovered that past architectural trends, popular in the late 19th and early 20th centuries and embraced by immigrants residing in Grove Hall, still shape the environment of this neighborhood. Multi-family and residential structures, including triple-deckers, dominate the landscape of the Grove Hall area. Such dense infrastructure contributes to a substantial amount of impervious surface, which leads to the heat island effect and a wide range of other environmental issues exacerbated by climate change and decades of systematic environmental injustice.

Conversely, the high density of relatively similar parcels and structures presents several benefits and opportunities. Specifically, projections of the impact and effectiveness of investments will be more accurate. Moreover, for projects that require permits, consistency in property types will allow for a simplified planning and permitting process, speeding up implementation and improving monitoring and evaluation of the results. It will also help identify best practices and refine strategies to maximize the return on investment.

We identified six tailored solutions, including decarbonization which involves geothermal heat pumps that can reduce greenhouse gas emissions by 30 to 50 percent, lowering energy use and cost. Implementing reflective pavements can reduce surface temperatures in urban areas and decrease energy consumption. Green roofs and white roofs, often known as cool roofs, reflect sunlight, reducing the demand for cooling the interior of the structure below. Green roofs can also absorb rainwater, alleviating the problem of excessive surface runoff. Permeable pavement is proven to lower surface temperature, effectively minimizing the urban heat island. It also absorbs rainwater and captures hazardous pollutants. EPA identified 22 formerly or currently contaminated sites that could be reused for renewable energy development, such as EV stations, which would benefit the community. Lastly, investing in solar panels can effectively help shift from fossil fuels to clean, sustainable solar energy while lowering the cost of electricity.

These six projects exemplify a holistic approach to addressing environmental challenges. The Grove Hall Green Zones project can provide the framework for similar communities to effectively assess existing infrastructure and utilize resources to invest successfully in a healthier, equitable, and sustainable future.

Introduction

Environmental issues are becoming more prominent as human industrialization progresses more rapidly. Studies and actions on ecological pollution have multiplied to create a sustainable society, protect the environment, and safeguard human health. Nevertheless, the research did not show disparities in the severity of anthropogenic climate change amongst societies until the 1970s (Pellow, 2016). While neighborhoods with high-income concentrations could obtain more significant investment and maintenance on environmental issues, communities with a predominance of low-income residents and people of color generally lacked green space coverage or had infrastructures in poor condition (Heynen et al., 2006). Although various efforts aim to tackle environmental justice issues for all groups and ethnicities, they usually concentrate on a particular topic, such as air pollution, diseases brought on by environmental pollution, or simply examining variations between communities through GIS analysis.

Grove Hall Main Street (GHMS), a non-profit organization with roots in Boston, aspires to address specific environmental hazards, such as air pollution, heat islands, et cetera, and to improve community resilience and public health through the creation of an urban Green Zone in the Grove Hall area. “Green Zone” refers to an area subjected to green design interventions, such as green businesses, practices, and technologies. These interventions will allow the community to not only address current environmental problems but also to offer opportunities for self-sustainable community growth that will fundamentally confront environmental justice problems.

This report, authored by Northeastern University’s School of Public Policy and Urban Affairs graduate students Anna Krzystyniak Sobiewska, Xuran Wu, Yifan Zhang, and Zexian Wang, concentrates on identifying opportunities to mitigate environmental challenges in the Grove Hall area. The team analyzed relevant geospatial data to create an inventory of community infrastructure, physical assets, and the opportunities they present for achieving the ultimate goal of investing in mitigation efforts and environmental justice projects.

I. Grove Hall Overview

The Historical and Cultural Background

The mansion built nearby by affluent merchant Thomas Kilby Jones in the 19th century gave the area its name: Grove Hall. It was mostly deserted in the early 19th century and predominated by farms and orchards in the countryside. Jewish immigrants, however, progressively displaced Yankee Irish as the majority of the population of Grove Hall in the later half of the 19th century and the early 20th century, and the region increasingly became the center of their secular and spiritual life. With the development of the local public transportation network, many residential buildings appeared in Grove Hall, which fueled real estate growth and appreciation. Due to numerous attacks against Jews and the suppression of Jewish-owned property in the 20th century, facilitated by the neighborhood's complicated demographic makeup, Jews were gradually expelled from Grove Hall. As the Boston Banks Urban Renewal Group offered housing loans in 1968, many low-income black families moved into Grove Hall, replacing Jews as the majority of the population.

Nonetheless, the region became more ethically contentious in the middle to late 20th century. The lack of investment and economic collapse caused gangs to expand, resulting in a higher crime rate. The Grove Hall community began to decline despite the local government's numerous revitalization efforts, which all had little impact (Emmanuel Gospel Center, 2013, pp. 1–14).

Geography

Grove Hall has no formal boundaries. Based on data provided by the community, Grove Hall is located at the junction of Blue Hill Avenue, Washington Street, and Warren Street, which connects Roxbury and Dorchester. Geographically, Grove Hall, covering 0.69 square miles, is surrounded by the neighborhoods of Dorchester to the east, Roxbury to the north, Franklin Park to the west, and Harambee Park to the south, located at the heart of Boston. The neighborhood's elevation is above the Boston average elevation of 82 ft (Boston Topographic Map, Elevation, Terrain, n.d.), and precipitation is concentrated from February to April and October to December (Boston Water and Sewer Commission, 2020). There is no direct MBTA subway service in the neighborhood, and eight bus stops are located on Blue Hill Avenue and Columbia Road, with four routes serving the Grove Hall neighborhood (Massachusetts Bay Transportation Authority, n.d.).

Socio-economic [1] status

Grove Hall is a relatively small community located with 0.69 sq mile, with 19,443 (as of 2020) with a median age of 31.9 in 2022. The area is quite diverse, with the diversity index of 79.5 with number 10,883 Black, 7,113 Hispanics and 4,025 representing other races.

Renters-occupied housing accounts for over 75% of the total number of 7,179 housing units while owner occupied accounts for 20%. There were 403 vacant unites in 2020. The median home value in 2022 was $595,231, while average home value was $613,148.

In 2022, the unemployment rate stood at 10%, significantly higher than the national average of 3.5% and the Massachusetts average of 3.7%. Additionally, the average household income in 2022 was $62,263, which is below the state average. Furthermore, 2,123 households, or 36% of all households, reported incomes below the poverty level.

In 2021, 2,586 households had at least one person with disabilities.

Green Zone Planning Framework

Grove Hall's complex history shapes the challenges it faces today. For decades, underdevelopment and unjust legislation, such as redlining, have contributed to a multitude of socio-economic issues exacerbated by environmental problems and climate change. Moreover, these environmental problems create a vicious cycle. For instance, the prevalence of large impervious surfaces and a lack of green spaces in the area contributes to the heat island effects. It leads residents to consume more energy to cool their often aged and inefficient homes, using systems that rely on fossil fuels, including natural gas. This increased energy consumption results in waste, higher energy costs, and additional pollution. As a result, not only are residents living in an increasingly worsening environment but are burden by rising costs of energy and healthcare. These mounting expenses further trap them in poverty, making it even more challenging for the community to break free from the cycle.

As the nation moves towards embracing equity, equality, inclusion, and environmental justice, many funding opportunities have emerged for environmentally friendly and sustainable projects addressing problems like air pollution, urban heat island effects, and other root causes of residents' health issues. However,

1 Socio – economic data was obtained by using ESRI GeoEnrichmentServices which uses the best available apportionment method to determine the value of each variable on the map layer.

community leaders must embrace comprehensive and innovative solutions to effectively take advantage of opportunities to address these complex and interconnected issues.

According to the Greater Grove Hall Main Streets organization[2], Grove Hall will benefit from Green Zones, defined as areas needing critical green intervention, representing a justice-oriented approach to investments, planning decisions, infrastructure development, and community participation. By implementing a Green Zone planning process, climate mitigation and resilience strategies are anchored, creating a pathway for environmental justice communities to address their challenges. A community master plan resulting from the Green Zone feasibility study ranks and prioritizes the social impact of various environmental infrastructure projects, leading to healthier and more resilient communities.

The Green Zone planning framework encourages collaboration with thought leaders in clean energy and the built environment to develop methodologies and tools for systematically supporting the transformation of environmental justice communities. The framework establishes a pathway toward social, racial, energy, and economic justice by quantifying and integrating the social impact of green infrastructure projects. It seeks input from various experts, including architects, engineers, material scientists, and innovators, to develop various solutions, such as green and white roofs, permeable pavements, rain gardens, and bioswales.

The creation of the Green Zone planning framework is designed to holistically develop methodologies and tools for use in other environmental justice communities, making the most of new federal legislation that provides billions in funding for clean energy-related projects. By creating a robust Green Zone planning framework, Grove Hall community will be better equipped to compete for federal grants and tax credits to reverse decades of environmental injustices.

2 Greater Grove Hall Main Streets is a 501 (c) 3 organization led by a Board of Directors who volunteer their time to provide strategic direction and program support by serving on one or more of the organization's committees, economic development, design, promotions, and organization. http://www.greatergrovehall.org/about-us/

II. Landscape Analysis of Grove Hall

Our landscape analysis aimed to assess and inventory the surface covers and structures within the Grove Hall area as part of a more significant effort to uncover relationships between existing infrastructure and environmental challenges. By doing so, we intend to identify viable opportunities and effective solutions for addressing these challenges.

To ensure that our analysis focused explicitly on the Grove Hall community, we used Geographic Information Systems (GIS) software to extract relevant and authoritative data for this area. We utilized multiple GIS tools that are part of ArcMap 10.8.2, ArcGIS Online, and ArcGIS PRO 3.1 to ensure the accuracy and reliability of our results.

To obtain the exact boundaries of Grove Hall, we relied on the Grove Hall Neighborhood Study conducted by Emmanuel Gospel Center (egc.org). Based on the description and visual representation provided in the document, we created a Grove Hall shape file layer, which served as the basis for our analysis.

Our data set was chosen in collaboration with Mr. Gregory King, a sponsor of this project who provided us with guidance, suggestions, and datasets that were successfully used in our analysis.

Finally, to effectively communicate the results of our analysis, we utilized a Story Map, a web mapping application that provides dynamic and interactive visualization of our findings. Grove Hall Landscape Analysis story map allowed us to collaborate and share the results in a way that is both engaging and informative.

Land Use and Land Cover Analysis

Overview

Our Land Use and Land Cover Analysis provided a comprehensive understanding of the spatial distribution of various land use types and categories. It revealed unique characteristics of a Grove Hall area, including complex relationships between the physical landscape and socio-economic phenomena occurring in this community.

Data and Methodology

The data used for the Land Use and Land Cover analysis was obtained from the MassGIS website (Commonwealth of Massachusetts, n.d.)

The data layers included: 2016 Land Cover/Land Use dataset, MBTA Bus Routes and Stops data and Property Tax Parcels data. The layers were downloaded in the shape file format, and we used the Clip tool to extract a geographic subset representing the Grove Hall area. Next, we created a feature class for further qualitative and quantitative analysis of features within the Grove Hall boundaries.

Results

Our analysis of Land Use and Land Cover data (Figure 1) revealed that Grove Hall is predominantly residential, with multi and single-family classes covering over 51% of the area.

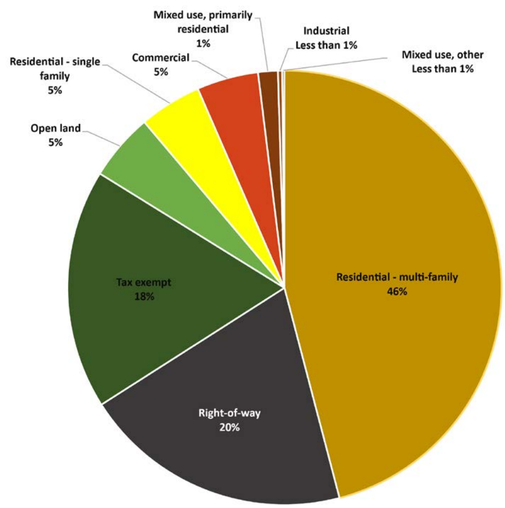

Figure 1. Land Use Categories by Area.

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Conversely, the commercial land use class, including industrial, accounts for less than 6%. A significant portion of the land is designated for transportation infrastructure. The Right-Of-Way, which accounts for 20% of the area, is the second largest class. On the contrary, open space accounts for 5%. The third largest category is Tax Exempt land use, which typically refers to land owned by tax-exempt organizations, does not generate revenue for the local government, and is not available for commercial or residential development.

Roads and Public Transportation

Grove Hall is at a strategic crossroads and benefits from a well-developed public transportation system. The community boasts 21.7 miles of roads, including 6.5 miles of major roads and 15.2 miles of secondary roads (Figure 2), and has 77 bus stops (Figure 3). This connectivity ensures that the community is well-connected to its surroundings, including one of the largest cities in the state and region. Convenient access to public transportation reduces residents' dependence on private vehicles and the demand for parking spaces. Moreover, it provides mobility for individuals with limited vehicle access, such as seniors, low-income demographics, people with disabilities, and youth.

Figure 2. Grove Hall Roads. Figure 3. Grove Hall Bus Stops and Bus routes

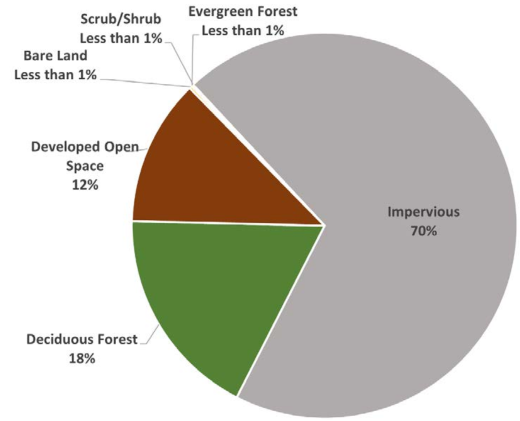

Figure 4. Grove Hall 2016 Land Use by Area.

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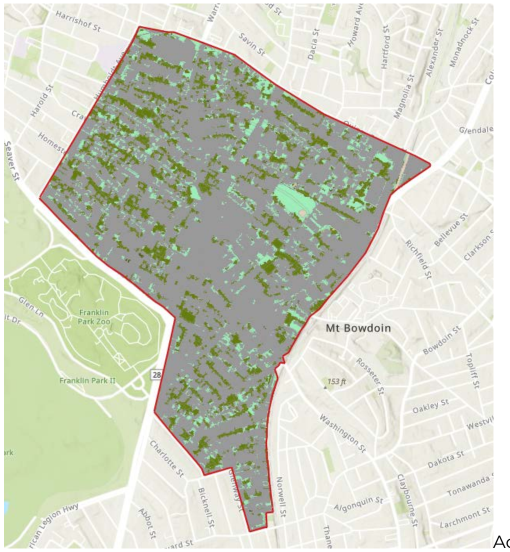
The location and connectivity of the Grove Hall neighborhood can attract businesses, employers, and residents, leading to economic growth and development. However, the large number of major roads within a small community contributes to significant noise and air pollution from traffic, affecting the safety of pedestrians and cyclists, as well as promoting urban sprawl (Karakayaci, 2016). While public transportation reduces the community's reliance on private cars, the negative impacts of major roads should be addressed to ensure sustainable growth and development in the area.

Land Cover

The analysis of the Land Cover data provides more evidence that Grove Hall is a highly urbanized and developed area. As Massachusetts 2016 Land Cover data shows, over 70% of the land is covered by Impervious Surface (Figure 4). The other two categories include Deciduous Forest accounting for 18%, and Developed Open Space, for 12%.

Impervious Surface



According to the Environmental Protection Agency, impervious cover refers to all human-made structures or ground coverings within a watershed that prevent rainfall from infiltrating into the underlying soil or groundwater, including rooftops, parking lots, streets, sidewalks, and driveways (Konrad, 2003).

Figure 5. Grove Hall Impervious Surface.

The high concentration of impervious surfaces in Grove Hall (Figure 5) suggests that the area has limited capacity to absorb rainwater or snowmelt, resulting in increased stormwater runoff (U.S. Environmental Protection Agency, n.d.). It can cause property damage through flooding and erosion in Grove Hall and neighboring communities in lower elevations, such as South Boston. Additionally, the proximity of Grove Hall to Massachusetts Bay contributes to the degradation of water quality and the loss of aquatic life.

Moreover, impervious surfaces, particularly dark materials such as asphalt, absorb and retain heat, exacerbating the urban heat island effect, which leads to local temperature increases. It can result in various negative impacts, from resident discomfort to significant, irreversible health conditions. Furthermore, the increased energy consumption for cooling worsens air quality, compounding these issues.

According to the City of Boston's Heat Resilience Study (City of Boston, 2022), Grove Hall is affected by extreme temperatures (Figure 6), with temperatures higher than 95 degrees during the day and 75 degrees at night. This finding underscores the urgent need to address the area's high concentration of impervious surfaces and implement measures to mitigate their negative impacts.

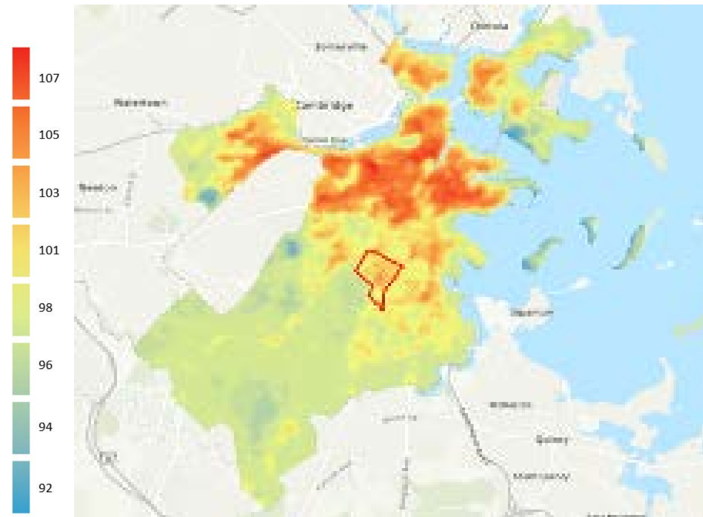


Figure 6. Heat Event Duration Map.

Source: Heat Resilience Solutions for Boston | Boston.gov

1.
2.

Grove Hall Parcel Analysis

Overview

The objective of the parcel analysis was to examine Grove Hall's infrastructure characteristics and pinpoint features that both contribute to environmental challenges and simultaneously offer numerous possibilities for systematic transformation. Analysis of the parcel data provided insight into the wide range of aspects of the Grove Hall Community. Grove Hall's architectural style reflects the early 20th-century trends, which have a distinctive impact on the community and presents unique challenges and opportunities for redevelopment and revitalization.

Data and Methodology

For our analysis of the Grove Hall Parcels, we utilized data from the Property Tax Parcels (2022) obtained from the MassGIS website. After extracting the subset of parcels for the Grove Hall area, we created a feature class named: Mass_Parcels_Grove_Hall_2022, which included 2385 unique records with all parcel attributes. However, nine records did not have any attributes attached. Therefore, we removed them from further analysis. Consequently, the analysis was conducted on a total number of 2376 records, referred to in the report as "parcels."

USE CODE	CLASSIFICATION
0	Multiple Use
1	Residential
3	Commercial
4	Industrial
9	Exempt

To better understand the parcel inventory, we examined multiple columns and concentrated on: USE_CODE, YEAR_BUILD, STORIES, and STYLE. We used the USE_CODE * classification, described in detail by the Massachusetts Bureau of Local Assessment, to identify six types of use: Residential, Commercial, Mixed-use/Primarily Residential, Mixed-use/Primarily Commercial, and Exempted. We created a new column that contained a text description of the USE_CODE.

Table 1. Use code classification.

Source: Microsoft Word - Classification_Code_Book_April _2019 (002).doc (mass.gov)

However, we found that the classification based solely on USE_CODE may not always accurately reflect the actual use of the parcel. For instance, we discovered that four parcels classified as Residential based on the USE_CODE are actually non-residential. These non-residential parcels include two daycare centers, a repair garage, and a parking garage.

To more accurately analyze Grove Hall parcels, we cross-verified USE_CODE with the STYLE column. The results were captured in the new column named current use. In this column, we copied existing attributes from the STYLE column and filled in missing attributes with descriptions provided by the Massachusetts Bureau of Local Assessment. For instance, parcels with USE_CODE : 390, 391, 440, 353 we labeled Vacant.

Results

Our analysis of 2376 parcels revealed valuable insight into a wide range of aspects of the Grove Hall community. Over 80% percent of all parcel inventory comprises residential parcels (Figure 7).

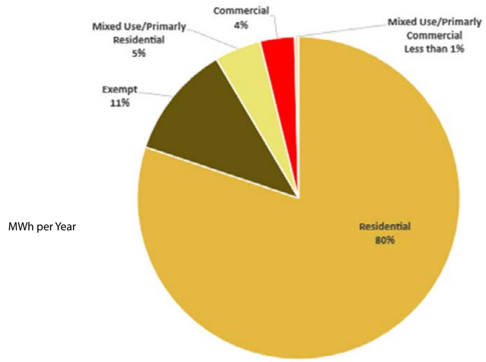
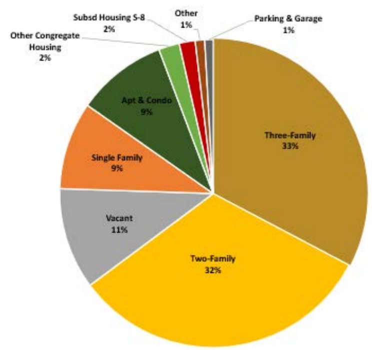


Figure 7. Parcels by Use Code.

Furthermore, out of 1904 residential parcels, 1239 parcels are multi-family, and only 176 are single-family homes (Figure 8).



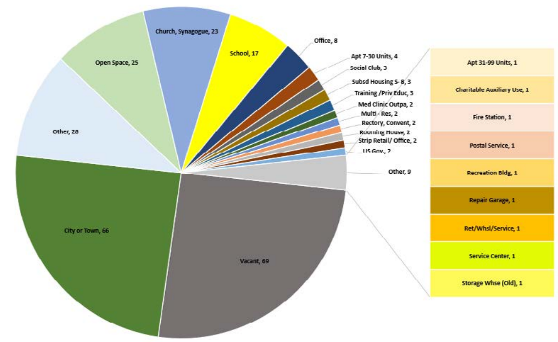
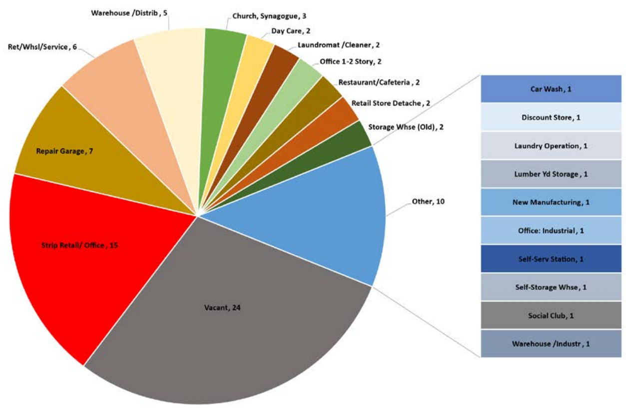


Figure 8. Residential Parcels by Use Code.

Figure 9. Exempt Parcels by Use Code.

Exempt is the second-largest category, with 270 parcels accounting for 11% of the Grove Hall parcel inventory. These parcels are not subject to property taxes due to certain types of property owners or specific types of use deemed to benefit the general public. The largest proportion of exempt parcels, excluding vacant parcels, includes government-owned properties,



open spaces, churches (including synagogues), and schools (Figure10).

Figure 10. Commercial Parcels by Use Code.

Only 4% of Grove Hall parcels fall under the commercial category, with 82 commercial parcels in total.

In total, there are 317 vacant parcels in the Grove Hall area, accounting for 13% of the inventory. Of these, 204 are residential parcels, while the commercial category has the largest percentage of vacant parcels (Figure 11).

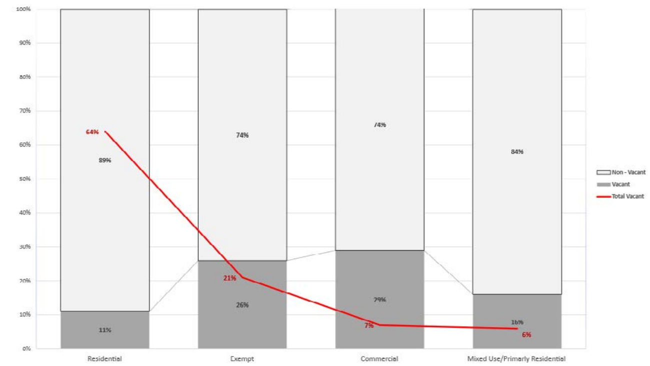


Figure 11. Vacant Parcels by Use Code.

Grove Hall area parcel composition distinctly reflects communities' urban character with dominant residential parcels and a small fraction of exempt, commercial, and mixed-use properties. This limited diversification has considerable implications for the community and its residents. The small number of commercial parcels indicates limited job opportunities for the population that is experiencing an unemployment rate of 10% - over three times higher than Boston and the state of Massachusetts. (Massachusetts Unemployment & Job Estimates for November 2022 | Mass.gov).

With the lack of commercial parcels that typically generate increased tax revenue and a notable number of exempt parcels, the community has reduced funds for public services such as parks and infrastructure. Consequently, residents have limited options and access to goods and services and need to rely on neighboring communities, which diminishes the community's sense of identity and independence. Moreover, the large number of vacant parcels signals economic stagnation and weak incentives for investors and developers. Grove Hall's economic growth may be constrained, as commercial properties often serve as centers for innovation and creativity, attracting new businesses and ideas to the area and creating an environment for development.

The high parcel density, particularly the prevalence of multi-family use properties, may indicate high energy consumption and emission of greenhouse gasses. A recent study found that natural gas emissions in the Boston area are three times higher than previously reported. The increased levels of methane—a primary component of natural gas with at least 80 times the warming power of carbon dioxide—appear to be closely linked with residential use. This revelation underscores the need for sustainable practices and energy-efficient solutions to mitigate the environmental impact in Grove Hall and similar urban communities.

Conversely, the high density of parcels that are relatively similar presents several benefits to the feasibility study, assessment, and implementation process of green projects. The projections of the impact and effectiveness of investments are significantly more accurate with parcels that have comparable characteristics. Moreover, for projects that require permits, consistency in property types will allow simplified planning and permitting process, speed up implementation, and improve monitoring and evaluation of the results. It will also help identify best practices and refine strategies to maximize the return on investment.

Grove Hall Buildings Analysis

Overview

Our analysis of the composition of the building types in the Grove Hall area revealed details that are critical for a comprehensive understanding of various aspects of the Grove Hall area. Specifically, the characteristic architecture of residential structures that predominantly represents three-level homes, known as triple-deckers, has significant implications for the community. Triple-deckers are designed to accommodate multiple housing units, which stimulates renting market rather than ownership. Additionally, the age of residential infrastructure suggests significant challenges in adopting new, efficient technologies to reduce the use and cost of energy and decrease carbon emissions. On the other hand, the unique charm of the historical structures attracts residents and provides opportunities for revitalization.

Data and Methodology

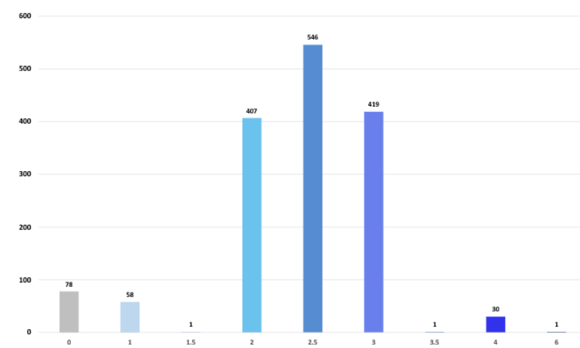
The data sets were obtained from the MassGIS website MassGIS Data: Building Structures (2-D) | Mass.gov and contain 2-dimensional roof outlines. We downloaded the data in the shapefile format and used the ArcMap Clip tool (Clip (Analysis)—ArcMap | Documentation (arcgis.com) to extract a geographic subset that represented the Grove Hall area and created a feature class to conduct analysis. Next, we joined the Building Structures (2-D) layer with MassGIS Data: 2022 Property Tax Parcels parcels data to obtain more details regarding the structures, including the Number of stories, Year built, and Occupation type.

The building's footprints were used effectively to visualize the distribution of different types of structures and differential based on age and height.

There are some discrepancies in the analysis due to the non-one-to-one relation between the number of parcels and the number of buildings. In other words, there are some parcels that have more than one structure on them; in other instances, multiple parcels share one structure.

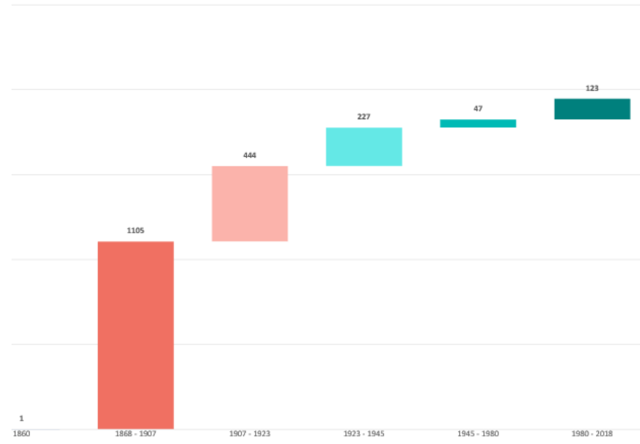
Results

Based on the building footprint data, in conjunction with 2022 Massachusetts Parcel Data, we identified 1540 structures in the Grove Hall area.



We discovered that building height distribution in not diversified and ranges between 1 and 6 stories (Figure 12), with only one building being six stories high and 59 with less than two stories. Over 89% of structures in the Grove Hall area are between 2 and 3 stories.

Figure 12. Grove Hall building by Number of Stories.



The average age of the buildings is 71 years (as of 2023), and the majority were constructed in the early 20th century (Figure 13), with 417 structures built in 1900 and 242 in 1905.

Figure 13. Grove Hall building by Year Built.

Over 85% of structures in the Grove Hall area are residential. Out of 1316 Residential buildings in this community, traditional triple-deckers account for over 9%, but the entire three-story residential infrastructures account for over 26 %. Additionally, 2 and 2.5 stories residential buildings represent 68% of the Grove Hall residential infrastructures.

With an average square footage of 3397 for two-family structures and 3996 for three-family buildings, the Grove Hall area residential buildings inventory reflects the popular early 20th-century urban New England building trend called triple deckers.

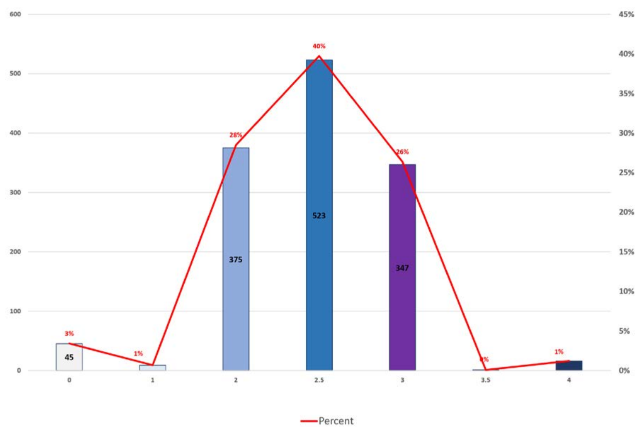


Figure 14. Grove Hall Residential Buildings by Number of Stories.

Triple-deckers are the iconic New England style of residential infrastructure that was very popular in the late 19th and 20th centuries, primarily among working-class immigrants (Landrigan, 2022). This three-story structure, with each floor a separate unit big enough to accommodate family, was an attractive option for investment and a path to ownership. The owner could live in one unit and rent out the other two. Due to its relatively simple design and affordable construction cost, triple-deckers dominated the urban neighborhoods providing low-cost accommodation to lower and middle-class workers (The New Haven Preservation Trust, n.d.).

The characteristics of residential buildings in Grove Hall suggest that most structures are designed to accommodate more than one housing unit, indicating a prevalence of multi-family housing in the area. Additionally, the ratio of owners to renters in Grove Hall indicates that the architectural style that originated in the late 1800s still significantly affects the community, disproportionately catering to renters rather than owners. While the median home value in the area is relatively high at $613,148 (approximate as of 2022) ESRI DATA, the average household income is $62,263 ESRI DATA, highlighting income diversity among residents. Notably, the presence of subsidized housing in the area may indicate a commitment to addressing housing affordability and social equity by meeting the needs of low-income populations.

On the other hand, the prevalence of multi-family housing and a renters-oriented community traditionally attracts young adults, as reflected in the median age of 31.9 years. Additionally, with a diversity index of 79.5 (U.S. Census Bureau, 2022), Grove Hall is above the state diversity index of 51.6%, highlighting the area's diverse population. Overall, these data suggest that Grove Hall is a vibrant and diverse community with a mix of housing options, income levels, and social needs.

As of 2023, the residential structures in the Grove Hall area are 109 years old on average, with two-family homes averaging 116 years and single-family dwellings averaging over 99 years old. It indicates that the housing stock in the area is relatively old and may require more frequent maintenance and repairs. It also suggests inefficient energy usage, leading to significantly higher energy consumption and greenhouse gas emissions. Older houses are often not energy-efficient, which can result in increased energy costs and negative environmental impacts. Therefore, energy-efficient upgrades and renovations are necessary to reduce energy consumption and mitigate the carbon footprint of these older homes.

Brownfields and Chapter 21 E Tier Classified Sites

Overview

Brownfield is a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant (U.S. Environmental Protection Agency, 2023).

Chapter 21E Tier Sites refers to regulation within Massachusetts General Law known as the Massachusetts Contingency Plan (MCP), a body of regulations designed to streamline and accelerate the assessment and cleanup of releases of oil and hazardous materials to the environment (The 193rd General Court of the Commonwealth of Massachusetts, n.d.).

Both terms refer to sites that pose risks to the environment and human health and significantly affect the communities' redevelopment efforts and economic growth. Therefore, we aim to inventory and visualize the location of all the sites within the Grove Hall area to pinpoint the issue and spotlight the opportunities for mitigation and improvement.

Data and Methodology

To calculate the total number of brownfields, we utilized data developed, inventory, and disseminated by the Office of Communications, Partnerships and Analysis, as well as the Office of Land and Emergency Management of EPA (2022) based on the solid Waste Land disposal data layer compiled by the Department of Environmental Protection (MassDEP).

The Chapter 21E Tier site location data was obtained from MassGIS in the format of Web Map Service. However, MassDEP maintains the data, and mapped sites represent only a subset of the total reported Chapter 21E sites tracked by the MassDEP Bureau of Waste Site Cleanup (BWSC) program. Sites under review that are not yet classified are not included.

Results

Under the Re-Powering America's Land initiative, The Environmental Protection Agency and the Massachusetts state government have identified 22 sites in the Grove Hall area that are currently or formerly contaminated yet have the potential to be reused for renewable energy development.

The DEP has developed a tier classification system for determining the danger level of a hazardous waste site to public health and the environment. Sites can be classified as Tier IA, IB, IC, or II, with Tier IA sites requiring the most stringent oversight and Tier II the least (Faber & Krieg, 2002).

Based on the MassDEP data, there are three Chapter 21E sites in the Grove Hall area, including:

- One TIER ID site that is considered to pose a higher level of risk and require extensive assessment, management, and remediation actions;
- Two TIER II sites that are considered to pose a lower level of risk and require less extensive and urgent actions

Brownfields, which are abandoned or underused industrial and commercial properties (Figure 15) with varying degrees of contamination, can pose challenges to development. In contrast, Chapter 21E properties are specifically classified and regulated under Massachusetts law. Within Grove Hall's 0.69 square foot area, the presence of **22** brownfield sites and **3** Chapter 21E Tier sites (Figure 15) has substantial implications for the community. These underutilized and undeveloped locations result in lost economic opportunities, reduced property values in nearby areas, and decreased interest from potential investors. Moreover, contamination negatively affects the local ecosystem, degrades overall environmental quality, and can lead to acute or chronic health issues such as respiratory problems, neurological damage, and cancer. Additionally, the social stigma associated with these sites can impede revitalization efforts.

Figure 15. Grove Hall brownfields and Chapter 21E Classified sites.

Conversely, brownfields and contaminated sites offer opportunities for the Grove Hall community to address current social, environmental, and economic challenges. Repurposing these properties for various green energy projects can lead to increased revenue, job growth, and achieving clean energy goals by reducing greenhouse gas emissions. Many programs provide funds for brownfield revitalization, including Environmental Protection Agency (EPA) Brownfields Program and Massachusetts Brownfields Cleanup.

Gas Leaks

Overview

Boston's aging infrastructure contributes to many natural gas leaks and, consequently, significant methane emissions. Methane has an atmospheric lifetime of about 12 years, as opposed to CO2, which remains in Earth's atmosphere for centuries before being removed by natural processes. However, methane's global warming potential is 28-36 times greater than carbon dioxide over a 100-year period (IEA, 2021). Therefore, gas leaks, particularly those emitting methane, can significantly contribute to global warming and economic losses since methane has commercial value.

Leaks reported in 2021 were responsible for an estimated 6,734 metric tons of methane emissions, equivalent to 579,138 metric tons of carbon dioxide, or $6.9 million of leaked gas (based on the EIA's average price of natural gas delivered to residential Massachusetts customers in 2021).

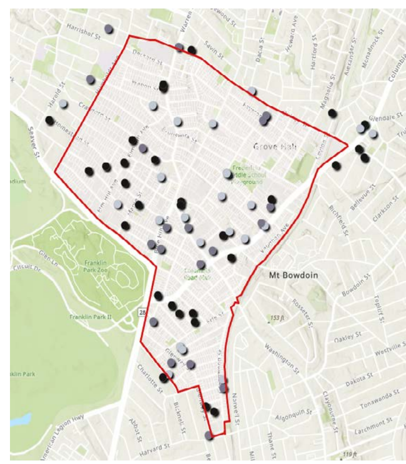
Our analysis exposes the geographic distribution and extent of the Gas leaks in the Grove Hall area and visualizes what, according to independent researchers, is only a fraction of the actual gas leaks issue.

Data and Methodology

Gas leak data was obtained from the HEET (Home Energy Efficiency Team), a non-profit organization that focuses on solutions to cut carbon emissions through systemic change. The data was obtained in an Excel spreadsheet format with locations in the format of an address. We used ArcMap geocoding processes to map the addresses and ArcGIS online to visualize data attributes. According to HEET (2023), the map is a snapshot in time of the last day covered by the annual report provided by utility companies to the Department of Public Utilities. Therefore, by the time the map is published, it may not reflect the current status at any given time. Furthermore, independent researchers find 1.5 to 3 times as many leaks as officially reported. For more information, please refer to: The Gas Leaks Map - HEET.

Results

Our analysis concluded that there are 61 identified and reported gas leaks in the Grove Hall area. As of April 2022, 35 leaks have been repaired, ten have been eliminated, and the status of 36 leaks remains pending (Figure 16).



Gas leaks are classified into three categories based on hazard level. Grade 1 leaks are the most hazardous and must be repaired immediately.

Figure 16. Gas Leaks by Repair Status.

Figure 17. Gas Leaks by Grade

Grade 2 refers to non-hazardous leaks that may become hazardous in the future; therefore, they must be repaired within a year. Grade 3 leaks are non-hazardous and are expected to remain non-hazardous; however, if designated after 1/1/2018, they must be repaired or eliminated within eight years. All three types were detected in the Grove Hall Area (Figure 17).

A noticeable number of gas leaks in the Grove Hall area indicates multiple issues beyond aging infrastructure, including insufficient or irregular maintenance, lack of leak detection, and inadequate monitoring protocols. Furthermore, weak regulatory enforcement enables negligence, waste of resources, and catastrophic long-term effects on the environment and human health.

However, the prevalence of gas leaks may also present an opportunity for an environmentally friendly solution. Given Grove Hall established natural gas infrastructure, there are potential synergies that can be explored, mainly for using distribution networks of natural gas to integrate geothermal energy. Based on a feasibility study conducted by BuroHappold Engineering (2019), networked geothermal systems could provide 100% of the heating and cooling for a significant portion of the state, improve safety, and immediately reduce emissions by 60%.

Rooftop analysis

Overview

Our rooftop analysis has provided us with comprehensive insights into the infrastructure of the Grove Hall area. With rooftops comprising more than 26% of the impervious surface, the community faces multiple challenges, such as exacerbating the urban heat island effect and challenging stormwater management, among others. Our findings also indicate that the majority of roofs are not flat, which limits their potential for solar energy generation or green roof installations. As a result, alternative approaches, like white roofs or permeable pavement, may be better suited to mitigate the adverse effects of the high density of impervious rooftops in Grove Hall.

Data and Methodology

The data utilized for the rooftop analysis was obtained in the form of a shapefile from the MassGIS website. Using ArcMap software, we created a subset of Building Structures (2-D) data containing a polygon dataset representing roofs in the Grove Hall area. According to MassGIS, the data was updated in 2022 based on the 2021 imagery.

Results

There are 2,612 rooftops in the Grove Hall area, which equals 5,161,690 sq feet/0.185 square miles. However, 21% are smaller than 70 sq feet, so we focused on and analyzed 2,065 rooftops with an area larger than 70 sq feet.

Using rooftop shapes and imagery, we discovered that 34% of rooftops are flat, while 66% are sloped roofs.

Figure 18. Grove Hall roofs by type.

Additionally, over 48% of flat roofs and 64% of sloped roofs are between 1,000 and 2,000 sq feet, leading to the conclusion that over 74% of all rooftops are between 1,000 and 3,000 square feet and not flat. In contrast, flat roofs account for over 80% of roofs larger than 3,000 square feet. This suggests that structures with large footprints tend to have flat roofs, while smaller structures are more likely to have non-flat roofs.

A higher concentration of non-flat roofs compared to flat roofs leads to multiple conclusions. While pitched, gabled, and hipped roofs are more visually appealing and provide a traditional look that contributes to the sense of character and charm of the community, they are more challenging for maintenance and restoration. Additionally, sloped roofs have limited roof usage and are more vulnerable to damage from high winds. On the other hand, flat roofs pose challenges for rainfall and snowfall management, effective insulation, and building ventilation.

With over 118 acres of rooftop area and an average of 1,976 square feet, Grove Hall roofs provide opportunities for community development and environmental as well as economic initiatives. By investing in initiatives like white roofs, green roofs, solar energy, and rainwater harvesting, Grove Hall may mitigate the effects of a high concentration of impervious surfaces and become more resilient to the impacts of climate change.

Solar Energy Production Potential in Grove Hall

Rooftops in urban areas offer ample space for solar panel installations, contributing to clean, renewable energy generation. In the Grove Hall area, there are over 2,600 rooftops. We conducted an analysis to identify the most suitable roofs and calculate their solar power generation capacity, as well as that of the entire community.

Data and Methodology

For our analysis, we used MassGIS Rooftop shape data and imagery layers from the most recent Lidar Terrain Data. The datasets include DEM as a file geodatabase raster dataset, Shaded relief image in JPEG 2000 format, ArcMap 10 (.lyr), and ArcGIS 2.9 (.lyrx) layer files.

To estimate solar potential, we utilized the Solar Radiation Analysis Tool in ArcGIS Pro. This tool analyzes the sun's effects on a geographic area over a specific timeframe, considering atmospheric effects, site latitude, elevation, slope, aspect, and the sun angle's seasonal shifts. It also takes into account shadows cast by surrounding topography.

The solar radiation calculations allowed us to estimate the electric power generation potential for each rooftop, block, and the entire neighborhood. The tool's built-in criteria included:

- Slopes of 45 degrees or less, as steeper slopes receive less sunlight
- Rooftops receiving at least 800 kWh/m2 of solar radiation
- Rooftops not facing north, as north-facing rooftops in the northern hemisphere receive less sunlight

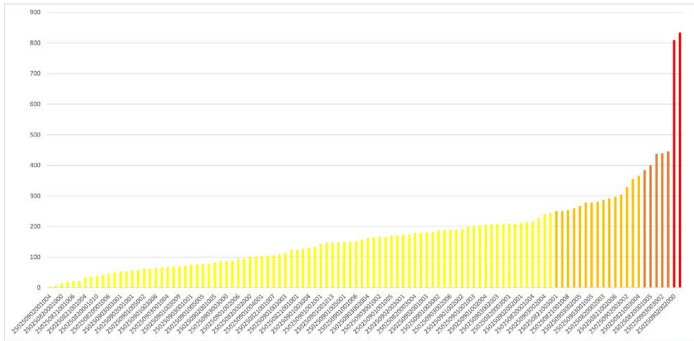
The tool also used the formula provided by the United States Environmental Protection Agency (EPA) to calculate solar energy generation potential, considering a 16% efficiency and an 86% performance ratio. This means that solar panels can convert 16% of incoming solar energy into electricity, with 86% of that electricity preserved through installation.

Results

Our analysis revealed that 75% of rooftops in Grove Hall could not generate 12 MWh per year, which was the average annual power consumption for a U.S. household in 2019. Out of 1,463 suitable roofs, only 391 can generate more than 12 MWh per year. However, given that most buildings are multi-family units, this is insufficient to offset energy consumption for all households.

Figure 19. Solar Power Generation by Structure

Figure 20. Solar Power Generation per Census Block



Our calculations show that the entire Grove Hall area has the potential to generate 18,825 MWh per year. Additionally, 109 out of 121 census blocks within the area are suitable for solar energy generation, with an average of 174 MWh per year. Two census blocks containing large, flat-roofed buildings have the potential to generate over 800 MWh per year, and 20 census blocks can generate between 250 and 500 MWh (Figure 21).

Figure 21. Solar Power Generation Capabilities by Census Block.

Conclusion

Our analysis demonstrates that the Grove Hall area has the potential to generate a significant amount of solar energy. With further investment, this capacity could be increased. Although having current technology and industry standards, it may not fully offset energy demand; there are numerous benefits to installing solar panels, such as reducing carbon footprints and reliance on fossil fuels. Grove Hall residents may also enjoy increased property values and attractiveness associated with energy-efficient homes in the housing market. Furthermore, solar panels signal forward-thinking, environmentally responsible behavior, which can improve the community's public perception among visitors, investors, and residents.

III. Grove Hall Environmental Challenges and Mitigation Opportunities

Decarbonization of Residential Structures

Overview

Definition

Since the beginning of the 21st century, people have been increasingly concerned with climate change. To address the existential threat of climate change, we need to reduce or even eliminate carbon dioxide and other greenhouse gases released into the environment, which is decarbonization. Urban areas or cities are responsible for 71% - 76% of world CO2 emissions from final energy consumption and 67% - 76% of global energy use (Intergovernmental Panel on Climate Change, 2015)"properties":{"formattedCitation":"(Intergovernmental Panel on Climate Change, 2015. And buildings account for the majority of carbon (CO2) emissions in heterogeneous and complex urban settings(Bhaskaran et al., 2023). Decarbonization of residential structures is the process of shifting away from fossil fuel-based energy sources, such as natural gas or oil, and replacing them with low or zero-carbon alternatives, such as solar or wind power. Decarbonization of residential energy usage is a significant step toward reaching carbon neutrality. And this process requires alternations to the design and construction of the building, as well as the installation of energy-efficient appliances and systems.

Benefits

Investing in the decarbonization of residential structures can create social value for the community in several ways:

Environmental benefits: Decarbonizing residential structures has significant environmental benefits as it can decrease greenhouse gas emissions and improve air quality, resulting in positive impacts on public health and the environment. For instance, according to the Environmental Protection Agency (EPA), residential buildings are responsible for approximately 20% of greenhouse gas emissions in the United States (U.S. Environmental Protection Agency, 2021). Therefore, decarbonizing residential structures can help reduce emissions from residential buildings, which is essential to achieving global climate targets.

Increased energy independence: According to the International Energy Agency (IEA), decarbonizing building is a critical element in achieving a sustainable energy future (International Energy Agency, 2020). By integrating renewable energy sources into homes, such as solar panels and wind turbines, they can generate their own electricity and reduce reliance on grid-supplied electricity (Barbose & Darghouth, 2022). This increased energy independence not only helps to reduce greenhouse gas emissions but also makes houses more resilient during power outages and less susceptible to fluctuations in energy prices.

Healthier indoor environments: Energy-efficient homes often have better insulation, ventilation, and air sealing, which can improve indoor air quality and reduce exposure to allergens, pollutants, and moisture-related issues. Studies have also shown that energy-efficient homes with better indoor air quality can lead to improved health outcomes. For instance, a study by the Lawrence Berkeley National Laboratory found that improved indoor air quality led to a 26% reduction in respiratory illnesses and a 33% reduction in asthma symptoms (Fisk et al., 2011).

Energy-efficient homes can contribute to healthier indoor environments through improved insulation, ventilation, and air sealing. Proper insulation helps to maintain consistent indoor temperatures and reduce the transfer of outdoor pollutants and allergens. Adequate ventilation helps remove indoor pollutants, moisture, and odors, as well as improve air quality and reduce the risk of health issues such as asthma, allergies, and respiratory infections. Additionally, effective air sealing can prevent the infiltration of outdoor pollutants and allergens, as well as moisture-related issues such as mold growth.

According to the U.S. Environmental Protection Agency(2021), indoor air pollution can be two to five times higher than outdoor air pollution and, in some cases, up to 100 times more polluted. Poor indoor air quality can have detrimental effects on human health, including respiratory problems, heart disease, and even cancer (World Health Organization: WHO, 2021). In contrast, energy-efficient homes with improved insulation and ventilation have been shown to have lower levels of indoor pollutants and allergens, leading to healthier indoor environments (Klepeis et al., 2001).

Job creation: The transition towards low-carbon residential structures has the potential to generate employment opportunities in various industries, such as solar and wind power installation, energy efficiency consulting, and green building construction. For instance, the installation of solar panels and wind turbines can create jobs in manufacturing, installation, and maintenance, while energy efficiency consulting can provide employment in assessing and improving energy use in buildings. Moreover, the construction of green buildings can also contribute to job creation in the architecture, engineering, and construction sectors. According to the Renewable Energy and Jobs Annual Review 2022 by the International Renewable Energy Agency (IRENA), the renewable energy sector employed over 13 million people globally in 2021, with the potential to reach 24 million by 2030 and 42 million by 2050. The report highlights that Asia remains the largest employer in the renewable energy sector, followed by Europe, North America, and Africa. Moreover, the renewable energy sector has proven to be more resilient than other industries during the COVID-19 pandemic, with employment in the sector increasing by 5.2% in 2020, compared to a 3.8% decline in the overall global workforce (International Renewable Energy Agency, 2022a). Therefore, the decarbonization of residential structures not only creates employment opportunities but also contributes to the growth of the green economy, improving the livelihoods of people in local communities.

Limitations

High upfront costs: One of the primary challenges associated with retrofitting existing homes into energy-efficient homes is the high upfront costs involved. According to Al Hashmi et al. (2021), retrofitting existing buildings can be a costly process, making it challenging for low-income households or those with limited access to financing options. The cost of retrofitting homes with energy-efficient features such as insulation, air sealing, and efficient HVAC systems can be a significant barrier, leading to the limited adoption of these technologies (AlHashmi et al., 2021)there is a growing energy demand associated with increased greenhouse gas (GHG.

Inadequate policies and incentives: One of the key factors that contribute to the challenges of decarbonizing homes is the lack of adequate policies and incentives provided by governments in certain regions. According to Fouquet (2018), the success of decarbonization efforts is heavily dependent on supportive government policies and incentives. However, the absence or inadequacy of such measures can create barriers to achieving the desired outcomes.

Behavior and lifestyle changes: Decarbonization of residential structures may require changes in household behaviors and lifestyles, such as reducing energy consumption, which some individuals may be resistant to adopting.

Decarbonization Planning for Grove Hall

Addressing Existing Environmental Issues

Air pollution: Grove Hall is an urban neighborhood that experiences air pollution from various sources, including vehicle emissions, construction activities, and residential heating. Transferring residential buildings to decarbonizing homes can help reduce the consumption of fossil fuels in colder months so that air pollution caused by house-releasing pollutants such as carbon monoxide, nitrogen oxides, and particulate matter can be reduced or even eliminated.

Energy waste: For the buildings in Grove Hall, residentials account for 86%, representing 1768 units of dwellings. And three family dwellings comprise 35% of the residential buildings, with a total of 623 structures. On average, the three-family dwellings are 116 years old, which indicates that those homes lack efficient heating and cooling systems, lighting, and appliances, as well as sufficient insulation and air sealing. All these indicators would contribute to higher energy consumption and waste.

Utilizing Proven Technologies and Programs

Geothermal Heat Pumps

Geothermal heat pumps, also known as ground source heat pumps (GSHP), are an energy-efficient and ecologically beneficial heating and cooling system that leverages the steady temperatures of the earth to transmit heat. Ball State University in Indiana serves as an exemplary case study for the potential of geothermal heat pumps. The university completed one of the largest geothermal projects in the U.S. in 2014, replacing its coal-fired boilers with a massive geothermal system that now heats and cools approximately 50 campus buildings. The university's investment in the system has reduced its carbon footprint by half and saved $2 million in annual energy expenditures (Ball State University Geothermal Project, n.d.).

Geothermal heat pumps have gained recognition for their ability to reduce energy consumption and greenhouse gas emissions significantly. According to a feasibility study conducted by the Heating Energy Efficiency Taskforce (HEET), ground-source heat pumps have the potential to play a vital role in meeting the heating and cooling needs of buildings in Massachusetts. The study found that widespread adoption of these systems could lead to a significant reduction in greenhouse gas emissions and energy costs. The report recommended the development of policies and incentives to encourage the greater use of ground-source heat pumps in the state.

Furthermore, a recent report by the International Renewable Energy Agency (IRENA) indicates that the cost of ground-source heat pumps has decreased by approximately 20% over the past decade, and the technology is expected to become even more affordable as it continues to improve (International Renewable Energy Agency, 2022b). These trends, combined with the potential economic and environmental benefits of geothermal heat pumps, make them an attractive alternative to traditional heating and cooling systems.

Deep Energy Retrofits

Deep energy retrofits are extensive repairs to a structure that attempts to reduce energy consumption by a substantial amount by enhancing the efficiency of the building's envelope, systems, and equipment. A deep energy retrofit project involves making significant upgrades to a building's envelope (e.g., insulation, windows, roofing) and mechanical systems (e.g., HVAC, lighting) in order to reduce energy consumption and greenhouse gas emissions. The TowerWise Project is an intensive energy retrofitting program that aims to improve the efficiency of 1,200 apartments in six different high-rise buildings in the City (The Atmospheric Fund, 2015). This project, which was completed in 2014, included the replacement of windows, the installation of high-efficiency boilers, and the implementation of cutting-edge energy management systems to improve the efficiency of the building as a whole. By its completion, the project had saved up to 30% in energy costs and reduced greenhouse gas emissions by 20%. Such programs could provide an excellent opportunity for Grove Hall to achieve sustainability while promoting economic growth and job creation.

Projected Results

The Grove Hall area is characterized by numerous triple-decker buildings, which are a typical architectural style in New England and prevalent in the area due to their narrow structure and capacity to house up to three families in identical apartments with shared front and rear stairways. As such, they represent an efficient solution for densely populated urban areas, with three-family dwellings comprising 35% of the parcel inventory in Grove Hall, totaling 623 structures. On average, these buildings are 116 years old, with a living area of 4,001 square feet.

A feasibility study conducted by the Home Energy Efficiency Team (HEET) suggests that the adoption of geothermal heat pumps (GHPs) for residential structures in Grove Hall can significantly reduce greenhouse gas emissions and achieve substantial energy savings. GHPs are highly efficient, with the U.S. Department of Energy reporting efficiencies ranging from 300% to 600%, meaning that for every unit of electricity consumed, GHPs can provide 3-6 units of heat energy (U.S. Department of Energy, n.d.).

Moreover, deep energy retrofit could be a promising solution for Grove Hall, given the average age of buildings in the area, which is 71 years old as of 2023, with the majority constructed in the early years of the 20th century. According to the Rocky Mountain Institute (2022), deep energy retrofits can result in energy savings of 30-50% or more by upgrading insulation, sealing air leaks, and improving heating and cooling systems. Therefore, considering deep energy retrofits for buildings in Grove Hall could contribute to significant reductions in energy consumption and associated greenhouse gas emissions.

Reflective Pavements

Overview

Definition

Reflective pavements, also known as cool pavements, are designed to reflect more sunlight and absorb less heat than traditional pavements. They are typically made of materials that have a higher albedo or reflectivity, such as light-colored concrete, asphalt, or coatings.

Reflective pavements can come in a variety of materials, including concrete, asphalt, and coatings. They can also vary in their level of reflectivity. For example, cool asphalt can reflect up to 35% of sunlight, while cool concrete can reflect up to 55% (U.S. Environmental Protection Agency, 2022b).

Benefits

Mitigate the urban heat island effect: Reflective pavements can reduce surface temperatures by several degrees and mitigate the urban heat island effect. By reducing surface temperatures, reflective pavements can improve the overall livability and sustainability of urban areas.

Improve air quality: Traditional pavements can contribute to the formation of ground-level ozone and other air pollutants, which can have negative health impacts. Reflective pavements can help reduce the formation of these pollutants by reflecting more sunlight and heat.

Increase the lifespan of pavement: High temperatures can cause traditional pavements to expand and contract, leading to cracking and other damage. Reflective pavements can reduce these temperature-related stresses and extend the lifespan of the pavement

Limitations

Discomfort for people: One of the drawbacks of reflective pavement is that it can make people uncomfortable as it reflects heat at them, potentially causing discomfort or even health problems. The reflected heat from pavements may increase thermal discomfort and can lead to a phenomenon known as the urban discomfort syndrome (Kousis & Pisello, 2020). This phenomenon results from the combined effects of high temperatures, humidity, and air pollution, leading to an increased risk of heat-related illnesses such as heatstroke, dehydration, and exhaustion. The discomfort is particularly acute in densely populated urban areas, where the urban heat island effect is pronounced.

Limited effectiveness: The effectiveness of cool pavements depends on the materials used, the amount of sunlight and heat exposure in the area, and local climate conditions. For example, in areas with less direct sunlight or cooler temperatures, the benefits of reflective pavements may not be as significant as those with high levels of sunlight and heat (AzariJafari et al., 2021).

Maintenance: Reflective pavements require regular maintenance to maintain their reflective properties. Over time, the reflective coating can wear off, reducing its effectiveness. If not properly maintained, reflective pavements can actually absorb more sunlight and exacerbate the urban heat island effect. Further, reflective pavements may experience reduced durability due to increased cracking and rutting, which can result in increased maintenance costs over time.

Opportunities in Grove Hall

Addressing Existing Environmental Issues

Grove Hall experiences the urban heat island effect due to the concentration of artificial materials in the area. Approximately 70% of the area is covered by streets, roofs, and sidewalks made of dark materials, with limited vegetation to mitigate heat absorption. This concentration of structures and lack of green spaces can exacerbate the effects of the urban heat island, leading to higher temperatures and increased energy consumption for cooling purposes.

In addition to the urban heat island effect, Grove Hall also experiences air pollution from vehicle emissions, construction activities, and residential heating. Air pollution can negatively affect residents' health, particularly those with respiratory problems or other health conditions (U.S. Environmental Protection Agency, 2022c). The combustion of fossil fuels in residential buildings can contribute to the formation of ground-level ozone and other air pollutants, which can increase the prevalence of asthma, respiratory disease, and other health problems.

The implementation of energy-efficient technologies, such as reflective pavements, green roofs, and geothermal heat pumps, in Grove Hall, could reduce residential buildings' energy consumption and air pollution. These technologies could also help mitigate the urban heat island effect, improve the comfort of residents, and create more sustainable and livable communities.

Utilizing Proven Technologies

Compared to standard pavements, reflective pavements can reduce surface temperatures by up to 10 degrees Celsius (Kappou et al., 2022). This has the potential to lower cooling energy needs and improve environmental and public health outcomes (R. Kumar, 2022). Although the efficacy of reflective pavements may vary depending on variables such as the materials used and the local climate, they are becoming a more common strategy for reducing the urban heat island effect.

To investigate how well reflective pavements can mitigate the metropolitan heat island effect, Phoenix has launched the Cool Pavement Pilot Program. Commercial parking lots and municipal streets are just two of the many locations in the city where reflective pavements have been placed as part of this program. The use of reflective pavements has been shown to decrease surface temperatures by up to 30 degrees Fahrenheit, resulting in greater pedestrian comfort and less energy needed to cool buildings (City of Phoenix, 2022).

Projected Results

The study by AzariJafari et al. (2021) sheds light on the potential impacts of cool pavements on mitigating the urban heat island effect and climate change impacts in urban areas. In particular, the study evaluates the impact of cool pavements in Boston, including the Grove Hall neighborhood.

According to the study, implementing cool pavements in Boston could potentially reduce surface temperatures by up to 2.2 °C (or approximately 4.0 °F), leading to a reduction in energy demand for chilling buildings and an improvement in outdoor comfort for pedestrians (AzariJafari et al., 2021). This decrease in ambient temperatures may also result in a decrease in greenhouse gas emissions, as less energy would be required to cool buildings.

Green and White Roofs

Overview

Definitions

Roofs are one of the structural components that can be utilized to mitigate the environmental challenges of urban living. There are at least two proven ways to address heat island effects, overconsumption of energy and lower greenhouse emissions. One is the green roof, also called roofs with plants, which comprises three main components: membranes, growth medium, and plants (Gaffin et al., 2009). Locally adapted plants are planted in a container that is usually light and contains a small amount of organic matter that helps the growing plants. A waterproof membrane ad an insulating layer comprise most of the bottom layer, which serves to waterproof the roof and shield it from damage from plant root penetration (Oberndorfer et al., 2007).

White roofs, often known as cool roofs, are a typical method for lowering indoor temperatures. By painting the roof white, it will reflect more sunlight, and so lose less heat. It can also reduce the demand for cooling energy and mitigate the urban heat island effect (Sproul et al., 2014).

Benefits

Green roofs help buildings in warm climates use less energy by cooling buildings through plant water evaporation and by adding extra insulation. Moreover, green roofs assist in reducing the load on municipal stormwater treatment facilities. It has been established that green roofs can absorb and store rainwater, alleviating the problem of excessive surface runoff in a short period due to the hardening of ground height (Mentens et al., 2006). By expanding the community's plant coverage, green roofs can also help lessen the urban heat island effect by reducing the amount of sunlight absorbed by the ground and increasing the precipitation penetration. Green roofs can simultaneously address several urban environmental hazards, providing a more significant overall benefit than conventional methods that can only mitigate one (Oberndorfer et al., 2007). Furthermore, without taking up additional space, green roofs can enhance the amount of greenery in densely crowded neighborhoods, improving the quality of life for locals. A study by Brenneisen (2006) also found that green roofs can serve as habitats for various insects, birds, and lichens, hence enhancing biodiversity.

The main benefits of white roofs are their affordability and effective cooling capabilities. They reflect 55-80% of sunlight, better than traditional and green-planted roofs (Akbari et al., 2001). In addition, white roofs are more affordable to build and replace than traditional roofs and have a longer lifespan (Sproul et al., 2014). The economic efficiency of white roofs is higher than that of other methods.

Limitations

Although green roofs have many benefits, their high price prevents them from being widely used. Green roofs are more costly than other methods since they require ongoing maintenance and are made of living plants. In addition, whether the leachate from plant growth substrates will release phosphate discharge into urban water bodies causing eutrophication, remains inconclusive (Karczmarczyk et al., 2018).

On the other hand, inexpensive white roofs do not benefit cities beyond the remarkable cooling impact and the resulting energy savings. The temperature has an impact on the functioning of white roofs as well. White roofs are less effective in reducing the heat island effect in winter at high latitudes and may increase the demand for heating fuels when temperatures are low (Oleson et al., 2010).

Roofs in Grove Hall

Addressing Existing Environmental Issues

Grove Hall's impervious surface currently covers 0.48 square miles, or 70% of the entire land area, whereas evergreen and deciduous forests occupy less than 19%. Grove Hall also has a higher temperature than Boston's median (City of Boston, 2022). This community's heavily hardened surface and scarcity of flora have been shown to escalate the urban heat island effect and cause further temperature increases (Soltani & Sharifi, 2017).

Nevertheless, just 34% of the community's roofs are flat, and up to 66% are slanted. Moreover, such sloped roofs facilitate the accumulation of air pollutants and result in increased levels of near-surface pollution (Huang et al., 2015).

Utilizing Proven Technologies

With the seventh-largest temperature difference between urban and rural areas, Kansas City is one of the top 10 cities in the U.S. that suffer from severe heat island effects. Additionally, the region's air quality is declining. These considerations have prompted Kansas City to prepare for more green roofs in 2018 to help with the region's worsening environmental issues.

In collaboration with the responsible departments and green roof architects, the local government and Environmental Protection Agency initially carried out a data analysis of the types and numbers of buildings and existing green roof construction in Kansas City to assess the amount of work that needs to be done. The next step was determining whether existing policies might impact the project's development. This research was done in order to take advantage of any regulations that would have the potential to directly or indirectly lower construction costs and win more support, as the Climate Protection Plan of 2008 enabled the City Plan Commission to support a prior $75 million investment in 2017 effectively.

The team then projected the expansion of green roof installations and evaluated the project's impact on Kansas City's water, heat, energy, and emissions. To better communicate the advantages of the project to the general audience, the health advantages of the green roof installation were also measured

The findings demonstrated that constructing Kansas City's green roofs mitigated major environmental issues. Like Kansas City, Grove Hall has a severe urban heat island effect problem, with a concomitant increase in energy use for cooling and heating. The sloped roofs that make up the majority of the building allow pollutants to collect in the neighborhood, making air quality a concern. Furthermore, the highly hardened ground prevents surface runoff from being dissipated. The installation of green or white roofs can address these hazards adequately.

Projected Results

The installation of green roofs on Grove Hall's buildings will surely boost the neighborhood's vegetation cover overall and address the issue of the surface's excessive hardening. Second, the green roof can more effectively shield the building from sunlight. When combined with vegetation's natural cooling process, the temperature inside and outside the building can be successfully decreased, eventually reducing Grove Hall's urban heat island effect.

The team discovered that if 30% of Grove Hall's roofs were covered with vegetation or had roofs painted with a covering of 70% reflectivity, surface temperatures might be lowered by 1°C or 33.8□ (Li et al., 2014). Urban heat island effect mitigation is improved by increasing the coverage area. Green roofs on buildings in Grove Hall will also enhance the area covered by vegetation and solve the issue of excessive surface hardening. With approximately 2,065 roofs throughout the community, Grove Hall could gain an additional 144,550 square feet of green coverage if all were calculated at 70 square feet per roof.

Permeable Pavements

Overview

Definitions

Permeable pavement is a type of Green Infrastructure that collects and infiltrates rainwater to control runoff and recharge groundwater. It comes in various forms, including porous concrete, pervious concrete, and concrete/plastic grid (Kumar et al., 2016). Parking lots, parks, sidewalks, and many other surfaces can all have permeable pavement placed. Depending on the structure and material of the permeable pavement, its infiltration capacity differs (Imran et al., 2013).

Benefits

Permeable pavements can efficiently minimize surface runoff as part of a stormwater management system, capture hazardous pollutants produced by urban activities, and aid in restoring the hydrological cycle of the city. Depending on the permeable pavement's design, the rate at which heavy metal pollutants are intercepted ranges from 40% to 99%. In addition to directly replenishing groundwater, precipitation that seeps into the soil can hydrate and oxygenate already-existing plants, promoting their growth (Mullaney & Lucke, 2014). Also, because permeable pavement improves transpiration from the earth, it can lower the increase in urban temperatures, decreasing the urban heat island effect and reducing energy consumption (Peluso et al., 2022).

Also, this technique can lessen the noise produced by the friction between passing traffic and the ground, given the permeable pavement's porous structure. Turf can fill the spaces between the concrete grid and plastic grid to increase community vegetation coverage further, enhance air quality, and create urban habitats (Chu et al., 2017).

Challenges and Limitations

Despite its many advantages, this pavement wears down with time, and its permeability diminishes due to pore blockage, which requires frequent cleaning and maintenance by the local authority (Kumar et al., 2016). (Kumar et al., 2016). In addition, no uniform technique is employed for all permeable pavements because they exist in various configurations and materials (Weiss et al., 2019). More detailed measurements and analyses of the surrounding area will be needed during the pre-construction phase and will increase construction costs.

Permeable Pavements Opportunities in Grove Hall

Addressing Existing Environmental Issues

The total area of Grove Hall is 0.69 square miles, and the impervious surface represents approximately 70% of all land cover which accounts for 0.48 sq miles. As shown in the graphic, the impervious surface area greatly exceeds the greenery area. As a result, precipitation in Grove Hall has difficulty infiltrating the ground and instead forms runoff at the surface, increasing the risk of urban flooding. The hardened ground and lack of green space contribute to temperatures in this neighborhood that are above the median for Boston and increase energy losses for cooling, exacerbating the heat island effect (City of Boston, 2022). The concrete surface of Grove Hall exposes residents to high temperatures. People with high-temperature sensitivity, such as chronic illnesses, infants, elders, and outdoor workers, are more likely to develop temperature-related illnesses.

Furthermore, for residents who lack cooling equipment, high temperatures can significantly reduce their comfort level. Given the increasing demand for cooling energy, residents' cost of living may increase, reducing Grove Hall's cooling availability and deepening the environmental inequity between this community and other affluent communities.

Utilizing Proven Technologies

To help restore the Ipswich Watershed, the local authority, with the support of the U.S. Environmental Protection Agency, is piloting several projects in the area. One of the demonstration projects is the Sliver Lake Beach Parking Lot in Wilmington. Half of the parking lot was replaced with various permeable pavements, while the other half was paved with asphalt for comparison purposes. Two measurements of the parking lot conducted by The U.S. Geological Survey five months before the project began and one year after completion showed that groundwater in the area was not contaminated by runoff from the permeable pavement, effectively reducing surface runoff and intercepting contaminants (Zimmerman et al., 2009).

In the City of Phoenix, Arizona, authorities conducted a survey to assess the efficiency of existing green infrastructure buildings in Phoenix. Data from 11 sites across the city showed that the storage capacities of pervious concrete were able to achieve from 47% to 73% of the standard in terms of stormwater management and reduce surface runoff by 90%. In terms of mitigating the heat island effect, although the survey showed that pervious pavements provide limited relief to the heat island effect on the surface, this may be due to municipalities painting these surfaces a dark color, lack of maintenance, and not installing them as designed. In general, permeable pavements can reduce surface temperatures through evapotranspiration in humid and moist conditions.

Grove Hall, a community with highly hardened surfaces, is at risk of flooding due to excessive surface runoff and suffers from the urban heat island effect. In addition, Grove Hall has a high population density, with just 4.5% of workers being able to walk to work and high levels of household sewage and vehicle emissions pollution. These factors are similar to those in Wilmington's parking lot. Precipitation in the Grove Hall area is concentrated between February to April and October to December and exceeds the overall average for Boston in 2020 in both periods. The highest precipitation occurred in April, 1.82 inches above the Boston average for the same period (Boston Water and Sewer Commission, 2020; National Weather Service, 2020). Excessive concentrations of precipitation can overload the sewer system and cause overflow.

Projected Results

The use of permeable surfaces efficiently reduces the risk of floods. It prevents potential contaminants in precipitation from contaminating groundwater by eliminating the need for additional space for water treatment equipment and making the best use of available space.

Parking lots are a good scenario for applying permeable pavement. Of the 0.48 square miles of impervious surface in Grove Hall, 10% is residential parking, 20 residential condo parking lots, and one residential garage, which are covered with asphalt or concrete. It means that at least 133,816 square feet of the impervious surface could be replaced with permeable pavement.

Moreover, permeable pavement can lower Grove Hall's temperature and lessen the impact of the urban heat island effect with regular upkeep and appropriate installation. The permeable pavement can also expand the green coverage of Grove Hall by installing a plastic grid or concrete grid and filling the gaps with turf, offering a greater level of residential satisfaction and a more acceptable living environment for its residents.

E.V. Stations as a Part of Brownfield Development

Overview

Description

Brownfield sites are abandoned, unused, or underutilized industrial and commercial facilities. They are not equivalent to contaminated land, but in actual cases, brownfields often suffer from some industrial contamination (Tedd et al., 2001). Industrial use may result in chemical contamination and biological harm to brownfields, and if left untreated, brownfields may negatively impact the surrounding ecosystem and the health of residents. There has been an increasing focus on brownfield revitalization in the U.S. in recent years. The U.S. Environmental Protection Agency Brownfields Program awards grants to redevelop contaminated lands known as brownfields (Haninger et al., 2017). There is also a greater emphasis on the impacts of brownfields and a greater willingness to transform them (Loures, L., & Vaz, E, 2018).

Unlike brownfields, E.V. Stations are a product of environmental protection. The United States uses 15.4 million barrels of oil daily, 2/3 of which is refined into motor fuel (Etezadi-Amoli et al., 2010). Battery-powered electric vehicles (BEVs) do not produce direct emissions and are less polluting to the environment. They are also become popular among consumers recently because of the low energy cost of electric vehicles. In order for electric vehicles to travel long distances, a large number of stable charging stations are essential. Therefore, E.V. stations increasingly appear in cities as facilities capable of charging electric vehicles.

Conversion of Brownfield and E.V. Stations

According to the Boston ZERO-EMISSION VEHICLE ROADMAP 2020, we summarize the conditions for the construction of E.V. Station as follows:

- Available and safe sites that meet the specific requirements of NEC National Electrical Code 625.28-625.30 for installing charging unit sites;
- Conforming connectors and charging equipment;
- Have cable facilities that can be energized;
- Visibility and lighting;
- The cost of construction;
- Policy Support;
- Electric vehicle traffic in the community.

Brownfield sites, as former industrial sites, usually have well-developed lighting and electrical installations. Moreover, the capacity standard of industrial electricity is high, and using the existing circuit of brownfield land to build E.V. stations usually does not require much capacity modification. Therefore, it is cost-effective to convert brownfield sites into E.V. stations directly. In addition, the U.S. government at all levels pays more attention to the transformation of brownfield sites, and there is a greater chance of obtaining policy support and financial subsidies for transforming brownfield sites into E.V. stations.

Benefits

Deploring former industrial sites can positively impact a community's environment, economic development, and quality of life (Lange, D., & McNeil, S, 2004). Brownfield conversion can reduce the harm of industrial pollution on a community's ecology and its residents' health. In addition, brownfield revitalization can enhance the attractiveness of the environment to neighbors, improve trails, recreational spaces, and the natural environment, increase community pride, eliminate epidemics, improve physical fitness, and increase property values. A change in brownfield sites can directly inject new economic vitality into a community (De Sousa, 2006).

Expanding the network of E.V. stations can improve the adoption of electric vehicles. The use of electric vehicles can reduce the use of fuel vehicles and significantly contribute to energy saving and emission reduction in the transportation sector. Moreover, electric energy has the advantage of low prices compared to fuel. Unlike fuel oil, the price of electricity is not affected by fluctuations in international crude oil prices, making it more stable and reliable for consumers.

E.V. stations can also inject new economic vitality into communities. According to national statistics on the income and age of E.V. owners from 2014 to 2019, E.V. owners typically have higher and younger incomes compared to non-EV owners (Walsh, 2019). E.V. owners often choose areas with dense charging facilities when traveling to deal with car range power issues. Convenient charging locations can contribute to community spending by attracting trolley owners with spending potential into the community.

Challenges and Limitations

Development of brownfields is about to face a dual land development challenge: reducing barriers to private sector redevelopment while linking reuse to broader community goals. Uncertainty about environmental contamination liability and cleanup standards may be faced during the cleanup process. In addition, the availability of funding and complex regulation can create challenges for brownfield development (McCarthy, 2002). Inconsistent visions of brownfield sites among community residents may also hinder brownfield development (Hammond et al., 2023). The different needs and backgrounds of interested participants may lead to divergent views on conversion.

The number of E.V.s purchased will directly affect the demand for E.V. Stations. Currently, E.V.s are still unable to completely replace fuel vehicles as the mainstream consumer choice. The construction of too many E.V. stations may lead to negative economic benefits (Sathiyan et al., 2022). In addition, the construction of E.V. stations will face the challenge of assessing the usage and consumption of electricity in the area where they are located.

Opportunities in Grove Hall

The City of Boston is strongly committed to carbon reduction, with emissions from the transportation sector accounting for 29% of Boston's total emissions and is vital to Boston's carbon reduction. The City of Boston values promoting electric vehicles as an essential means of reducing carbon emissions from the transportation sector. 2019 ranked Massachusetts eighth out of 50 states for electric vehicle sales nationwide. According to the City of Boston's plan, 23% of new vehicles in Boston will be electric in 2025; Boston consumers are expected to adopt electric vehicles at a rate of 54% (low scenario) to 71% (high scenario) of new vehicle purchases by 2050 (Boston Transportation Department, 2019). The increased demand for electric vehicles will inevitably increase the demand for E.V. stations.

Grove Hall has only one E.V. station, which does not meet Boston's municipal planning needs. According to Boston's Zero Emission Vehicle Program, Boston plans for every household to be within a 10-minute walk of an EV-sharing facility or public charging station. Grove Hall's charging station density is well below the Boston area average. The City has constructed and commissioned one public charging station in the Grove Hall area, the only E.V. station in the Grove Hall area.

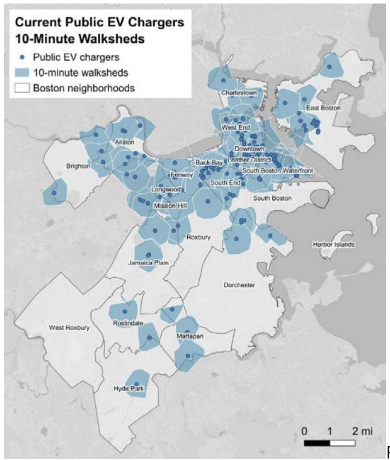


Figure 22. Current Public EV Charges in 10-Minute Walksheds.

Source: MassEVIP

Grove Hall, which lacks E.V. stations, has a good chance of receiving grants to reduce construction costs. The Massachusetts Electric Vehicle Incentive Program (MassEVIP) supports purchasing electric vehicles and charging stations by eligible public entities. Brownfields at Grove Hall meet the requirements for Direct Current Fast Charging, Public Access Charging, and Multi-Unit Dwelling & Educational Campus Charging application requirements and will most likely receive significant construction funding.

Analysis of installation conditions

Grove Hall has 22 identified brownfield sites, mainly concentrated in the Blue Hill Ave area. This area is flanked by many stores involving restaurants, shopping, and other industries, making it one of Grove Hall's key commercial areas. The closest charging station to the area is a 10-minute walk away, which is relatively inconvenient for consumers. The harsh winter weather in Boston will also make walking more difficult and time-consuming. Therefore, converting brownfield sites into E.V. stations could effectively alleviate the lack of charging stations in the business district and encourage trolley owners to come and spend money.

Therefore, we recommend building E.V. stations on five brownfield sites in the area of ECO R3-353-359 and ECO R3-328. The stations will be mainly Level 2 charging stations, allowing cars to be charged in 3-6 hours. It is expected that eight charging stations will be built.

Projected Results

After construction, the vehicle will range 19.2 miles on a one-hour charge. Each charging station uses a 208/240-volt A.C. electric circuit to transfer up to 19.2 kW to the vehicle. Eight charging stations will provide 3,686 miles of range per day for the nearby trolley after construction. A vehicle releases 411 grams of CO2 per mile driven(U.S. Environmental Protection Agency, 2022). Therefore, the E.V. stations at Grove Hall will reduce CO2 emissions by 1,514.95 kilograms per day of charging miles when completed

Brownfields can have an ecological impact on a community due to potential contamination. Grove Hall can take advantage of Boston's favorable policies and subsidies to retrofit brownfields with E.V. stations to help the community better adapt to the new energy-efficient environment.

Solar energy

Overview

Description

Solar panels are a renewable energy technology that converts sunlight into electricity. They are widely used in residential, commercial, and industrial settings to generate clean and sustainable power. Energy production contributes significantly to carbon emissions. Shifting from fossil to renewable energy sources in the next 50 years will substantially impact climate change mitigation (Gerarden, 2023). As one of the renewable energy sources, solar energy can effectively curb the use of fossil energy and significantly contribute to the climate crisis(Fauzi et al., 2023).

Solar P.V. technology has been adopted in many sectors, especially the public sector, such as buildings, street lighting, concentrating solar power systems, and floating systems(Dixit, 2020). The government is also promoting the use and penetration of solar energy in residential areas through rebates, grants, and tax exemptions (Alipour et al., 2021).

Benefits

Solar power can free the power industry from its dependence on coal. Burning coal produces large amounts of carbon dioxide and ash. Large amounts of carbon emissions contribute to the greenhouse effect; dust in the air reduces air quality and may cause respiratory diseases. Solar energy can effectively avoid these problems and generate environmental benefits as a clean energy source. In addition, 80% of the materials used to make solar panels are recyclable. At the end of their service life, recyclable materials will be assembled into new solar panels and other parts, enabling resource recycling and reclamation (MCEC).

The contribution of solar energy to low-income communities is also particularly evident. The cost of solar power generated by households is lower than the price of public electricity, with specific price differences depending on the price of electricity in different regions (López et al., 2022). As an emerging industry, the solar industry requires a large workforce for installation and diffusion, which can create significant employment. Evidence shows that new energy companies encourage female engagement, helping to alleviate issues such as gender equality in employment (Adenle, 2020).

Challenges and Limitations

There are many challenges associated with the adoption of solar panel technology. The primary ones include high upfront costs and suitable locations. From the point of view of the installation structure, the necessary condition for the use of solar panels is sufficient sunlight. Based on sufficient sunlight, we consider the roof's slope, the installation's solidity, wind, and vibration protection, et cetera.

Moreover, the policy can directly influence the diffusion of solar energy. The promotion of solar energy should also consider the actual economic benefits. The cost of installing panels, the use of energy storage systems (ESS), and the dispatch and replenishment of the utility grid are all factors that can affect the actual economics of solar energy.

Opportunities in Grove Hall

According to NASA data calculations, the average daylight in Boston is 200 days per year, lower than the U.S. average of 205 days. The average sunshine in Boston is 4.7 hours per day, which is also relatively lower than the U.S. average of 5 hours per day. Therefore, installing solar cells in the Boston area must be aided by technical means such as adjusting the tilt, reducing building shading, et cetera.

The size and tilt of a roof also significantly impact the efficiency of solar energy use. Generally, the flatter the roof, the larger the area exposed to the sun and the higher the power generation efficiency. In addition, chimneys, corners, and edges of the roof can also reduce the actual usable area of the roof. Therefore, we usually consider that the larger the roof area, the greater the potential for building solar power plants.

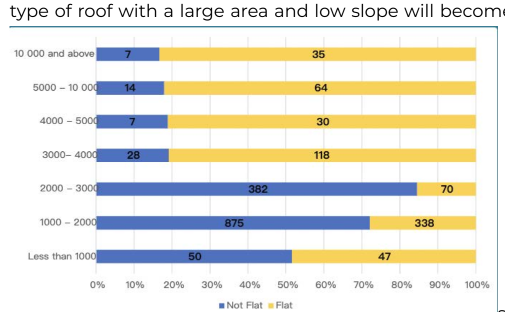
To identify the most suitable roof in the Grove Hall area, our team utilized the ESRI tool, which used three criteria:

- the slope of 45 degrees or less, as steep slopes tend to receive less sunlight;
- rooftops should receive at least 800 kWh/m2 of solar radiation;
- rooftops should not face north, as north-facing rooftops in the northern hemisphere receive less sunlight.

Solar Energy Production Potential

Grove Hall has 2,614 roofs, of which 1,768 are residential; the rest can be identified as commercial and non-residential roofs. Of the 2,614 roofs, 21% are less than 70 square feet in area. Considering the sunlight conditions in Boston, we believe that roofs less than 70 square feet in area are not suitable for solar cell installation from an economic viewpoint. Therefore, we will focus our analysis on the 2065 roofs with an area greater than 70 square feet.

Of the 2065 roofs larger than 70 square feet, over 48% of flat roofs and 64% of non-flat roofs are between 1000 and 2000 sq feet. 74% of the roofs in Grove Hall are between 1000 and 3000 sq feet are uneven. Grove Hall's roofs are between 1000 and 3000 sq ft. For roofs larger than 3000 square feet, 80% of the roofs are flat. This shows that the larger the roof, the more likely it is to be flat. This type of roof with a large area and low slope will become a high-quality potential



solar panels installation.

Figure 23. Grove Hall Roof Tops by Area.

Policy and Financial Support

Boston, where Grover Hall is located, has good policy support that may effectively promote the use of solar energy locally and save the cost of solar installation and use in terms of taxes and subsidies.

Solar Massachusetts Renewable Target (SMART): SMART is the primary incentive program for solar electric projects at properties serviced by the National.

This program can effectively reduce the cost of installing solar equipment and the financial pressure of installation.

In addition, households that install solar power equipment are able to receive tax exemptions. Most residential solar electric systems qualify for a state personal income tax credit for 15% of the total cost of the solar electric system, with a maximum of $1,000.

It is estimated that for a household with a 2,000-square-foot home, installation costs approximately $25,000 before incentives and $17,000 after incentives. This is a savings of more than 30% of the installation cost (MCEC).

Projected Results

Using ArcPRO, we identified suitable rooftops for solar panels. The tool considers multiple factors, such as the atmosphere, dimensionality, altitude, and slope, that may impact solar radiation. According to the United States Environmental Protection Agency (EPA), solar energy can be generated with 16% efficiency and 86% performance ratio. Solar panels can convert 16% of solar energy into electricity, and as the electricity passes through the installation, 86% of it is preserved.

Combining the above tools and analysis methods, we calculated the solar energy usage potential of Grove Hall. Approximately 12 MWh of electricity was consumed by the average American household in 2019. The Grove Hall area has 75% of rooftops that cannot generate 12MWh. In total, there are 1463 suitable rooftops, but only 391 can generate more than 12MWh annually.

Our calculations indicate that the entire Grove Hall neighborhood could generate 18,825 MWh annually. As a result of our analysis, Grove Hall's 121 census blocks are suitable for generating solar energy. Regarding potential, the value ranges from 4.8 MWh to 834 MWh yearly, with the lowest value being 4.8 MWh and the highest value being 834 MWh yearly.

Solar panels, as an innovative energy source, can contribute significant value to the Grove Hall community in terms of environmental benefits and social impact. However, due to the sunlight conditions in the Boston area and the roof conditions of the community, only 15% of the buildings in Grove Hall can fully utilize solar power to provide their electricity needs. This approach can effectively meet the demand for electricity while minimizing the cost of electricity for users and contributing to the community's environmental protection and global climate change.

IV. Discussion and Future Research

This document presents the results of a landscape analysis within the Grove Hall area, reflecting the scope determined in collaboration with our client. Moreover, the scope of this study is limited by the data and methodology used, which prevented our team from including all known physical features, assets, and environmental characteristics of the Grove Hall area. Due to the nonformal boundaries of the researched area, the outcomes are approximations. Throughout the information and geographic data gathering process, our team found that the scale of existing sources did not always match, and some original datasets could not be edited without altering their scale and losing accuracy.

Some may argue that our report is limited and lacks context for the surrounding area; for example, the land cover analysis demonstrates a large amount of impervious surface, but Grove Hall residents benefit from the substantial green space of Franklin Park. It is important to recognize that we intentionally limited our study to gain an in-depth understanding of the physical assets within the community boundaries. Furthermore, our study excluded socio-economic status to focus on infrastructure aspects and explore correlations with Grove Hall environmental issues. Although socio-economic factors play a significant role in shaping Grove Hall's overall environmental condition, our study aimed to find solutions by implementing proven technologies into the area's infrastructure.

A significant part of our study focused on addressing environmental issues we discovered. However, due to time constraints and client requirements, we limited our suggestions to six solutions that align with our client's interests and prove effective, practical, and economically viable. For example, our recommendation of residential decarbonization was based on our client's suggestion, which stems from his in-depth knowledge of Grove Hall infrastructure. Similarly, we researched reflective pavement and cool roofs because their implementation is relatively simple, cost-effective, and provides immediate results. Painting a roof or pavement with reflective coating can instantly mitigate the heat island effect, reducing power demand for cooling and consequently decreasing greenhouse emissions and residents' spending on utilities. Growing trees would have a similar effect, but it takes significantly longer to notice the results.

Further Studies

The intent of our research was to use it as part of a larger project, with landscape analysis as the first step in addressing Grove Hall's environmental challenges and identifying solutions that fit a holistic approach to mitigating issues. To facilitate additional research, it may be advantageous to consider social value investing, which involves investing in enterprises or projects that yield not only financial gains but also social or environmental benefits (Buffett & Eimicke, 2018). This strategy is gaining traction among investors seeking favorable financial returns while promoting positive social and environmental impacts. The appendix of our study will comprise the description of Envision, a tool designed to assess the environmental factors prevalent in the Grove Hall community, which could be used by future research groups to gather information on air quality, noise pollution, and the availability of green spaces.

In summary, the study presented in this document is designed to establish a baseline for identifying environmental issues in the Grove Hall area. We anticipate that it will help in the implementation of the Green Zone Planning Framework and in achieving environmental justice and a sustainable environment for Grove Hall residents in the future.

Appendix

The Envision Sustainability Rating System was created by the Institute for Sustainable Infrastructure (ISI) to evaluate and rank the long-term viability of infrastructure projects from a sustainability perspective. The method provides a thorough analysis of the sustainability of projects and aids in pinpointing improvement opportunities.

Quality of Life, Leadership, Resource Allocation, Natural World, and Climate & Resilience are the five pillars upon which the Envision Sustainability Rating System rests. Ten to fourteen quantifiable credits per criterion are utilized to determine the project's sustainability score. The credits are based on sustainability-related best practices, standards, and guidelines created by a wide range of organizations and professionals

Functions of the Instrument:

- A five-part sustainability evaluation that considers the whole picture.

- Credits that can be measured and are based on the standards, rules, and best practices in sustainability that have been produced by a wide range of organizations and professionals.
- A central hub for evaluating and ranking projects, accessible over the internet.

*There is a certification program for sustainability experts to learn how to use Envision called "Envision Sustainability Professional" (ENV SP).

Benefits:

- Provides a comprehensive evaluation of projects' sustainability and identifies areas for improvement.
- Helps promote more sustainable and resilient infrastructure development.
- Supports sustainability professionals in becoming experts in using the system.
- Eases the process of sustainability assessment by using a standardized framework.

Technical restraints:

- Calls for a thorough assessment of the project's viability, which can be taxing on both time and money.
- Potentially necessitating further knowledge of sustainability rating and assessment.

Northeastern University has already obtained collaboration with the Institute for Sustainable Infrastructure and certification training for students, making it easier to implement this tool in the next phase of the project.

*To obtain further details, one may reach out to Professor Abdel Mustafa. a.mustafa@northeastern.edu

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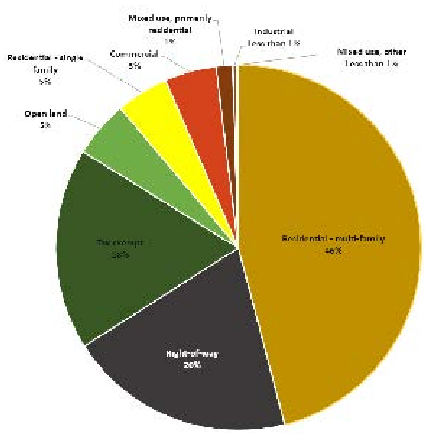
Grove Hall Overview

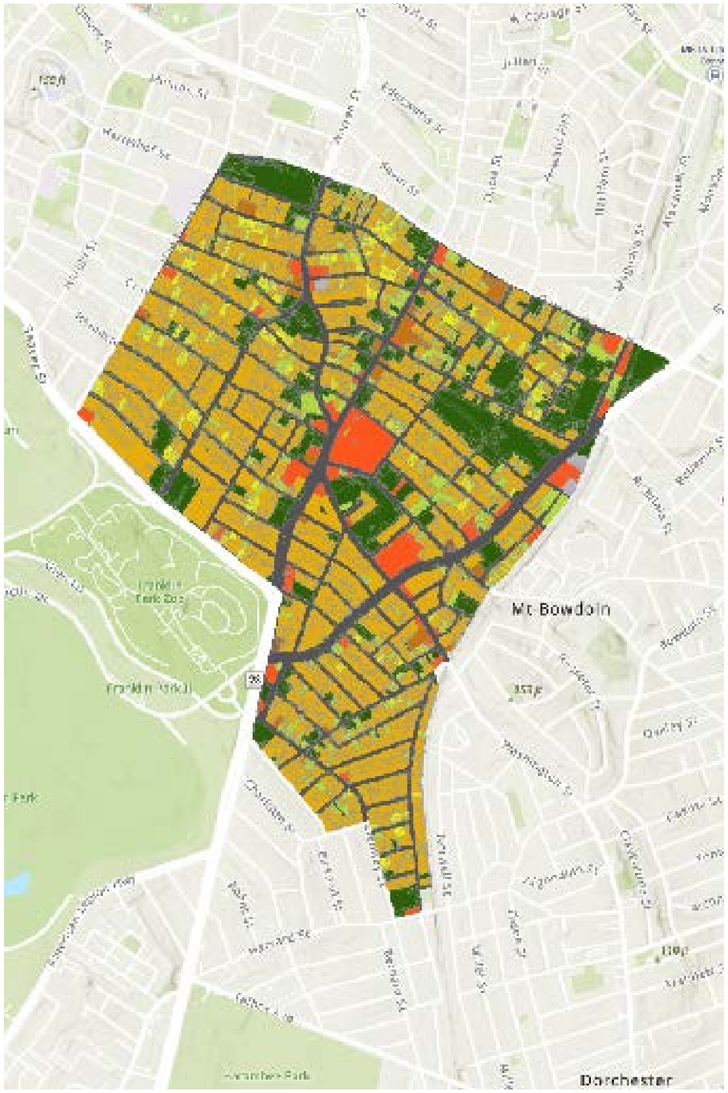
Land Use

The Grove Hall area spans 0.69 square miles and it is predominantly residential, with multi and single-family classes covering over 51% of the area. Conversely, the Commercial land use class, including industrial, accounts for less than 6%.

A significant portion of the land is designated for transportation infrastructure. The Right-Of-Way, which accounts for 20% of the area, is the second largest class. On the contrary, open space accounts for 5%.

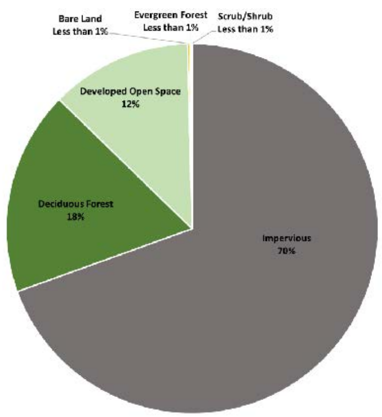
The third largest category is Tax Exempt land use, which typically refers to land owned by tax-exempt organizations, does not generate revenue for the local government, and is not available for commercial or residential development.





Land Cover

Grove Hall is a highly urbanized and developed area. As Massachusetts 2016 Land Cover data shows, over 70% of the land is covered by Impervious Surface. The other two categories include Deciduous Forest accounting for 18%, and Developed Open Space, for 12%.



1 - What are Green Zones and why should we be building them across America?

A - What is a Green Zone

B - What is not a Green Zone?

C - Why Do we need Green Zones?

D – Purpose and Objectives

2 - Creating a Green Zone in Boston and Across America

A - The Green Zone Framework Our Approach to Environmental Justice

B - Proposed Legislation

3 - Introduction to Case Studies

A. Large Scale or City-Wide Green Projects

B. Green Zone specific Projects

4 - Why a Greater Grove Hall Green Zone?

A. Greater Grove Hall Green Zone Initiative Our Strategy
B. Auditing and Assessment
C. Project Selection
D. Partnership formation
E. The Case of Grove Hall
F. How Will Climate Change Affect Grove Hall?
G. Taking The Next Steps Proposing Interventions

5 – Technologies – Itemize the Technologies

A. Smart Cities Technology
B. Stormwater Management - Bioswales, rain gardens, commercial rainwater harvesting, the technologies required to build sponge cities.
C. Urban Farming - bioshelters,, roof gardens, vertical farming,
D. Solar - urban wind energy solutions,, microgrids,
E. Air - Carbon Sequestration, carbon capture, and storage,

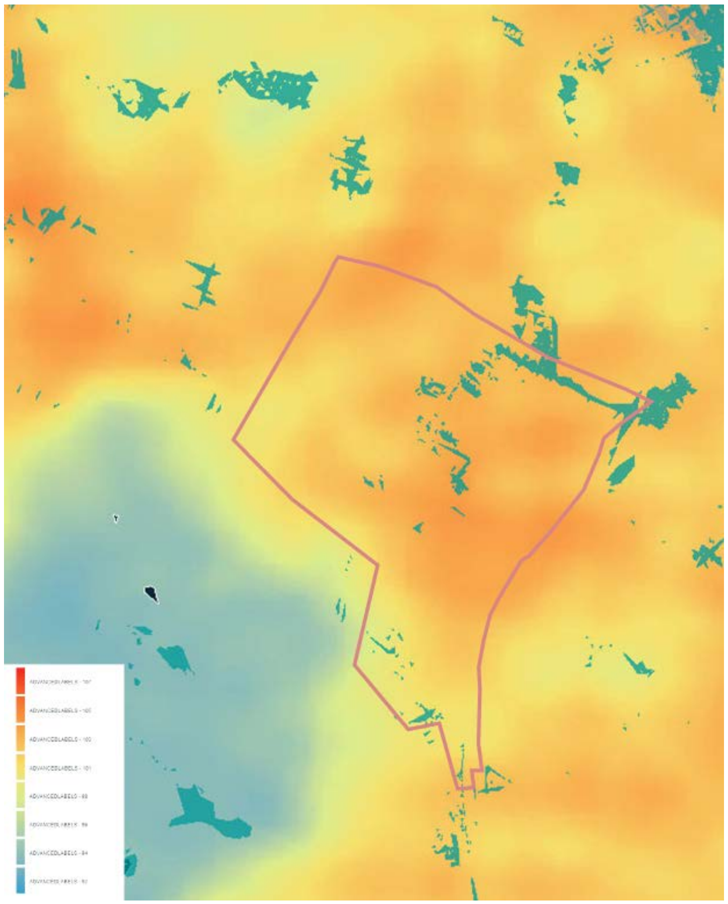
Heat Island Mitigation, net-worked ground-source heat pumps, commer-cial, passive energy heating/cooling systems,

Urban Commercial Recycling - Comercial waste reduction.

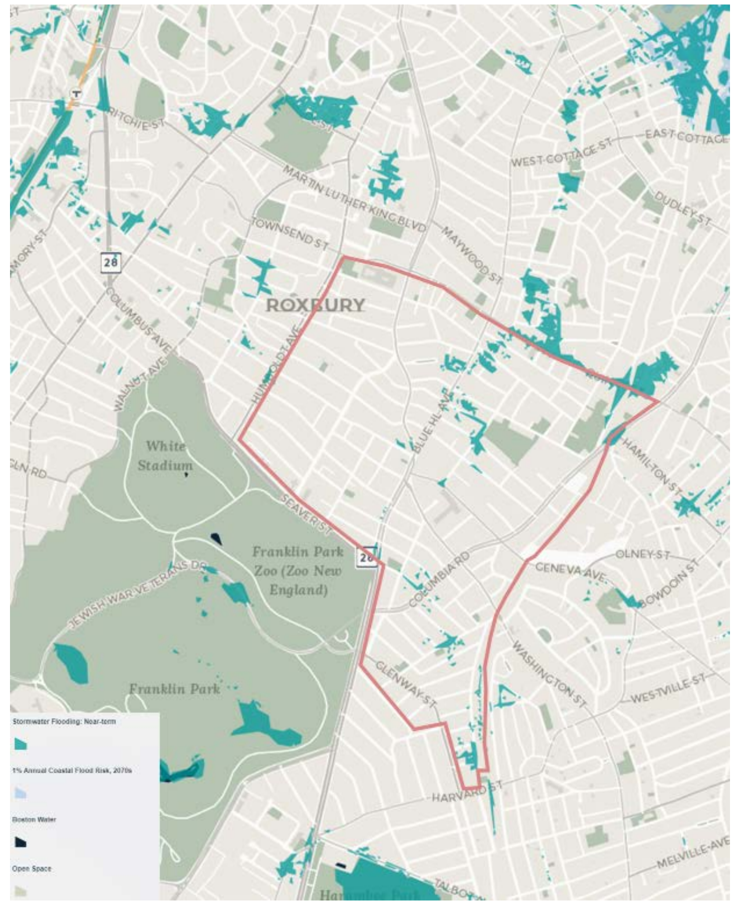
"The urban environment presents challenges that are different from other geographies. Therefore solutions should address the unique challenges of urban settings, particularly in typical Black and brown communities.

Appendix 1: Barr Foundation

Heat Island



Strom Water

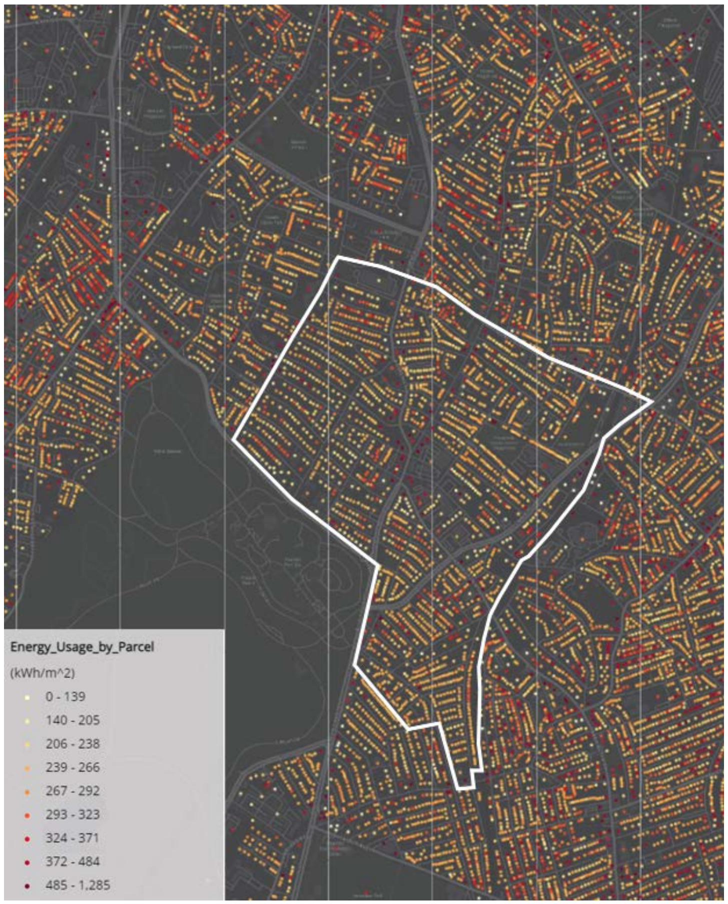


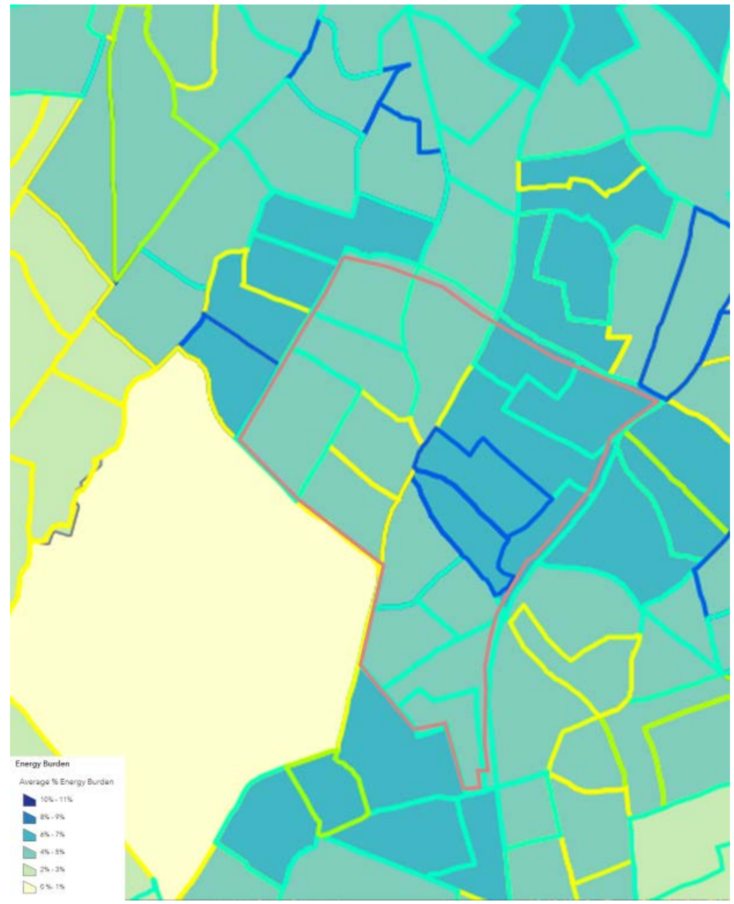
Energy Burden

Energy burden is the percentage of a household's total income spent on home energy bills. The average in MA is 3%.

Median energy burden is 3.1%, and the median low-income energy burden is 10.1% in the Boston metropolitan area.

A quarter of low-income households have an energy burden above 19% in the Boston metropolitan area, which is more





Subsection 2: Green Zone Case Studies

i. Green Zone Case Studies Part II
ii. Grove Hall Green Zone Initiatives: Case Study Evaluations

Green Zone Case Studies Pt. II

Providence, Minneapolis, Portland, and California

Greater Grove Hall Green Zone Initiative: Our Principles

The Greater Grove Hall Green Zone Initiative seeks to remediate land-based environmental challenges in the Boston neighborhood of Grove Hall through a collaborative, multi-sectoral project implementation process that consistently highlights community voices.

The Green Zone Initiative is guided by the principles of...

1. Collaboration

a. We seek to partner with the public, private, and nonprofit sectors to achieve land-based investments and policy changes in the neighborhood of Grove Hall, specifically by integrating Green Zone policies within pre-existing city planning initiatives and programs.

2. Systems Thinking

a. A long history of environmental racism and consistent lack of community inclusion in official planning processes calls for a comprehensive assessment of challenges, opportunities, and solutions that will advance environmental justice (EJ) in the neighborhood of Grove Hall.

3. Cumulative Impact

a. By concentrating resources in the most environmentally burdened communities such as Grove Hall, we will help to center Diversity, Equity, and Inclusion (DEI) in Boston's environmental and climate resilience planning.

4. Authentic Community Engagement

a. We believe in the value of soliciting community input throughout the assessment and project planning processes so that their experiences and visions for change are prioritized in our solutions.

Greater Grove Hall Green Zone Initiative: Our Strategy

This section briefly outlines our strategic approach to implement the Green Zone Initiative:

1. Auditing and Assessment -partially completed, ongoing

a. During this phase, Green Zone team members collected data on the environmental, sociodemographic, and public health indicators within the Grove Hall neighborhood.

b. Opportunities for intervention were also identified during this process (e.g. permeable paving, green roofs, street trees, and urban agriculture sites).

c. We will also solicit qualitative community member input regarding their lived experiences within an environmentally burdened community and how these conditions impact their quality of life.

2. Project Selection -ongoing

a. Based on our assessment data, team members will determine some of the 'best practices' for potential project-based interventions.

b. Potential interventions will be assessed based on the availability of potential partners, project scale and expected time to completion, funding sources, and alignment with community input.

c. We are primarily focused on built environment interventions, but we are open to regulatory changes if they are deemed an appropriate response.

3. Partnership Formation -upcoming

a. We will identify potential partners within the public, private, or nonprofit space who are currently pursuing projects or initiatives related to our proposed interventions.

b. We will garner partnership-based support based on the principle of cumulative impact and the value of investing in Grove Hall as a pilot community to test scalable environmental land use interventions.

c. At this time, we will solicit community input to inform the contours of the project, present some potential solutions, and create a space for community members to voice what they would like to see happen.

Key Terms and Definitions

1. Greater Grove Hall Main Streets (GGHMS)-

The 'backbone' nonprofit organization that is leading the Green Zone Initiative in the neighborhood of Grove Hall.

2. Environmental Justice (EJ) -

A concept that refers to the fair and equitable treatment of communities, especially low-income and minority communities, with respect to the enforcement and development of environmental laws, regulations, and policies.

3. Cumulative Impact-

Due to long history of racist land use practices and continual disinvestment, many low-income, minority communities today experience disproportionate environmental burdens such as high land surface temperatures, lack of green space, and concentrated air pollution, which inflict a cumulative negative impact on residents' quality of life.

4. Ground-Truthing-

This describes the process of directly engaging with people who experience the day-to-day effects of environmental burdens, thereby allowing them to inform policy solutions and interventions.

5. Frontline Communities-

Those who experience disproportionate environmental burdens.

6. Built Environment -

As opposed to policies and regulations that dictate how public and private operations may be undertaken, this concept refers to the physical elements of the environment such as roads and sidewalks, commercial buildings, utilities, and public open spaces.

Greater Grove Hall Green Zone Initiative: Our Approach

Goals and Objectives

The following slides analyze a diverse sample of 8 organizations and initiatives from across the country that address environmental justice concerns. These case studies serve 2 purposes:

1. To inform and improve upon our strategic approach to the Grove Hall Green Zone Initiative

2. To provide points of comparison that we may leverage to distinguish our unique approach towards achieving environmental justice in Grove Hall

Methods

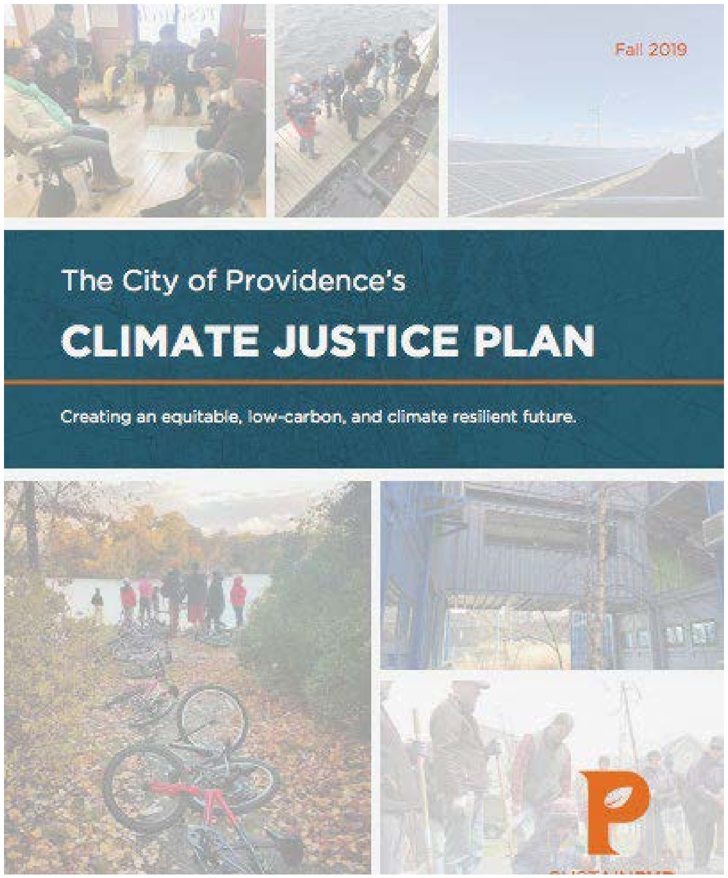
The methodology for this assessment is organized by:

(1) first, describing each case study's mission, formation and vision for change, tactics for advancing environmental justice, relationships within the political sphere, and methods of organizing and community engagement

(2) second, discussing differences and similarities between the case study's approach and the Grove Hall Green Zone Initiative strategy. This process is meant to help us modify our strategic approach and value system based on the lessons learned from these case studies.

Providence, RI Climate Justice Plan, est. 2019

The Providence Climate Justice Plan seeks to create an equitable, low-carbon emission, and climate-resilient future that centers frontline community engagement and decision-making within a collaborative governance framework.



Providence Climate Justice Plan, Con't

How was the Providence Climate Justice Plan developed?

- 2016 -The Office of Sustainability partners with the newly formed Racial and Environmental Justice Committee (REJC) to incorporate a racial equity lens into the city's environmental planning initiatives

- 2017 -The REJC publishes their Just Providence Framework, based on the theoretical framework of a Just Transition, which the Office of Sustainability formally adopts

- 2019 -The City of Providence receives a grant to develop a citywide climate action plan, which through the application of a social and environmental equity lens, becomes a Climate Justice Plan

- The multi-sector planning process includes City departments, the non-profit Acadia Center, frontline community leaders (REJC), independent consultants, and 3rd party facilitators

- Important -Frontline community member input is prioritized during the planning process, since they are identified as the primary stakeholders in this Plan

Tactics: How does the Climate Justice Plan advance environmental justice?

-Co-learning and Capacity Building for a Collaborative Planning Process

- Early stages of planning involved an Energy Democracy Community Leaders Program, which trained 10 frontline community leaders in the principles of environmental justice, energy democracy, and technical aspects of environmental and climate resilience planning

- Robust anti-racism/anti-bias training for City department representatives working on the Plan

- Participants from the Community Leaders Program led the community engagement process in frontline communities and used qualitative feedback to inform potential solutions and interventions

- Developed ideas are relayed back to community members in an accessible format in order to solicit feedback and suggestions for improvement

- One key goal of the Plan is to apply solutions that will address community concerns and priorities, so this feedback is a critical component of this process

- The Plain maintains that equity is a pillar of sustainability, and this quality applies to outcomes and the process of planning to achieve those outcomes

Tactics: How does the Climate Justice Plan advance environmental justice? Con't

- Each of the 7 sections has explicit...

- Objectives (goals for improvement)

- Targets (measurable outcomes)

- Actions (strategies and responsible entities necessary to achieve targets and objectives)

- 7 sections include...

- **Lead by Example-**focus on transitioning municipal power sources to 100% renewables

- **Collaborative Governance and Accountability**-ensures that those most impacted by climate crises are centered in decision-making processes

- **Housing and Buildings**-anti-displacement and equitable access to clean energy sources

- **Community Health** -creating conditions for healthier air and recreational spaces

- **Local and Regenerative Energy** -providing for a sustainably oriented local economy and meaningful work opportunities

- **Clean Energy**-expanding equitable access to renewable energy sources

- **Transportation** -ensuring that everyone has safe access to multiple forms of transportation

Legislation and Politics: Securing Public Sector Commitment to Environmental Justice

- The Plan team clearly identified major decision-makers and made sure that they understand why frontline communities need to be prioritized in environmental resilience planning

- This is why they conducted robust anti-racism training in the early stages of the planning process

- To this end, community members have to be their own advocates for change by first developing capacity through education and then pushing decision-makers to consider their lived experience in the process of defining important policies, which guided the Providence Climate Justice Plan

Accountability and Community Involvement

- The Plan team was able to maintain their focus on serving frontline communities by informingthe general public of their plans but forgoing formal public comment periods and public meetings

- The Plan's strategic action items will be gradually implemented within a collaborative governance framework, which will be achieved in-part by creating formal spaces within City departments that include EJ advocates and frontline community members

Strategy: Grove Hall Green Zone vs. Providence Climate Justice Plan

1. The Providence Climate Justice Plan's co-learning process is a method that Grove Hall should emulate in working with decision-makers to systemize environmental justice in citywide plans. Otherwise, we cannot expect robust community feedback or cooperation from the City without mutual capacity to understand each other's experiences and what everyone brings to the table.

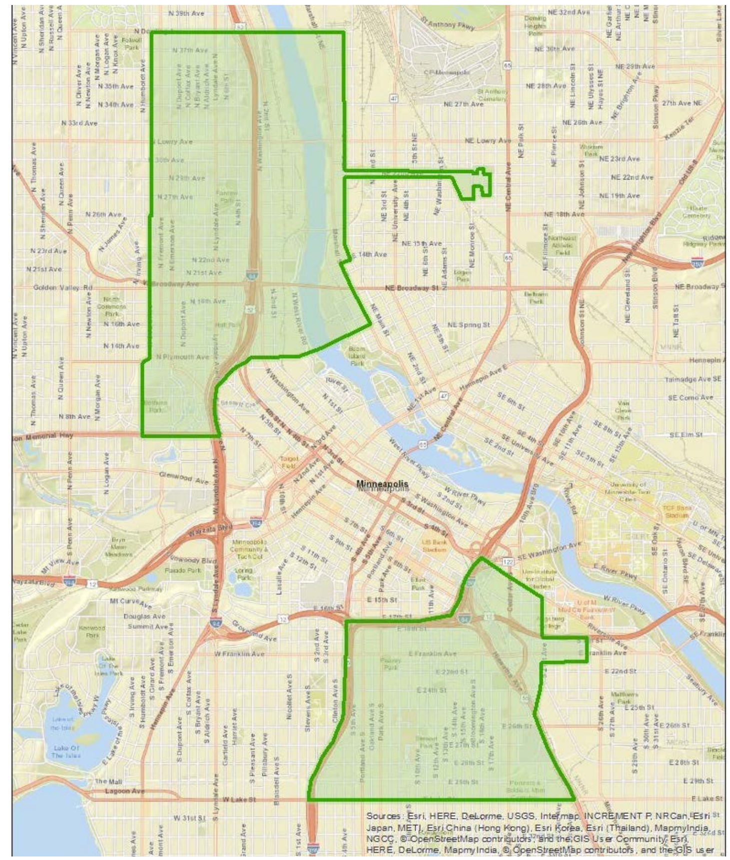
2. Frontline community leaders who are known and trusted by community members acquire qualitative feedback to inform the Providence Climate Justice Plan, which Grove Hall should consider as a way to authentically engage and inform residents of the changes that are necessary to respond to their quality of life concerns.

3. The multi-sector planning process is an important element of Providence's Plan and reflects the cooperative approach that defines the Green Zone, although our strategy does not entail creating a single unified plan but rather integration into pre-existing planning initiatives.

4. The ultimate goal of the Climate Justice Plan, which is to systemize environmental justice and equity into citywide environmental planning, is exactly what we seek to do in Grove Hall.

Minneapolis Green Zones Initiative, est. 2017

The Minneapolis Green Zones Initiative is a "place-based policy initiative to promote health and economic well-being in communities that are overburdened by environmental pollution and face greater social, economic, and political vulnerability."



Minneapolis Green Zones Initiative, Con't

How and when was the Minneapolis Green Zones Initiative established?

2013
- Minneapolis Climate Action Plan incorporates Green Zones as a priority item at the insistenceof a group of environmental justice (EJ) advocates who formed their own Working Group

Feb. 2016
- As a result of continual urging of EJ advocates, City Council passes a resolution to establish a Green Zones Workgroup, convened by the City's Office of Sustainability

April 2016 -March 2017
- 2013 Green Zones Workgroup (comprised of City staff, agency partners, and community stakeholders) meets regularly to develop designation criteria, goals, and strategies

- Designation criteria based on cumulative impact framework
- mapping tool categorizes communities based on environmental challenges AND socioeconomic vulnerability

April 28, 2017
- Minneapolis City Council approves designation and policy recommendations to inform implementation of two Green Zones, a Northern Green Zone and a Southside Green Zone

- City Council appoints Task Forces for each Green Zone to develop Work Plans

Dec. 2019
- Southside Green Zone publishes their Work Plan

March 2020
- Northern Green Zone publishes their Work Plan

Tactics: What is their strategic approach to advancing environmental justice (EJ)?

- This Initiative never would have come to fruition in City Council had it not been for EJ advocates pressuring the City to act on this priority item

- The Office of Sustainability-appointed Workgroup is intentionally comprised of community members (10) and City and agency staff (9) in order to center lived experience directly in the group's deliberations

- City staff are selected based on their ability to approach residents' concerns sensitively and allow for supportive dialogue

- Community member participants, however, wish that they felt on more equal footing with City agency representatives according to post-Workgroup evaluations

- The 2 Green Zone Task Forces have no formal decision-making authority, but their Work Plans -informed by consistent community member input -form the groundwork for actionable policies assigned to key City agencies and departments

Legislating the Green Zones within City Government

- The only formal resolution that passed in City Council established the 2 Green Zones (based on cumulative impact framework) and Green Zone Task Forces in April 2017

- This gave a formal structure to the formation of Green Zone policies in designated areas by dedicated teams

- However, nothing to-date has been legislated due to lack of follow-up within City Council and City Departments

Administrative Structure, Accountability, and Community Involvement

- The Task Forces are still active, but there is very little accountability from city agencies in terms of following through on priority items outlined in Work Plans

- A Memorandum of Understanding (MOU) may be necessary to get the ball rolling

- So far, state and private foundation grants have sustained the Green Zone work, but political buy-in from City agencies will be necessary to sustain this initiative long-term with enhanced policies and regulations

Strategy: Grove Hall Green Zone vs. Minneapolis Green Zones

1. The current challenge of the Minneapolis Green Zones is that the Work Plan action items depend on city agency accountability, but without a formal commitment to follow through on these items, the Work Plans have stalled. The Grove Hall strategy will not depend on formulating a comprehensive plan, but rather focuses on strategic outreach to potential partners in order to secure the Green Zone's integration within pre-existingpolicies and planning initiatives.

2. The cumulative impact framework is a key sticking point that justifies the cause for targeting resource deployment to communities that are most vulnerable to environmental, health, and socioeconomic burdens. To this end, community input is a key lever in the effort to gain political support for built environment interventions.

3. Grove Hall seeks to emulate Minneapolis' method of collaboration between city agency plans and community stakeholder input as a way to systemize the value of community agency in decision-making processes -especially related to land use -that affect their daily quality of life.

EcoDistricts: Established in Portland, Oregon, 2009

The EcoDistricts Protocol is a flexible performance framework that fosters environmentally sustainable, socially equitable, and climate just development at the neighborhood and district scales.

EcoDistricts®

EcoDistricts Con't

How and when was the EcoDistricts Protocol formed?

- 2009 -Portland Mayor Sam Adams founds The Portland Sustainability Institute (PoSI)

- 2009 -2012 -A partnership forms between PoSI, the City of Portland, and the Portland Development Commission to develop 5 EcoDistrict pilot projects in Portland to (1) accelerate sustainable neighborhood-scale development and (2) revise the EcoDistricts Framework into the EcoDistricts Protocol

- 5 EcoDistrict Pilots: South of Market (SoMa) EcoDistrict, South Waterfront EcoDistrict, Foster-Green EcoDistrict, Gateway EcoDistrict, and Lloyd EcoDistrict

- All of these areas were designated Urban Renewal Areas (URAs), so they were chosen for their potential to absorb investments based on their formal designation as URAs

- All 5 neighborhoods engage in stakeholder engagement/organizing, baseline assessments, pre-existing plan reviews, feasibility studies, creation of priorities within a Roadmap, and initial implementation phases

- Lessons derived from these pilots inform the updated Protocol still in use today

- 2012 -PoSI Board votes to expand beyond Portland and rebrands organization as EcoDistricts

Tactics: How does the EcoDistrict Protocol advance environmental justice?

- The Protocol serves as a strategic guide to organizing, planning, and implementing sustainable, neighborhood-scale development agendas

- Stage 1: Imperatives Commitment

- Convene stakeholders from all sectors (public, private, nonprofit, institutional) with a shared commitment to Equity, Resilience, and Climate Protection

- Aim to include entities that have the power to leverage technical capacity and funding as well as community representatives who lend critical first-hand knowledge to the conversaPartion

- Stage 2: Formation

- Organize stakeholders and establish governance structure for the planning process

- Create an 'asset map' of neighborhood -where do opportunities exist?

- Sign a formal Declaration of Collaboration (or DOC, which is similar to an Memorandum of Understanding) to lock in long-term commitments to implementing project plans

- Stage 3: Roadmap

- Identify related programs that could be incorporated into plans and baseline indicators of neighborhood conditions (environmental, health-related, etc.) -these will form the basis for outcomes evaluation and reporting

- Establish priority items based on available data andcommunity input

- Develop strategies and a timeline to achieve priorities based on technical and financial feasibility, which partially depends on funding capacity of participating stakeholders

- Mix in both short-term, low-cost goals and long-term, higher-cost goals so that the project does not lose momentum and maintains credibility

- Stage 4: Implementation and Performance

- Provide consistent updates on work products and priority items

- Amend the Roadmap as needed

Legislation and Politics: Securing Public Sector Commitment

- Secure early commitment from key politicians or appointed officials to spread the news and gain support for the initiative amongst like-minded public sector officials

- This step is crucial to obtain funding and resource opportunities for the Roadmap planning phase

- Leverage a few important political connections -keeping in mind who has power and influence -in order to organically grow base of support and political buy-in

Administrative Structure, Accountability, and Community Involvement

- The Declaration of Collaboration is the primary document through which long-term commitments are secured amongst all stakeholders, but the Roadmap planning that follows is not strictly limited to the signatories of the DOC

- The Roadmap planning group and the DOC signatories ideally meet regularly after the Roadmap is published to evaluate progress, amend goals, and communicate updates to each other

Strategy: Grove Hall Green Zone vs. EcoDistricts

1. Unlike the EcoDistricts Protocol, the Green Zone does not depend on formalizing long-term commitments from project stakeholders because (1) our projects aim to be integrated into already established planning initiatives and (2) the assessment and project ideation process will take place before any external partnerships are formed.

2. Similar to the EcoDistricts Protocol, we must develop baseline performance metrics during the assessment process in order to evaluate the most critical interventions based on environmental consequences -as well as other factors like community importance -and use these metrics after implementation to find out if the interventions worked.

3. Our assessment process entails a similarly multi-pronged approach by looking at many factors that influence the feasibility of a proposed intervention, such as pre-existing projects and potential partners, technical complexity, and community priorities.

4. The Green Zone will similarly seek community input early on and throughout the planning and implementation phases of the Initiative so that the final projects reflect substantial community buy-in and alignment with their needs.

5. The Green Zone Initiative does not have a framework to ensure accountability during the project planning process -how will we establish credibility amongst community members?

Los Angeles “Clean Up, Green Up” Ordinance, 2016

The Clean Up, Green Up (‘CUGU’) Ordinance reduces the cumulative health impacts of incompatible land uses in 3 LA neighborhoods -Boyle Heights, Pacoima, and Wilmington -through a legal framework that regulates development standards for highly polluting industries.

How and when was the Clean Up Green Up Ordinance passed?

- 2011-The LA Collaborative for Environmental Health and Justice (the Collaborative), a coalition of environmental justice organizations, academics, and the Liberty Hill Foundation, publish theHidden Hazardsreport

- Use pollution data from state and federal sources and conduct ‘ground-truthing’ of residents’ experiences living in highly polluted communities

- Air quality monitoring technology used to measure unacceptably high levels of air pollution in disadvantaged neighborhoods

- Community-based environmental justice organizations represent each of the 3 neighborhoods -Boyle Heights, Wilmington, and Pacoima -and lead residents in organizing, providing public testimony, meeting with city councilors, circulating petitions, media reports, etc.

- The Collaborative’s selection criteria for the 3 neighborhoods:

- Each neighborhood’s nonprofit organization is committed to EJ and has experience in organizing residents for advocacy campaigns, public testimony, etc.

- The cumulative impact of environmental burden and pollution is some of the worst in LA

How and when was the Clean Up Green Up Ordinance passed? Con’t

- The Collaborative receives letters of support from the U.S. EPA, LA County Federation of Labor, several local businesses, and other government agencies

- The Collaborative holds press conferences with key city councilors, especially the councillors whose districts cover the 3 eligible neighborhoods, in support of CUGU

- 2016 -2 ordinances which comprise the CUGU Ordinance pass in the LA City Council

  - 1st Ordinance (184245) -Amends LA Municipal Code building regulations

  - 2nd Ordinance (184246) -Establishes “Clean Up Green Up” Supplemental Use Districts (SUDs), as well as conditional use and notification requirements for the 3 neighborhoods and citywide

  - LA Sanitation and Environment Department creates and funds an Ombudsperson to oversee enforcement of new regulations

Tactics: CUGU's strategic approach to advancing environmental justice (EJ)

- The CUGU ordinance utilizes a regulatory -as opposed to investment-based -approach to EJ

- Ordinance 184245 -Establishes the SUD in the three designated neighborhoods

- Enhanced development standards for polluting commercial uses -improved site planning, lighting, signage, fencing, enclosure, setbacks, driveway placement, noise, etc.

- 500 ft. buffer zone from sensitive uses (i.e. schools and elder facilities) for new and change-of-use auto facilities

- Conditional use requirements for oil refineries and asphalt manufacturing (citywide)

- Substantiated notice requirements for surface mining (citywide)

- Ordinance 184246

- New building code regulations that include green building elements, cool roofs, improved air filtration, etc.

- New Ombudsperson is responsible for enforcing compliance and assisting businesses in obtaining resources to 'green' their operations in compliance with the new ordinances

Legislating the Clean Up, Green Up Ordinance within LA City Government

- Development standards are regulatory, performance-based, and apply to site changes or new uses that are subject to the new regulations → enforcement is formalized within different departments according to the 2 CUGU ordinances (Depts. of Building and Safety, City Planning, and Sanitation and Environment)

Administrative Structure, Accountability, and Community Involvement

- Although the Dept. of Sanitation and Environment appointed an Ombudsperson to enforce new regulations, this is A LOT of work for one person, so violations may fall through the cracks

- There is no community participation in regulatory implementation, which means that public agencies are not being held accountable in ways that they would be if residents had a formal venue to express their concerns (i.e. community advisory board)

- Since these regulations only apply to new or changed uses, the implementation of the CUGU SUD is very slow and incremental!

Strategy: Grove Hall Green Zone vs. LA CUGU

1. Although the Green Zone is not a political campaign like CUGU, we need to understand whose support the Green Zone will need to succeed. We need to develop a 'power map' to guide our partnership formation strategy, asking "Who pulls the levers of change, and what kinds of resources can we gain from a partnership with them?"

2. Similar to the Collaborative, GGHMS must demonstrate capacity for collaboration and justify the Green Zone Initiative based on data and ground-truthed evidence, as well as prepare potential solutions for a strategic path forward.

3. The Green Zone team must evaluate potential partners to help with the assessment process just as the Collaborative partnered with academic institutions, community groups, and a nonprofit foundation to conduct the neighborhood evaluation process at the beginning of their campaign.

4. The CUGU Ordinance established new regulations to mitigate polluting industries, which is different from our focus on built environment investments that yield relatively quick, visible results. However, we must be keep an eye out for new or incompatible land or commercial uses that could -and should -be subject to stricter regulation and maintain accountability to the community on this front.

5. Like CUGU, the process of identifying root causes of environmental and health-related challenges must give rise to appropriately structured interventions guided by community input -or else the problems really won't be solved at their core!

California Environmental Justice Alliance (CEJA): Green Zones Initiative, est. 2010

The California Environmental Justice Alliance, which directs the Green Zones Initiative, is a statewide coalition of community-led environmental justice (EJ) organizations that advocate for policies to alleviate systemic environmental, economic, and social burdens for EJ communities.

CEJA Green Zones Initiative Con't

How and when was the Green Zones Initiative established? What is their vision for change?

- 2010 -Several organizational leaders with CEJA (est. 2001) seek to establish a viable framework for comprehensive community changeby stimulating political will at the grassroots level and allowing EJ communities themselves to identify problems and solutions to environmental burdens

- Vision for systemic change is rooted in a bottom-up approach, defined by community-led planning-the specific problems of a given community are identified and targeted for remediation by residents themselves

- Necessitates a cumulative impact frameworkto evaluate combined impact of multiple sources of environmental harm in communities so that comprehensive approaches to remediation may be developed

- Collaboration and partnership formationis key tactic to advance advocacy campaigns and leverage resources for large-scale change

Tactics: What is their approach to advancing environmental justice (EJ)?

-3 key strategies:

- REGULATION

- Directing public and private funds to Green Zone communities, in-part through legislative directives like Transformative Climate Communities (see next slide)

- Community-led planning, visioning, and advocacy -building solutions to advance EJ based on lived experience!

- Outcomes of CEJA and the Green Zone Initiative:

- Build an alliance-based EJ movement across the state of California

- Advance statewide policy and legislation through collective advocacy

- Benefit from knowledge-sharing and networking amongst like-minded organizations

- IMPORTANT -An essential aspect of EJ is uplifting the political power of historically disinvested, overburdened communities through organizing, education, and capacity-building at the grassroots level

Legislation and Regulation: Leveraging Political Will at the State Level

-Regulation is viewed as crucial tactic to set a floor on environmental policy, while enabling communities to go beyond what is required by the set floor in terms of environmental justice

- 2016 -SB1000, "The Planning for Healthy Communities Act"

- All planning jurisdictions are required to adopt an Environmental Justice element, or at least integrate EJ goals, into their General Plans (i.e. comprehensive planning documents)

- 2017 -CEJA advocates help to pass statewide Transformative Climate Communities (TCC) program at the state level

- Provides funding to partnership-based groups to implement community-led projects that advance the health and environmental quality of overburdened communities

Organizational Structure, Governance, and Community Organizing

- Every single EJ organization has their own organizing tactics, engagement strategies, and goals based on local context, identified community needs, and available tools at their disposal

Strategy: Grove Hall Green Zone VS. CEJA Green Zones

1. Regulation vs. Investments -While CEJA advocates for regulations that allow communities to benefit from resources derived from legislation, Grove Hall will focus primarily on securing built environment investments that will yield tangible benefits in the community.

2. As with CEJA, Grove Hall seeks to direct public (as well as private and non-profit) resources to overburdened communities, but we want to incorporate the Green Zone Initiative within currentenvironmental planning initiatives, rather than advocate for new policies, programs, or regulations.

3. The Cumulative Impact Framework unites our approach to that of CEJA because it pushes us to develop comprehensive solutions to mitigate inter-connected environmental problems.

4. CEJA seeks to stimulate political will at grassroots level, which is different from our approach in that we want to help community members identify challenges in their communities and recognize their sources in order to give us feedback on potential solutions, but we will not expect consistent community-based organizing and advocacy.

5. Similar to CEJA member organizations' advocacy campaigns, Grove Hall must develop partnerships in order to accumulate resources and capacity during planning and implementation phases.

Center on Race, Poverty, and the Environment (CRPE), San Joaquin Valley, est. 1989

The Center on Race, Poverty and the Environment provides technical and legal assistance, community organizing services, and policy advocacy support to grassroots community organizations in the San Joaquin Valley who seek to achieve healthier, more sustainable communities.

How and when was CRPE formed? What is their vision for change?

- 1989 -Founded as a 501(c)(3) by environmental and civil rights lawyers Luke Cole and Ralph Abascal to provide legal assistance to grassroots communities fighting for environmental justice

- Eventually start hiring community organizers to form grassroots groups that can advocate on their own behalf, assisted by legal and technical expertise of CRPE staff

- Community-building tactics include: door to door organizing and surveying, hosting community meetings, which provide a platform for advocacy groups to form organically

- Policy education and community capacity-building are central to CRPE's mission of empowering grassroots groups to identify problems in their communities, develop policy solutions, and advocate on behalf of their own interests

Center on Race, Poverty, and the Environment Con't

Tactics: What is their approach to advancing environmental justice (EJ)?

- Environmental justice starts with community will, but in order to build a successful campaign, CRPE must assess social capital within the community (levels of trust, strong or weak ties) and the capacity to form workable advocacy groups

- Start with asking community members (door-to-door conversations, surveys, etc.) what kinds of problems they would like to see fixed in their communities

- Then, organize an informational session to educate community members on the commonly identified issues, why they exist and what they are derived from, and what might be done about it

- Identify where potential workable groups may exist and what issues they care about, and invite them to follow-up

- Once they have a policy issue they want to pursue, CRPE lends legal and advocacy support to help community groups advance their goals

Legislation and Regulation: How to navigate the political landscape

- CRPE is very active in pursuing new policies and legislation, not only in resisting bad policy

- Community identifies key issues → CRPE holds several workshops and brainstorms policy solutions → CRPE staff lawyers form official policy proposal and share with community → once approved, policy can be disseminated and shared with key political decision-makers

- Keys to successful policy advocacy -get to know politicians and agencies who act onthe values that you seek to achieve, analyze their motivations and interests, demonstrate that your program has a lot of value and credibility that would make them look good if they supported it (this is the hard truth!)

Organizational Structure, Governance, and Community-Building

- Staff and board members are enablers of community priorities -their organization exists because of CRPE-facilitated grassroots community groups that put forth policy issues and advance them at the legislative and regulatory level
-They allow community groups to form their own 'governance' structure based on their relationships, personality assets and strengths, and past experiences

Strategy: Grove Hall Green Zone vs. CRPE

1. GGHMS is a conduit for including community voices based on solicited feedback. As opposed to CRPE's approach, the Green Zone strategy is not dependent on direct community advocacy. Our method includes community members in the assessment and project selection processes through (1) learning about their experiences, (2) educating them on the causes of the problems that must be addressed and potential solutions, and (3) determining the benefits that community members would like to see in the final projects.

2. Similar to CRPE, GGHMS must evaluate pre-existing social networks within Grove Hall in order to authentically engage community members in the qualitative assessment and project selection processes for the Green Zone.

3. As with CRPE, the Green Zone Initiative is logistically strategic -we will (1) startwith the facts (data and community input), (2) brainstorm actionable interventions based on assessment criteria, (3) work to secure public, private, and nonprofit partnerships and investments, and (4) start community-informed project implementation processes.

Environmental Health Coalition (EHC), San Diego/Tijuana, est. 1980

The Environmental Health Coalition advances environmental and social justice in San Diego and border communities through educating, empowering, and organizing communities affected by environmental pollution to speak up against these injustices.

How and when was EHC established? What is their vision for change?

- Founded in 1980 as the Coalition Against Cancer to fight against disproportionate health impacts of polluting, toxic sources in vulnerable communities

- EHC Theory of Social Change involves…

- Cultivating political consciousness, activating strong community base of support, strategic analysis of root problemsand taking action, continual leadership development among community members

- They capitalize on the power of community participation and political will to motivate policy-makers to respond with concrete deliverables

Environmental Health Coalition, Con't

Tactics: What is their approach to advancing environmental justice (EJ)?

- Before any action is taken, problems must be identified through data-driven analysis and building community voice through education and outreach by those who are familiar with the community

- People need to be informed about an issue and about how they can act in order to feel like they can make a difference!

- Once desired outcomes -rooted in community values -have been established then it is time to pitch actionable policies to key decision-makers

- Follow-up with continual community organizing and advocacy (via public testimony, meeting with public officials, circulating petitions, sending letters, media -any way to build political pressure!)

- IMPORTANT -public officials want to hear from their constituents, and the more the better!

- Need to establish a 'narrative' that humanizes the on-the-ground effects of environmental injustice beyond the data and statistics

- This is why local advocacy (as opposed to a larger scale) is key → constituents can connect with key decision-makers must easier and therefore more strongly affect policy outcomes

Legislation and Regulation: How to navigate local politics

- EHC relies on building consistent relationships with elected and unelected officials who have the authority to make the changes that they want to see in their communities

- The goal of EHC is as much about achieving environmental justice as it is about ensuring public sector accountability to vulnerable communities

Organizational Structure, Governance, and Community Organizing

- EHC staff community organizers regularly keep in contact with local community constituencies and groups called Community Action Teams (CATs)

- CATs are comprised of committed community leaders who help guide neighborhood campaign strategy, educate residents about environmental policy issues directly affecting them, and encourage more people to get involved in policy campaigns

- The crux of EHC's work is the complementary work of staff members' technical expertise and connections with key decision-makers andcommunity involvement, input, and thought leadership

Strategy: Grove Hall Green Zone vs. EHC

1. As a member of CEJA, EHC engages community members who directly experience the day-to-day effects of environmental racism and empowers them to have a political voice. Our approach differs in that community members are not expected to directly and consistently advocate for Green Zone investments.

2. Similar to EHC, Grove Hall promotes acumulative impact framework in order to justify the cause for developing neighborhood-based environmental justice policies that yield an intentional concentration of resources.

3. Grove Hall's approach also involves community ground-truthing during the qualitative assessment process, which is essential to put a human face on quantitative statistics and data.

4. Similar to EHC, Grove Hall seeks to build relationships with key city agencies and decision-makers and ongoing initiatives/projects to secure investments that will contribute to the Green Zone Initiative.

Center for Community Action and Environmental Justice (CCAEJ), Inland Valley, CA est. 1978

The Center for Community Action and Environmental Justice (CCAEJ) empowers frontline communities in the Inland Valley to organize and campaign for policies to improve their social and natural environment.

How and when was CCAEJ formed? What is their vision for change?

- 1978 -Glen Avon community members, especially women and mothers, lead the effort to shut down the Stringfellow Acid Pit toxic waste site, which generated many negative health outcomes especially among children (asthma, nose bleeds, etc.)

- There was a recognition among participants in this effort that if they did not defend their own well-being, public agencies that are meant to regulate harmful impacts will do nothing!

- CCAEJ believes that frontline community members have both a right anda responsibility to inform policy conversations with their own lived experience, so they work to educate residents about the root causes and connections between the quality of the local environment and their quality of life.

Center for Community Action and Environmental Justice Con't

Tactics: What is their approach to advancing environmental justice (EJ)?

- A central tenet of CCAEJ's work is to empower frontline community members -especially women -to speak up for themselves in public settings and take a role in forming policies that better serve the goals of environmental justice

- Many problems derived from incompatible land uses are not 'top of mind' for community members because they are either invisible or taken for granted. It is up to CCAEJ to draw those connections by translating technical concepts to make them more relatable and encouraging community members to voice their experiences in policy-making spaces (especially regarding land use)

- To this end, it is important to be knowledgeable about who makes the decisions that affect the community, why they make those decisions, and howthey can be pushed to act differently

- Once they are familiar with the political 'levers of change,' community groups can formulate what they want to be different and present their case to the appropriate decision-makers

- CCAEJ also helps frontline community members understand key political decision-making bodies and how they can influence -or even become a member of -these bodies

Legislation and Regulation: How to navigate the political landscape

Before approaching policy-makers, CCAEJ advocates make sure that they understand the root cause of the issue at hand, outline its effects on the community, and develop a workable solution -this way, policy-makers will have something to respond to when CCAEJ advocates approach them

- Start with small wins to build credibility among both high-ranking decision-makers and community members, which will build on and augment previous successes
Organizational Structure, Governance, and Community-Building

- All advocacy work starts with frontline community members at CCAEJ, and staff members are meant to engage with, organize, and empower their constituents to speak about their own experiences to influence policies that affect their quality of life.

- If directly impacted community members are not at the decision-making table, the right decisions will never be made.

Strategy: Grove Hall Green Zone vs. CCAEJ

1. Like CCAEJ, we seek to highlight the lived experiences of residents of Grove Hall in order to support our case for environmentally just interventions -data is essential in defining the problem, but community voices make the data concrete and relatable.

2. Unlike CCAEJ, Grove Hall will focus on built environment investments -as opposed to regulatory interventions -in recognition of the fact that physical land use is critical to supporting community health and economic vitality

3. Direct integration of environmental justice in citywide planning initiatives is our goal in Grove Hall, so like CCAEJ, we need to come to the table having (1) completed a comprehensive neighborhood assessment, (2) fully understood the consequences of specific land use challenges, and (3) developed realistic solutions within the capacity of the appropriate entities that we may approach

4. Unlike CCAEJ, we seek to develop a comprehensive selection of solutions for the environmental challenges of Grove Hall and apply them to ongoing plans and initiatives, rather than advocating for individual policy solutions as they develop.

Conclusion: Grove Hall Key Strategic Lessons

This concluding section outlines four key strategic lessons derived from this case study research to inform the Grove Hall Green Zone Initiative going forward.

1. Community Engagement: Although community members are not expected to directly advocate on behalf of the Green Zone Initiative, Grove Hall should develop robust strategies to incorporate their feedback from the start and stay accountable to community members in the decision-making processes that affect neighborhood conditions. Set the floor for community involvement at a level where they are the driving force behind the problem definition and the development of potential solutions through consistent engagement and education.

2. Capacity for Collaboration: In many of these case studies -especially CUGU and CEJA organizations -collaboration and joint advocacy is essential in the process of revealing environmental injustices and exerting the requisite political pressure to motivate policy-makers to respond. Grove Hall should evaluate their capacity to work with other groups to advance their goals at the policy-making level.

3. Neighborhood Assessment Criteria: An effective EJ initiative must come to the table with a very clear idea of what the problems are and their causes, what needs to change in response to these conditions, and what are the most viable evidence-based solutions. As demonstrated in all of the case studies, the hard work of EJ advocacy necessitates that Grove Hall approach this initiative with clearly defined aspirations, measurable and achievable outcomes, and targeted strategies to effectively work with decision-makers on project and policy implementation.

4. Citywide Adoption of Environmental Justice: Boston is an environmentally vulnerable city as whole, necessitating that climate resilience planning apply to all corners of the city. However, Grove Hall must leverage the cumulative impact framework -as every case study in the report did -to highlight the importance of addressing disproportionate environmental impacts in EJ communities across the city.

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Key Sources and Additional Readings (hyperlinked)

U.S. EPA EJScreen: Environmental Justice Screening and Mapping Tool

Providence Climate Justice Plan

- Just Providence Framework

- Climate Justice Alliance Just Transition Framework

Minneapolis Green Zones Workgroup Report

- Minneapolis Northside Green Zone Work Plan

- Minneapolis Southside Green Zone Work Plan

EcoDistricts Protocol Homepage

CEJA Green Zones Initiative Fact Sheet

Grove Hall Green Zone Initiative: Case Study Evaluation

Eileen Michaud and Jude Hernandez

Introduction: What is a Green Zone?

A Green Zone describes a framework for neighborhood development within a designated geographic area, established informally or formally (i.e. via zoning reform), that prioritizes the environmental and economic health of communities that have been over-burdened by years of environmental pollution and lack of investment.

Key elements of a Green Zone

- Seeks to reduce and prevent pollution and other environmental hazards such as impervious land surfaces and lack of green street canopy through sustainable land use policies and built environment interventions
- Combines the three goals of sustainable economic development, environmental resilience, and community health
- Centers community decision-making and participation to inform challenges and opportunities for intervention, sometimes called "ground-truthing"

Introduction: Why would a municipality want to create a Green Zone?

A Green Zone is an opportunity for a neighborhood or an entire municipality to center **environmental justice** in future land use policies and economic development within historically disinvested and environmentally-vulnerable communities

Key benefits of implementing a Green Zone

- Flexibility - a Green Zone can function as a pilot program to begin with, and if successful, expand to a larger scale
- Attract investment in neighborhoods by sustainably-oriented businesses and services
- Create a regulatory framework to apply for private grants and public funding (e.g., the recently proposed American Jobs Plan)
- Encourage private sector innovation and investment in sustainable, 'green' practices
- Create areas of environmental and economic vibrancy while strengthening community health and civic engagement
- Encourages equity by bringing resources and reinvestment to communities that suffered decades of neglect and disinvestment.

Introduction: Research Questions

Research Questions

1. How are Green Zones created?
1. How are Green Zones governed? What is the leadership and decision-making structure?
1. Who directs the policy agenda and oversees implementation of policies, programs, and regulations?

Framework for Analysis: Case Studies

In order to provide a robust set of suggestions and best practices to answer our research questions, we evaluated 20 case studies focusing on community and economic development, environmental sustainability, and/or multi-stakeholder engagement within the United States

Key Questions for Evaluation

- What are the organization's or program's goals?
- How and when did the organization or program form? What was the enabling process?
- In the context of their mission and goals, how do they 'get stuff done'?
- What is their governance structure? Who makes the decisions and implements them?

Pittsburgh EcoInnovation District, Uptown/West Oakland neighborhoods, est. 2017

Organizational Goals → The Pittsburgh EcoInnovation District seeks to capitalize on opportunities within the built environment to support the needs of existing residents, expand entrepreneurship and job growth, and enhance the environmentally sustainable development of the Uptown neighborhood.

How and when was the Pittsburgh EcoInnovation District founded?

- Uptown Partners, a major neighborhood-based nonprofit, spearheads the community visioning process for an EcoInnovation District (EID)
- Following 2 years of planning and outreach guided by Uptown Partners and the Dept. of City Planning, the draft of the EID Plan and Zoning is

published in July 2017, followed by a formal 30day public comment period

- 2-year planning process includes 2 block party ‘open houses’, surveys, focus groups, oneon-one interviews, community meetings, and a public webpage

- The City Planning Commission approves the EcoInnovation District Plan - with form-based and performance-based district-wide zoning amendments - in Sept. 2017

- The City Council adopts the Plan in Nov. 2017; signed into law by Mayor Peduto in Dec. 2017

Pittsburgh EcoInnovation District Con’t

Policies and Programs: How do they ‘get stuff done’?

- Major agenda items - community atmosphere and affordability, commercial development, mobility and road safety, and public space infrastructure
- All agenda items taken on by multiple stakeholders, agencies, and organizations in the public and private sector including...
  - Proposed Bus Rapid Transit (BRT) system connecting Uptown to downtown Pittsburgh
  - Colwell Connections rail trail
  - Community visioning process and public land disposition for a City-owned parcel
  - Slow Streets infrastructure ideas for major thru-ways in the neighborhood
  - Green infrastructure to ease burden on the sewer system
  - Rezoning - Uptown Public Realm District, includes incentives for sustainable design/operational elements
- The accomplished and ongoing projects so far are largely self-fulfilling on the part of City agencies and departments, but the support/advocacy from Task Force subcommittee members are still important influences

Pittsburgh EcoInnovation District, Con’t

Administrative Structure and Governance

- Multi-stakeholder Uptown Task Force - created in the EID Plan and convened by

Duquesne University - serves an oversight role

1 Includes residents, local service providers, city departments, small businesses, educational institutions, large landowners, and energy providers

- Not much ‘teeth’ to this Task Force - basically receives subcommittee work plans and reports out on progress

- 4 specialized subcommittees focus on conceptualizing and implementing major agenda items

1 Advocacy role for city initiatives is particularly important even though many projects currently in-the-works are not the direct result of the EID plan

Lessons for Grove Hall: Pittsburgh EcoInnovation District

- Use organizational structure of GGHMS to convene public and private sector stakeholders to contribute to Green Zone visioning and implementation process; a central leadership structure/steering committee would lend efficiency to the process
- As well as incorporating robust community engagement processes using several methods (surveys, community events, interviews, etc.) it is crucial to evaluate, build out, and improve social capital among potential stakeholders
- Trust-building and mutual agreement amongst parties - especially amongst and between residents and the public sector - is essential to move towards mutually beneficial goals for the neighborhood

Talbot-Norfolk Triangle EcoInnovation District, Dorchester, est. 2013

Organizational Goals → The TNT EcoInnovation District is a comprehensive sustainable development initiative spanning 13 blocks of the Codman Square neighborhood with the goals of implementing green infrastructure, facilitating green job training programs and developing the neighborhood’s sustainability agenda

How and when was the EID established?

- 2010/2012 - Talbot-Norfolk Triangle Neighbors United seek to implement a sustainability agenda for the neighborhood
- 2013 - the EcoInnovation District is established with the goal of implementing the community’s priorities; heavily reliant on the Codman Square Neighborhood Development Corporation (CSNDC) to facilitate community engagement process, provide technical assistance, and manage programmatic implementation
- IMPORTANT - the EcoInnovation District has no formal legislative or legal designation, but rather encapsulates an organic community effort to make their neighborhood more sustainable, environmentally-resilient, and healthier for residents

Talbot-Norfolk Triangle EcoInnovation District Con't

Programs and Partnerships - How do they 'get stuff done'?

- Public and Private Partnerships (PPPs) are key to successfully implementing a variety of programs including...
  - National Green Infrastructure Certification Program - Established in partnership with the North America Cities Network, this program trains primarily men of color and re-entry citizens in green infrastructure installation and maintenance → huge upcoming market demand for this industry in Boston
  - Lime Energy - partnership that provided energy-efficient business retrofits
  - Tree-planting project in neighborhood - partnership with the Nature Conservancy
  - Slow Streets designation for major cut-thru makes streets more livable and pedestrian-friendly
  - Installing bioswales and rain gardens to mitigate stormwater runoff and cool streets

Talbot-Norfolk EcoInnovation District Con't

Programs and Policies: How do they 'get stuff done'? Con't

- Codman Square NDC (David Queeley) is the primary organizational partner with TNT Neighbors United - as well as Codman Square Neighborhood Council - to facilitate the implementation of the programs listed in the previous slide
- Very community-directed process, requiring consistent communication between neighborhood partners and the CSNDC

Administrative Structure and Leadership Roles

- Very informal leadership structure, but the neighborhood groups largely form the backbone of the programmatic goals of the TNT EcoInnovation District
- That said, it is imperative that the CSNDC build and maintain trust and transparency with community members through mailing lists, meetings, etc. so that they feel motivated to contribute to their efforts

Lessons for Grove Hall: Talbot-Norfolk Triangle EcoInnovation District

- It is helpful to have pre-existing 'social capital' in the neighborhood so that the process of organizing around sustainable development goals has a community framework and a specific geographic area to build on
- There is something to say for taking a loose approach to programmatic goals and presenting the Green Zone idea to stakeholders as an opengoal initiative guided by sustainability principles
- The possibility of creating a 'green zone' overlay district - in collaboration with the BPDA - would systemize the sustainable goals of Grove Hall and provide a more formal framework for achieving goals

Green Impact Zone, Kansas City, MO, 2009 - 2014

Goal: The Green Impact Zone initiative is an effort to concentrate resources — with funding, coordination, and public and private partnerships — in one specific area to demonstrate that a targeted effort can literally transform a community

How and when was the Green Impact Zone established?

- Green Impact Zone Devastated over the years by high rates of poverty and violence, high levels of unemployment and crime, and high concentrations of vacant and abandoned properties; the Green Impact Zone would target a 150-block area in Kansas City's urban core
- Rep. Emanuel Cleaver (D-Mo.), from Kansas City, conceived the idea of connecting a range of stimulus-funded programs over the next two years to target dollars to this one area to jump-start its economic recovery and community revitalization

How did the program work?

- The Green Impact Zone advances interconnected goal-setting to turn around every aspect of this one, central-city area of Kansas City, Missouri, to make it an attractive place to live and work

How did the program work? Con't

- The zone pursues a multi-faceted strategy— motivated by stimulus funding opportunities— around enhancing the area's sustainability, public safety,

stabilization, housing conditions, access to jobs and services, and economic vitality

- The plan included weatherizing every home that needed it to save homeowners money; demolishing dangerous buildings; repaving streets; replacing a key neighborhood bridge; establishing a bus rapid transit system, providing a comprehensive job training and placement program, providing integrated community policing and neighborhood services, and expanding the capacity of neighborhood-based organizations

- Active involvement with nonprofits, business, and civic leadership is particularly crucial for ensuring that the Green Impact Zone projects are carried through on the ground **Administrative Structure and Leadership Roles:**

- Mid-America Regional Council (MARC), the region's metropolitan planning organization, was the lead organization on operational and financing activities

Administrative Structure and Leadership Roles: Con't

- The MARC organizes participants and has convened weekly meetings since the onset of the initiative between city departments, six neighborhood groups from the zone, four community development organizations, Kansas City employment and energy nonprofits, and other organizations impacting the area

- Also involved in the Green Impact Zone is the local electric utility, Kansas City Power & Light, which plans to undertake the area's smart-grid project and look into alternative energy options for the zone's businesses and institutions **Enabling Legislation and Funding:**

- The city council in Kansas City unanimously passed a resolution to advance the Green Impact Zone initiative, by partnering with the MARC. From 2009 to 2012, that the city would invest $4.2 million in the Green Impact Zone for administrative costs for office space and staff to manage this complex initiative, and support a wide variety of projects

Enabling Legislation and Funding: Con't

- Kansas City's initial investment has helped leverage numerous additional federal grants, and these public investments leveraged other funding that totaled over $178 million, which included:

   - Various American Recovery and Reinvestment Act (ARRA) funding sources in the millions for transportation, housing, energy, and the environment

   - Millions were also invested from the utility company, and Private Public Partnerships (PPP)

Lessons for Grove Hall: Green Impact Zone

- With a smaller footprint, resources could go farther, Congressman Emanuel Cleaver believed that a concentration of resources would yield more significant results than if the same resources were sprinkled across the city or metropolitan region. The 150 block Green Impact Zone proved it could
- Any neighborhood revitalization takes years, even decades, to be fully realized. Quick results should never be expected when rectifying decades of disinvestment and environmental degradation in communities of color.
- Funding should always be used by deadlines if there is an end date, otherwise that funding will be lost and used somewhere else.

Sun Valley Ecodistrict, Denver, CO, est. 2013

Goal: To make the Sun Valley neighborhood greener, equitable, more walkable, revitalize the riverfront, and restore industrial buildings like IronWorks for businesses and co-working spaces. **How and when was the EcoDistrict established?**

- Starting back in 2013 with the conclusion of the Decatur-Federal Station Area Plan (SAP), the Denver Housing Authority (DHA) partnered with the EcoDistricts organization for a plan to improve the Sun Valley neighborhood

- Multiple planning processes have been completed to date including the Decatur-Federal SAP, the Sun Valley General Development Plan (GDP), and the most recent Sun Valley Transformation Plan (Choice Neighborhood Implementation (CNI) Planning Grant). These plans all outlined the challenges and the incredible potential for positive public and private investment in Sun Valley.

- DHA, in collaboration with the City and County of Denver and many others, built a foundation which has built transformative plans and continued revitalization efforts.

Sun Valley Ecodistrict Con't

How does the program work?

- Through seven years of extensive planning and four years of engagement with the

EcoDistricts organization, DHA and the Sun Valley stakeholders have systematically worked through a series of planning and formation milestones with an emphasis on authentic outreach and master planning activities

- The outcome culminated in 10 Community Master Plan Goals, ranging from youth and education focus to 'Hubs' for jobs & job access, art, education, entrepreneurial success. All project must be be based on the goals
- In 2016, the DHA formed the 501(c)3, Sun Valley EcoDistrict Trust (SVED) to solidify a governing model to attract strategic partners, implement the district-scale solutions proposed in the Transformation Plan and EcoDistricts Roadmap, and monitor district progress and success indicators
- The SVED is the master developer (Land, Infrastructure, Hubs, District Solutions) entity structured to lead the district wide implementation and sustainable redevelopment of Sun Valley

Sun Valley Ecodistrict Con't

Administrative Structure and Leadership Roles:

- The Housing Authority of The City and County of Denver are the lead stakeholders
- SVED is the master developer entity structured to lead the district-wide implementation and sustainable redevelopment of Sun Valley. SVED is a nonprofit entity, separate from the City and County of Denver and the Denver Housing Authority

Enabling the EcoDistrict and Funding:

- No specific legislation was needed for the implementation of the EcoDistrict, but updates to zoning had to happen
- The implementation of a Station Area Plan (SAP) and General Development Plan (GDP)– master plan for coordinating development, infrastructure improvements, and regulatory decisions as development proceeds within the subject area–were needed to allow for different developments in Sun Valley.
- With the awarding of a $30 million Housing and Urban Development (HUD)

Choice Neighborhood implementation grant, implementation of the Sun Valley Neighborhood Transformation Plan was possible

Lessons for Grove Hall: Sun Valley EcoDistrict

- Attracting funding is a requisite - Sun Valley was able to do so through preparation and years long planning by:
   Completing Environmental Reviews
   Having district wide Health Metrics
   Detailed District Energy plans/reports
- Broad coalitions of partners open doors to alternate funding sources, shared knowledge, expertise, and support
- Planning departments play a pivotal role in making sure goals can be met through community or zoning updates to allow for green infrastructure projects or developments

High Falls EcoDistrict, Rochester, NY, est. 2014

Goal: The High Falls EcoDistrict is a neighborhood-scale sustainability and design project. Through extraordinary ecological design, stewardship, and community advocacy, we will create a resilient Rochester – one neighborhood at a time

How and when was the High Falls EcoDistrict established?

- The City of Rochester was built on industrial flour mills, factories and energy production facilities situated along the banks of the Genesee River, which was centered around the high waterfall
- Since the 1960's riots, the city, and High Falls in particular, were left abandoned and in a dismal economic state
- High Falls is an area that had suffered the most from poor investments and a derelict environment. With the relocation of the community college downtown campus, a sports complex, a burgeoning innovation center, a new greenway and a growing residential influx, a new progressive urban plan along with strategic investments will help create a new sense of destination

How and when was the High Falls EcoDistrict established? Con't

- In spring 2015, Greentopia began a two-year study to identify projects that will advance an Ecodistrict framework. The study engages business owners, artistic communities, local government, developers, and citizen's groups **How will the program work?**
- The EcoDistrict will enhance energy efficiencies and the promotion of new technologies
- The program will encourage the creation and use of a multimodal transportation system to deal with the overabundance of parking lots and the inability to move around center city easily and quickly
- It will also return the riverfront to public access and reconnect the Genesee Riverway Trail. A material and waste goal to have 90% waste diversion and district wide composting by 2030.
- Increase accessibility to fresh foods in the EcoDistrict through urban gardens and pop-up markets
- Advocate for neighborhood development that displays the equitable, vibrant and diverse character of resilient places

Administrative Structure and Leadership Roles:

- The ecodistrict is coordinated by the nonprofit Greentopia
- Initial guidance for the district would come from the Critical Team, which is a small, core group of multidisciplinary professionals who are committed to the process of forming the EcoDistrict
    - The Critical Team meets every month to assist the Greentopia project coordinator with the details of the project and provide hands-on support
    - After the formation phase, the EcoDistrict will be an entity unto itself, run collaboratively by the stakeholders within the EcoDistrict

Enabling the EcoDistrict and Funding:

- In 2013, the planning process has been funded by a $240,000 grant from New York State Energy Research and Development Authority (NYSERDA) to create an EcoDistrict plan in collaboration with EcoDistricts organization

Enabling the EcoDistrict and Funding: Con't

- In 2016, the City of Rochester created a Community Climate Action Plan (CAP) to provide a framework for sustainable projects and actions that will help Rochester reduce its greenhouse gas emissions
- With the EcoDistrict plan complete, they are currently in the process of pursuing official certification from the national EcoDistrict organization. In the meantime, Greentopia is implementing projects on behalf of the city to follow through on their CAP and updated city master plan

Lessons for Grove Hall: High Falls EcoDistrict

- Community buy-in is important, especially when the community being served is not particularly progressive. The program should always be working on advancing a sustainability culture in the area
- Mayoral support can be the reason why an EcoDistrict moves forward or not. It is important to ensure any program or initiative have the backing from the highest office at the city level

Groundwork Lawrence, City of Lawrence, MA, est. 1999

Organizational Goals → Groundwork Lawrence is a 501(c)(3) and local trust/chapter of Groundwork USA that collaborates on and manages environmentally sustainable community initiatives (e.g., open space improvements, fresh food access programs, environmental education initiatives) through a multisectoral partnership model.

How and when was Groundwork Lawrence (GWL) founded?

- Late 1990s - The Groundwork organizational model is imported from England by the National Park Service (NPS), and a feasibility study is conducted in the City of Lawrence
    - Cooperative initiative among the City of Lawrence, Lawrence into Action and the NPS
- 1999 - Groundwork Lawrence is established as an expansion of a brownfields remediation study receiving funding from the EPA (a prerequisite to formation of a local chapter or 'trust')

Groundwork Lawrence Con't

Policies and Programs - How do they 'get stuff done'?

- PARTNERSHIPS (public, private, and nonprofit) are the cornerstone of their organizational model - share expertise and resources to implement programs and offer services
- The process for initiating partnerships can come from within GWL staff or from external partners themselves, depending on who has a need, who has resources to meet that need, and whether a partnership may offer complimentary resources

Administrative and Leadership/Decision-Making Roles

- Board of Directors and Advisory Council - comprised of residents, property owners, City agencies, banks, social service providers, business owners, etc.
    - Provide guidance and strategy for GWL, but the staff themselves are really the ones who actively seek out partnerships based on their 'boots on the ground' perspective
- Management and Support Staff - Management team generally initi-

ates partnerships but it is also expected of other staffers to keep a pulse on the needs of the community and be out and about at meetings, events, etc.

Lessons for Grove Hall: Groundwork Lawrence

- Lawrence is a very small community (6.5 sq. mi.), approximating a neighborhood scale in Boston, indicating that GWL's multi-sectoral partnership model is feasible to replicate in Greater Grove Hall
- There is no requirement, necessarily, to establish sole jurisdiction or absolute control over initiatives, projects, programs, etc. - partnerships allow for the sharing of resources and knowledge that no one organization can accomplish on their own!
- It is necessary to obtain input from all community stakeholders and inform them of programmatic updates - a central steering committee could serve this role if staffers/subcommittee members are the 'boots on the ground' and responsible for knowing what kinds of services are needed for the community and actively forming partnerships

PlaNYC 2030, est. 2007

Goal: A city-wide comprehensive sustainability plan for the purpose of creating a greener, greater, stronger, more resilient New York

How and when was PlaNYC established?

- Initially developed as a strategic land use plan, but as the Mayor and his staff realized that sustainability was the common theme that tied everything together, the plan eventually evolved into a sustainability plan

- Through Mayor Bloomberg's leadership and vision, city policymakers and agency directors ultimately determined that in order to grow in a sustainable manner, all of these efforts would need to be managed under an overarching strategy

- This led to the 127 initiative PlaNYC. Unveiled on Earth Day 2007, the long range comprehensive plan provides a vision for the future growth of New York City – to accommodate one million more people in an already dense city, while at the same time reducing the City's greenhouse gas emissions by 30 percent and improving the City's infrastructure. The plan addresses three main challenges – growth, aging infrastructure, and an increasingly precarious environment

How does the program work?

- The city sets interim milestones to be met by certain timelines for the various initiatives in the long range plan
- Mayor's Office of Long-Term Planning and Sustainability (OLTPS) and Mayor's Office of Recovery and Resiliency collaborate and work with city departments, private business, and community groups to implement and complete city-wide goals for the plan

- The city's sustainability and resiliency initiatives are designed so that progress can be reported on an annual basis
- By law, the City has to issue an update to PlaNYC every four years. This update process allows the city to be responsive to changing conditions and to continually serve the needs of all the City's citizens

Administrative Structure and Leadership Roles:

- Mayor's Office of Long-Term Planning and Sustainability is responsible for the coordination and implementation of PlaNYC at the executive level

Administrative Structure and Leadership Roles Con't:

- The Sustainability Advisory Board provides technical expertise and advice to the Mayor's Office of Long-Term Planning and Sustainability. The Board includes environmental advocacy organizations, community and environmental justice organizations, designers, developers, and business leaders
- City departments, private entities, and community organizations are involved in implementing goals and initiatives, and report to Mayor's office

Enabling Legislation:

- To meet many of the goals and initiatives of the PlaNYC, various legislative bills were introduced. No enabling legislation was needed for the plan itself, but local and state legislation was needed to ensure the plan would not sit on the shelf

Enabling Legislation: Con't

▯ The City Council with assistance from OLTPS, drafted a bill to institutionalize OLTPS and the Sustainability Advisory Board. The local law also establishes a timeframe for reporting progress on the plan's implementation and for the periodic update of the plan. Local law 17 of 2008 was passed by the City Council and then signed into law by the Mayor in May 2008

▯ Bill No. A11226 provided a one-year NYC property tax abatement for green roof construction.

▯ Bill No. A11202 provided a four-year NYC property tax abatement for installation of solar panels

- In total there were 19 laws enacted within the first three years of the program that ensured that PlaNYC could or almost meet its goals

Lessons for Grove Hall: PlaNYC 2030

- It was important to ensure the plan is realistic and achievable with current technologies
- The importance of top-down leadership and support to define roles and the direction the plan
- Formed the plan using quantifiable and measurable goals, targets, and objectives
- Reaching out to advocacy organizations, scientists and the public from the beginning of the process to ensure their support long-term
- A political actor (mayor, councilmember, state/federal representative) that can champion the process from start to finish, and leverage expertise and knowledge in the legislative process for funding or laws that will ensure the plan meets its goals long-term

Hartford Climate Stewardship Initiative, est. 2018

Initiative Goals → The goal of the Hartford Climate Stewardship Initiative, guided by the Climate Action Plan, is to develop policies that will strengthen Hartford's environmental quality and climate resilience in ways that will enhance community health, the local economy and social equity.

How and when was the Initiative started?

- 2016 - City of Hartford Planning and Zoning Commission forms a working group called the Climate Stewardship Council (CSC) comprised of nonprofit leaders, state and regional government reps, and private businesses within the Hartford region
    - Goal is to establish a formal Climate Action Plan
        - Significant public input through website, twitter account and several public meetings
- 2017 - City Office of Sustainability is created to implement objectives of the Climate Action Plan
- 2018 - Hartford Planning and Zoning Commission and City Council formally adopt the Climate Action Plan

Hartford Climate Stewardship Initiative Con't

Policies and Programs - How do they 'get stuff done'?

- 6 "Action Areas" defined in the Climate Action Plan - energy, food, landscape (i.e. green infrastructure), transportation, waste, and water
- The Office of Sustainability is the primary city government entity through which these priority areas are managed

Administrative Structure and Leadership/Decision-Making Roles

- Office of Sustainability, a Hartford government agency created in 2017, implements the objectives outlined in the 2018 Climate Action Plan
- The Office of Sustainability only employs a Director and small Green Infrastructure

Team, so interagency coordination and resource-sharing is important to their work

Lessons for Grove Hall: Hartford Climate Stewardship Initiative

- Political buy-in from city leadership is very important for advancing and institutionalizing a comprehensive plan to address climate resilience and social equity within a particular neighborhood or entire municipality
- Invite as many stakeholders as possible to the planning table in order to benefit from a variety of interests and perspectives when deciding on priority items and an actionable agenda
- It is necessary to form strong partnerships with organizations that may provide services and resources outside the scope of the public sector

Rain Check 2.0, Buffalo, NY, est. 2015

Goal: To expand green infrastructure, reduce stormwater runoff, protect public health, incorporate equity considerations as critical elements of green infrastructure decision making, and educate and engage stakeholders in Buffalo on green infrastructure benefits and implementation

How and when was Rain Check established?

- Buffalo's stormwater has an aging combined sewer network from 1938 that continues to collect and treat increasing amounts of rain and melting snow
- Like many combined systems, combined sewer overflows (CSO) in Buffalo Sewer systems cause wastewater to flow into the region's streams and rivers, and Lake Erie. Green infrastructure (GI) is part of Buffalo's solution to manage runoff, improve waterways, increase resiliency, and enhance

quality of life in the city

- Starting in 2014, the Buffalo Sewer Authority (BSA) moved forward to meet the GI commitments of their CSO's Long Term Control Plan (LTCP). The LTCP was approved by state and federal regulatory agencies in 2014 and included implementing GI strategies for runoff control

Rain Check 2.0 Con't

How does the program work?

- Rain Check 2.0 builds upon 1.0 and will incentivize property owners to transform impervious surfaces into pervious ones through grants calculated based on square footage of impervious surfaces. The BSA has set aside a few million to give as grants for green infrastructure improvements

- Rain Check 2.0 proposes three areas of focus:
    - New developments must meet strict stormwater requirements
    - New investments in the public sector should consider green infrastructure
    - Targeted properties should be encouraged to add green infrastructure

- To remove barriers to participation, the BSA is exploring ways to offer design-build services to private property owners so they do not have to finance the project upfront themselves and wait for reimbursement

- Lastly, Rain Check 2.0 will apply a lens of equity considerations to both the Rain Check 1.0 and 2.0 work. Buffalo Sewer is building upon regional equity initiatives to best understand how green infrastructure strategies can be equitably implemented and benefit communities and those involved in their construction and maintenance

Rain Check 2.0 Con't

Administrative Structure and Leadership Roles:

- BSA is the lead agency within the city for addressing climate change

- Buffalo Sewer convened a Technical Advisory Committee (TAC) to advise on best practices and help build a community of action around green infrastructure
- The Mayor's Office champions the the water quality effort, the BSA works with the Mayor and other agencies within the city

Enabling the Rain Check and Funding:

- In 2014, BSA finalized the Long Term Control Plan (LTCP) and includes first generation green infrastructure projects with focus on green streets, green demolitions and vacant lots

- In 2015, Rain Check is launched

- In 2016, Buffalo Common Council adopts Buffalo Green Code, an updated city zoning ordinance that includes on-site stormwater management requirements for all new development

- The largest Environmental Impact Bond (EIB) in the country at $30 million was launched. The funds from this investment will allow the City of Buffalo and Buffalo Sewer Authority to capitalize on the Rain Check Buffalo program with the 2.0 grant program

Lessons for Grove Hall: Rain Check 2.0

- Building upon the original scope of the program and improving upon it:
    - Prior to Rain Check 2.0, there was 1.0, and it identified key solutions that could be quickly implemented
    - 2.0 overlaid additional concerns such as equity and building communities of action on to the achievable and technical solutions front
- Economic benefit is a major motivator for parties to implement green infrastructure. Stormwater fees and incentives are ways for cities to invest in stormwater green infrastructure. However, if these revenue streams are not available, broader collective action will be needed

Green City, Clean Waters, est. 2011

Goal: The City of Philadelphia's 25-year plan to transform the health of the City's creeks and rivers primarily through a land-based approach. By implementing green stormwater infrastructure projects such as rain gardens and stormwater planters, the City can reduce water pollution impacts while improving essential natural resources and making our neighborhoods more beautiful

How and when was the Green City, Clean Waters Plan established?

- Developed in 2009 by the Philadelphia Water Department (PWD), the Green City, Clean Waters plan is the city's commitment towards meeting regulatory obligations while helping to revitalize the city

How does the program work?

- $2.4B from the PWD for addressing water quality goals as set both by the Pennsylvania and the National Combined Sewer Overflow (CSO) Control Policies. These projects will be implemented over a 25-year period, with metrics and milestones developed to measure progress along the way

How does the program work?

- Utilizes rainwater as a resource by recycling, reusing, and recharging long neglected groundwater aquifers rather than piping it away from communities into already stressed tributaries
- Maintains and upgrades one of the nation's oldest water infrastructure systems.
- Creates public green stormwater infrastructure projects
- Engages citizens through meetings and public events to educate about green infrastructure, and allowing residents to shape the investments Green Stormwater Infrastructure that transform neighborhoods
- Millions of dollars awarded as grants that invest in local parks, schools, streets, and public housing for Green Stormwater Infrastructure
- Implements incentivized stormwater infrastructure projects
- Measures progress through Greened Acres that capture and manage the first inch of stormwater

Administrative Structure:

- The Philadelphia Water Department is public utility company with a robust full time staff
- The utility works collaboratively in conjunction with the Mayor's Office and other city agencies to push the program forward **Enabling the Program:**
- The EPA requires municipalities to create a CSO Long Term Control Plan (LTCP) to develop and evaluate a range of CSO control alternatives to meet water quality standards
    - In partnering with the EPA, the City of Philadelphia and the PWD agree to identify additional specific sub-watershed GI demonstration projects in selected locations, including in EJ communities, to show the early benefits to neighborhood livability through innovative green approaches
    - The City will conduct monitoring and modeling studies of the tidal and non-tidal river reaches in the region and continue to support water quality modeling and vessel research

Enabling the Program: Con't

- Representatives of the City and EPA will meet periodically to assess the goals and commitments of this Partnership Agreement to evaluate and assure progress. EPA and

the City will identify key individuals that will be responsible to advancing this Agreement. Other partners in the success of this effort such as non-governmental organizations may be engaged from time to time to assist and help assess progress As a public water utility they are beholden to their customers and the mayor's office.

Regulations (state and federal) guide decisions of the utility ultimately, but the mayor's office and its customers provide a vision for how to do so

Lessons for Grove Hall: Green City, Clean Waters

- The importance of collaborating with partner agencies that will lead to contributions, shared expertise, guidance, and support toward the realization of the plan
- Leveraging every opportunity for available funding can save utility customers money on green infrastructure projects down the road
- Utilizing vacant public property for green infrastructure projects often lowers the cost burden for cities, organizations, and taxpayers

Rain to Recreation, Lenexa, KS, est. 2000

Goal: To implement and maintain water quality and flood control projects that protect the natural and developed environment, while providing public education, involvement and recreational opportunities

How and when was the program established?

- To accommodate the rapid growth, the city initiated a citizen-driven, long-range community plan in 1996, Lenexa Vision 2020, in which citizens showed strong interest in a stormwater management program
- Lenexa then surveyed its citizens and found that nearly 80 percent had interest in a program that would
    - Reduce flooding
    - Improve water quality, preserve the environment and open space and
    - Provide for new recreational opportunities in the undeveloped portion of Lenexa
- Reflective of citizen interest, voters went to the polls in August 2000 approving an

1/8-cent sales tax to support the Rain to Recreation Program by a margin of 3 to 1

Rain to Recreation Con't

How does the program work?

- The Watershed Management Master Plan provided direction for the

Program in the form of policies, practices and projects

- In conjunction with the Systems Development Charge, a policy endeavor recently completed and also adopted by the City Council in April 2004 was to update the unified development code (UDC) to incorporate low impact development (LID) standards, a process that took several years to complete including a series of stakeholder meetings, inter-department cooperation and Kansas City Metro wide collaboration

- Other functions of the program include; utilizing green infrastructure and stormwater best management practices to treat and reduce runoff, and monitoring lakes, creeks and streams for pollution, identifying problem areas and planning protection **Administrative Structure and Leadership Roles:**

- A department within the City of Lenexa, Rain to Recreation has its own staff and leads the initiatives it was set to do, all while working in conjunction with the city council and other departments within the city to meet its goals

Rain to Recreation Con't

Enabling the Program and Funding:

- The initial planning for a stormwater management approach began in 2000, and a watershed management master plan that same year created the framework for the adoption of a Land
Disturbance Ordinance to support erosion and sediment control efforts in 2001

- In 2002, Lenexa was the first municipality in the Kansas City metropolitan area to adopt a Stream Setback Ordinance, making it a regional leader in watershed protection

- In 2006, an Illicit Discharge and Detection Ordinance was passed

- In 2000 an 1/8-cent sales tax to support the program was put to the voters that would help fund the program initially. The 1/8-cent sales tax was again approved in August 2004 to finally expire in 2010
- Initially, Rain to Recreation received some funding from the city's general fund account and a now-expired one-eighth cent sales tax. Currently, the program is funded three ways:

  ▯ A stormwater utility fee established in 2000 that is collected as a special assessment on Johnson County property tax bills

  ▯ A systems capital development charge, so that as new developments are built, growth pays for growth

  ▯ Erosion and site development fees, assessed at the time of land disturbance and site development permits

Lessons for Grove Hall: Rain to Recreation

- When creating Master Plans, it is imperative that they provide direction for the Program in the form of policies, practices and projects. This can be accomplished through:
  ▯ Surveys
  ▯ Community meetings
  ▯ Inter-departmental meetings
- Plans take years of work to come to fruition and should not be hastily done. All stakeholders (constituents, businesses, organizations, government) should be involved and their voices taken into account to provide overall direction

Chesapeake Bay Program, est. 1983

Chesapeake Bay Program
Science. Restoration. Partnership.

Organizational Goals → The Chesapeake Bay Program is a collaborative partnership that seeks to restore and protect the water quality, surrounding ecosystems, and 64,000 square-mile watershed of the Chesapeake Bay area

How and when was the Chesapeake Bay Program founded?

- 1983 Chesapeake Bay Agreement - establishes Chesapeake Executive Council, comprised of governors of Maryland, Virginia, and Pennsylvania, mayor of D.C., an administrator of the EPA and the Chair of the Chesapeake Bay Commission (est. 1980)
- 2010 Chesapeake Bay Total Maximum Daily Load (TMDL) - EPA regulation that allocates a "pollution diet" to impacted states in an effort to reduce the excess amount of nutrients and toxins that enter the Bay

  ▯ Each of the 7 partner states implement this regulation by establishing Watershed
  Implementation Plans (WIPs) that are managed by local governments
- 2014 Chesapeake Bay Watershed Agreement - present-day guiding document that establishes updated goals for the program to be achieved by 2025 through targeted Management Strategies

Chesapeake Bay Program Con't

Policies and Programs - How do they 'get stuff done'?

- The Bay Program is a voluntary, non-regulatory partnership model, although certain regulations like the EPA's TMDL impact the scope of their work

- Program partners at all levels of leadership include local, state, and federal government, NGOs and nonprofits, business/commercial groups, and environmental organizations

Administrative Structure and Leadership/Decision-Making Roles

- The policy decisions that guide the Bay Program hinge on the principles of consensus and subsidiarity, although there are distinct levels of leadership, listed in descending order...

 Executive Council (EC)- public-facing entity, sets 'big fish' priorities like water quality

 Principals' Staff Committee - recommend policy actions and serve advisory role to EC

 Management Board - review Management Strategies and Work Plans from the GITs (see next bullet) via the biennial Strategy Review System

 Goal Implementation Teams (GITs) are each responsible for implementing strategies to achieve their team's goals (specific priority groups include sustainable fisheries, habitat protection, watersheds, etc.) by creating 2-year Work Plans and Management Strategies

Lessons for Grove Hall: Chesapeake Bay Program

- Administrative method - Form separate working groups or subcommittees for different priority items (like GITs) and have them report to a public-facing 'executive board' of sorts to maintain public accountability and transparency
- Consensus-based structure of policy formation is an admirable strategy, but also requires a great deal of stakeholder education and negotiation that may stymie efforts to take action
- Might be more feasible to get an idea of community priorities before any decisions are made so that implementation process is less fraught with differing perspectives and competing visions

Economic Revitalization Zones (ERZs) in City of Portsmouth, NH

Goals of the ERZ program → The ERZ program is a State of New Hampshire tax credit program which incentivizes businesses to create new jobs and stimulate economic development in areas that are in need of revitalization

How did this program begin? What was the legislative adoption process?

- Adoption process began at the state level - Department of Business and Economic Affairs
- Program is reaffirmed every 5 years based on tax credit availability
- Each NH municipality has the option to adopt the ERZ program, which must pass through the local city council/board of selectmen and receive approval by the state
- The City is responsible for marketing this program to attract and retain eligible businesses and property owners

Economic Revitalization Zones Con't

How does Portsmouth implement this program?

- The City passed this program as a way to revitalize vacant and/or underused parcels in and around Portsmouth that qualify as brownfields or low-income areas with declining population over last 20 years
- The program applies to individual businesses, who may claim a tax credit against their financial investment in new job creation

Administrative considerations

- Economic Development Manager for the City of Portsmouth is responsible for managing and marketing the program to developers and property owners, who must apply to the state for approval

Lessons for Grove Hall: Economic Revitalization Zones

- A similar tax credit incentive program with sustainability requirements may have huge potential to fill commercial vacancies in Grove Hall neighborhood
    - Possible 'green business' zoning overlay - needs City approval
- Possible program involving City-sponsored neighborhood brownfield clean-up to host pop-up event for the Green Zone Initiative to gain traction and visibility in the community
- Need to get owners of vacant parcels on-board with a tax credit incentive program in order to attract qualified tenants
    - Accompany a program like this with a branding campaign in order to establish the area as a 'sustainable business community'

The Detroit Greenways Coalition, est. 2007

Organizational Goal → The Detroit Greenways Coalition advocates for and provides technical assistance to build a city-wide network of greenways and bike lanes to beautify neighborhoods, connect people and places, and stimulate neighborhood-level economic development

How and when did the coalition form?

- Collection of nonprofit and philanthropic organizations - including Michigan Trails and Greenways Alliance and Community Foundation for Southeast Michigan - advocate for and fund greenways in the city to make up for lack of City government action
- The Coalition forms in 2007 as a way to achieve better organizational status for funding and advocacy purposes

The Detroit Greenways Coalition, Con't

Policy Outcomes and Advocacy - How Do They 'Get stuff done'?

- Major liaison between the City and community members in terms of advocating for greenways, connecting amongst City departments, and accessing funding opportunities
- Extent of Coalition's experience and knowledge r/e greenways functions as leverage for advocacy and funding goals

Administrative Structure and Leadership/Decision-Making Roles

- One staff member and Executive Board, which represents nonprofits, elected officials, and community leaders
- Capacity of organizational leadership is best exemplified in light of the Coalition's ability to break the silos of city government and deliver results for communities

Lessons for Grove Hall: Detroit Greenways Coalition

- Especially if the Green Zone is advocating for several policy outcomes, there is a need for dedicated and experienced subcommittees or working groups to focus on those priorities
- To this end, forming connections within relevant City departments, such as Public Works and Environment Dept., is key to 'getting stuff done' and overcoming political interia in City government

- Form relationships with community representatives to maintain a finger on the pulse of community members' priorities; with this taken into account, it is possible to incorporate organizational goals within the framework of what the community currently wants and needs

Million Trees Campaign, New York, est. 2007

Goal: One of 127 initiatives in PlaNYC2030, New York City's long-term sustainability plan. The campaign was formed to revitalize New York City's urban forest by planting and caring for one million new trees throughout the city's five boroughs, by 2017

How and When Did the Campaign Form?

- Started as a Public Private Partnership (PPP) between a city government agency (NYC Parks Department) and a nonprofit organization (New York Restoration Project (NYRP))
- With strong backing from then Mayor Bloomberg, the campaign would also contribute to preparing the city for one million more residents over the next two decades, strengthen the city's economy, combat climate change, and enhance the quality of life for all New Yorkers

Policy Outcomes and Advocacy - How Do They 'Get Stuff Done'?

- One of the original initiatives PlaNYC, the campaign was funded by the City of New York and private sponsors

Million Trees NYC Con't

Policy Outcomes and Advocacy - How Do They 'Get Stuff Done'? Con't

- NYC Parks department was tasked with planting 700,000 of the trees in public right of ways (sidewalks, parks, medians)
- NYRP was responsible for tree planting 300,000 on properties outside of NYC Parks' jurisdiction. Their efforts also included reaching out to individual homeowners, land owners and managers, residential and commercial developers, landscape architects, and local community organizations for help with tree planting on public and private properties

Administrative Structure and Leadership/Decision-Making Roles

- The MillionTreesNYC Advisory Board was set up to advise NYC Parks and NYRP staff on tree planting, education, stewardship, public policy, research/ evaluation, and marketing
- The Advisory Board consisted of seven discrete Subcommittees. Each Subcommittee had three co-Chairs: one representative from NYC Parks, one from NYRP, and one from an outside organization or agency. Subcommittee members included representatives from government agencies, non-profit organizations, businesses, educators, researchers, and long time community stakeholders

Lessons for Grove Hall: Million Trees NYC

- If attempting to bring in new economic development, the greening of business districts increases community pride and positive perception of an area, drawing customers to the businesses
- Restoring the urban forest is also correlated with improved health. Growing evidence shows that trees help reduce air pollutants that can trigger asthma and other respiratory illnesses
- Environmentally, tree planting can also serve to improve water quality protection, lower heat island effects, and slow climate change

The Detroit Black Community Food Security Network and D-Town Farm, est. 2006

Organizational Goals → The Detroit Black Community Food Security Network (DBCFSN) is a 501(c)(3)organization that empowers Black Detroiters to achieve food security, community self-reliance, and food systems knowledge. One of the key programs is the D-Town Farm, a 7acre urban agriculture project that harvests over 30 varieties of produce and engages community members in conversations pertaining to food justice and community nutrition.

How and when did the DBCFSN and D-Town Farm form?

- School garden and food security curriculum at since-closed K-8 Nsoroa Institute expanded to a home garden program
  - This program morphs into a plan amongst project volunteers and other individuals to systematize food justice initiatives in the Detroit Black community
- The DBFSN was founded in 2006 in order to establish Black community leadership in food production/urban agriculture movement
- LOTS of political pressure exerted on City leadership to receive long-term lease on City land for the D-Town Farm
  - Media interviews, petitions, legal aid, etc.

The Detroit Black Community Food Security Network and D-Town Farm, Con't

Programs and Community Involvement: How do they 'get stuff done'?

- Huge reliance on community relationships in order to support the D-Town Farm program and grow volunteer/patronage network
- None of their work would be possible without strong buy-in from local residents, but still requires a great deal of community education, honest conversations, and outreach to promote the goals of the farm program

Administrative Structure and Leadership/Decision-Making Roles

- Farm staff - recruited from involved community members and through social media networks
- 5 members on the Board of Directors
- Robust farm volunteer network - recruited from tight knit community members who are invested in developing their communities

Lessons for Grove Hall: DBCFSN and D-Town Farm

- Cultivating strong and authentic community relationships is of paramount importance in order to initiate and grow any kind of community engagement program, especially volunteer-dependent projects
- Organizational representatives need to get to know community members' lived experiences within the neighborhood in order to cultivate support for initiatives that might not be an immediate priority for many people
- Social media networks (i.e. Facebook, Instagram) are a HUGE way to reach community members and promote engagement opportunities, events, and new programs

E+ Green Building Program, Boston, est. 2011

Program goals → The main goal of the E+ Green Building Program is to demonstrate the economic and design feasibility of energy positive building practices in alignment with the City of Boston's goal of achieving net zero carbon emissions by 2050

How and when was E+ Program established?

- Established under Mayor Menino; brings together the BPDA, Boston Department of Neighborhood Development, and the Environment Department to incentivize energy-positive green building design on cityowned parcels
- 3 pillars - energy, environment, and equity
- Initial financial incentives and awards offered by program sponsors, including NSTAR and National Grid, BPDA, and U.S. Green Building Council
    - These incentives were recently phased out - no longer needed
- Ultimate goal of the program - standardize and require green building practices in all new development in Boston by raising public awareness through model developments supported through the E+ Program

Boston E+ Green Building Program

E+ Green Building Program Con't

How does the program work?

- 2 main criteria - buildings must be energy positive (i.e. produce more energy than they consume) and achieve or exceed requirements for LEED for Homes Platinum rating
- Legal process → public land disposition and issuance of competitive RFP requests
- Leverage City-owned land assets in order to grow the program's portfolio of projects and demonstrate the scalability of green design interventions

Administrative Structure and Partnerships

- Public-Private Partnership between BPDA, Boston DND and Environment Department and private development teams who respond to competitive RFPs
- Sponsorship and promotional support provided by Eversource, National Grid, U.S. Green Building Council, Mass. Chapter of U.S.Green Building Council, and Boston Society of Architects

Lessons for Grove Hall: E+ Green Building Program

- GGHMS has potential to partner with the inter-departmental team involved in the E+ Green Building Program to begin selection process for eligible parcels in the Grove Hall neighborhood
- Identify owners of vacant parcels or empty lots to determine their interest in promoting green building practices in the neighborhood
    - Promote value of energy-positive green building practices as costefficient, brand-worthy, and an innovative approach to attract sustainable business activity in the area
- Huge potential for Grove Hall neighborhood to serve as a model for scalability of green building practices in the City of Boston

Smart Growth America Program, est. 2000

Goal: A nationwide program that works with local elected officials, real estate developers and investors, economic development agencies, and federal and state agencies to ensure everyone in America no matter where they live, or who they are, can enjoy living in a place that is healthy, prosperous, and resilient

How and when was Smart Growth America Program established?

- Smart Growth America was founded with three staff members in 2000, and officially recognized as a 501(c)(3) organization in 2003

- In 2003 former Maryland Governor Parris Glendening joined the organization as the President of Smart Growth America's Leadership Institute to help states and local governments use a smart growth approach
- In 2012, they became the new home of the National Complete Streets Coalition and the National Brownfields Coalition. Smart Growth America continues to be a leading advocate for federal policies and programs that support great neighborhood development

Smart Growth America Program Con't

How does the program work?

- Form Based Codes Institute: (FBCI): offers classes, technical assistance and other resources to communities and professionals interested in learning about form-based zoning codes—the regulatory framework for mixed-use, walkable urbanism
- Governors' Institute on Community Design: Advises governors and state leaders as they seek to guide growth and development in their states
- Local Leaders Council: A nonpartisan, diverse group of municipal officials who share a passion for building great towns, cities, and communities. The Council supports those who are implementing smart growth strategies and advises Smart Growth America about how state and federal decisions affect local communities
- National Complete Streets Coalition: Promotes the development and implementation of policies and professional practices that ensure streets are safe for people of all ages and abilities, balance the needs of different modes, and support local land uses, economies, cultures, and natural environments
- Transportation for America: Helps communities plan for smarter, strategic growth as an investment for their future. We teach local leaders about the technical aspects of smart growth development, and provide customized advice on how communities can use smart growth strategies to their advantage

Smart Growth America Program Con't

Administrative Structure and Leadership Roles:

- As a nonprofit with a nationwide footprint, Smart Growth America has a robust full time staff, which includes: Program Directors, Program Managers, Policy Associates, and Research Associates, all of whom serve a purpose in running the various programs, workshops, campaigns, and institutes

Current Legislation being pursued:

- Complete Streets Act 2021: (Federal Legislation)
    - Sets aside federal funds to support Complete Streets projects (five percent of annual federal highway funds)
    - Requires states to create a program to provide technical assistance and award funding for communities to build Complete Streets projects
    - Directs localities to adopt a Complete Streets policy that meets a minimum set of standards to access that dedicated funding

Lessons for Grove Hall: Smart Growth America

- Funding is an important component to providing programming and money should never be left on the table. An effort should always be made to apply to all grants when available
- An organization is only as strong the reputation it cultivates, and partnerships can assist in building it
- Relationships should never be diminished, and can be important down the road. An effort should always be made to build upon them, they can be fruitful in the future

Ping Tom Memorial Park, Chicago, est. 1999

Organizational Goals → The Ping Tom Memorial Park is a 17-acre riverside urban green oasis situated adjacent to the Chinatown neighborhood, serving as a site for community gathering, exercise and recreation, and cultural events.

How and when was the Ping Tom Memorial Park founded?

- 1991 - Chicago Parks District purchases a 12-acre site along the Chicago River at the urging of the Chinese American Development Corporation founded by civic leader, Ping Tom - and the Chinatown Riverside Park Advisory Council (PAC), a community-based coalition

- 1999 - The first phase of the park is completed, incorporating Chinese design elements through the landscape design work of Chinese Americanfounded Site Design Group
- Early 2000s - An additional 5 acres is acquired by the City, and the Ping Tom PAC - renamed from the earlier PAC - is a major advocate for completion of the park expansion
- 2011 - 2013 - The Northern portion of the park and the multi-purpose fieldhouse are completed

Ping Tom Memorial Park Con't

Programs and Operations - How do they 'get stuff done'?

- The Ping Tom Memorial Park is under the jurisdiction of the Chicago Park District, so they are responsible for running park programming, managing the budget, and appointing a park supervisor

Administrative/Governance Structure

- Although the Ping Tom Memorial Park is governed under the authority of the Chicago Park District, the Ping Tom PAC is very active in advising and advocating for community needs to the Park District representatives, the district's City Councillor, and other relevant City entities
- Ping Tom PAC organizes fundraisers, park clean-ups, suggestion boxes, etc. to supplement the City's primary involvement in managing the park and to account for community members' needs for services and activities offered

Lessons for Grove Hall: Ping Tom Memorial Park

- Forming productive partnerships with relevant City agencies is a key mechanism to obtain the necessary resources and expertise to implement highly-resourced community projects and initiatives
- A robust community-based advocacy network - possibly organized by a backbone organization like GGHMS - is an essential tool to push the City to deliver on desired neighborhood amenities like parks and rec facilities
- Continual community input and engagement as projects are being implemented by professional entities is important in order to foster morale that will encourage potential patrons to utilize the amenity after the project's completion

Fairmount Cultural Corridor (FCC), est. 2012

Goal: Create a vibrant livable business district made stronger through an active, local creative economy and anchored by the historic Strand Theatre

How, why, and when was FCC established?

- Originally established as a pilot program formed 2012 as the Upham's Corner ArtPlace Pilot (UCAP)

- Investments from the Boston Department of Transportation and renovations coming to the Upham's Corner Station led to concern from some of the community that the longterm plans for Upham's Corner were not about them; With the question being not only who the changes are for, but who gets to decide on what the changes are
- This moment of concern (opportunity and threat) was a primary reason why community organizations, arts organizations and funders came together to engage local residents, artists and merchants in creative placemaking
- Nine organizations over 24 months worked and came together with residents, artists and merchants to eventually form the FCC

Fairmount Cultural Corridor Con't

How does the FCC program work?

- By engaging a wide variety of people and partners; including community-based nonprofits with history and trust amongst residents to local merchant associations and artist collectives, to larger institutions like universities, performing arts organizations and city planners, UCAP aimed to bring together a wide variety of resources and perspectives through creative placemaking
- The nine organizations had various roles, but they worked together to support local artists and display, supported and engaged merchants/business, and engaged residents.
- Local residents, artists and merchants played a large role in shaping UCAP. They provided leadership as community liaisons, commissioned artists, volunteer event planning partners and local champions
- Through creative placemaking activities; The Dudley Street Neighborhood Initiative Multicultural Festival, Upham's Corner Street Fair, and use of the Strand

Theatre allows for community engagement at the ground level. UCAP partner Upham's Corner Main Street (UCMS) added another dimension—connecting the local business community to community events and the Strand Theatre

Fairmount Cultural Corridor Con't

Administrative Structure and Governance:

- Initially the large UCAP partnership was broken into "core partners" (the nine organizations) and "secondary partners" (resident advisory groups), with an understanding that the core partners were charged not just with their own work, but with overseeing the entire initiative, while the secondary partners were responsible more specifically for their own roles and work in Upham's Corner
- The initiative moved to a monthly structure of "all partners" meetings and benefited from greater input in all aspects of its work

Lessons for Grove Hall: FCC

- Large collaborations require strong coordination: moving processes forward, convening meetings, sending notes, and keeping an eye on the deliverables
- Tiers of inclusion can be problematic: if the goal is to be all inclusive, be all inclusive and ensure everyone that is part of the process has a voice at the table
- Having a brand anchor for a program can pay dividends, and act as focal point of a plan; a place where all stakeholders can unite, and be utilized by all. In this case, the Strand Theatre played that role

Final Conclusions, Recommendations, Next Steps

Research Question #1 - Creation of a Green Zone

1. Identify key partnerships and allies - especially within City of Boston departments and agencies - who could lend regulatory expertise and/or financial support to the Green Zone initiative and reach out as soon as possible

2. Identify nonprofit and private-sector partners in the same space or with similar goals in order to build relationships and form potential for future collaboration

3. Reach out to neighborhood leaders and organizations in order to evaluate social capital networks, potential supporters, and conversely, any weak spots in terms of trust in City leadership in particular (because the City will be a key partner)

4. Think about 'branding' for the Green Zone Initiative → stimulate public awareness and interest in the effort, which may attract potential partners as well. Having an anchor location for any initiative is worth looking into. High Falls has a majestic waterfall and Fairmount utilized the Strand Theatre as focal points to generate interest.

5. Establish Greater Grove Hall Main Streets as the lead stakeholder/partner in order to establish boundaries for roles, responsibilities, and goals for Green Zone partners

Final Conclusions Con't

Research Question #2: Green Zone Governance, Leadership, and Decision-Making Roles

1. Cultivate and maintain awareness of community priorities through robust outreach efforts

(social media, website, surveys, possibly host community pop-up events or neighborhood 'tours' along with project partners once COVID-19 subsides)

2. Prioritize community member input and leadership in ALL decision-making forums, and make sure that they are well-informed enough to meaningfully participate in the planning process
3. Establish the values that will form a thread through all Green Zone projects (sustainability, innovation, community health, economic vitality, etc.) → ensure that none of these values are compromised in any pursuit
4. Multi-leveled organizational model → form subcommittees and/or working groups to tackle discrete subject areas once they are decided upon (green infrastructure, food systems, sustainable transportation, commercial enterprise and green business practices, etc.)
5. Again, Greater Grove Hall Main Streets can serve as the primary oversight/advisory entity for the various Green Zone initiatives, serving a public-facing role

Final Conclusions Con't

Research Question #3: Policy Agenda Priorities and Organization

1. Take advantage of existing regulations (municipal, state, and federal) and funding opportunities in order to strategize policies that are reasonably achievable due to existing political and financial support
2. Do not underestimate the importance of thorough planning and policy/program prioritization this will position the initiative to receive funding and political support that otherwise would go to a 'better-organized' project
3. Be patient and believe in the process, the implementation of a large program cannot be rushed. It will take time, energy, and resources to get it done right.
4. Having a high-ranking elected official advocate and bat for you during the legislative process (if pursuing legislation) can be the difference between having a bill signed into law or not.

Credits

We would like to thank Professor Landsmark for informing us of the opportunity to work on this amazing project. We also would also like to thank the staff from the various agencies and organizations that took our calls, answered our emails, and directed us to the right information to complete our case studies. Lastly, we want to thank Ed Gaskin for his leadership, knowledge, and support during the entirety of this process. It is our hope that meaningful steps can be taken toward implementing a Green Zone in Grove Hall and beyond.

Subsection 3: Special Studies

i. Vertical Farming and Urban Farming
ii. Smart Cities

Urban Farming Options for Grove Hall

Farming Options for Grove Hall

Grove Hall in Boston has a significant number of vacant lots.

This is because:

- There are a significant number of brownfields that haven't been developed

- Highest number of brownfields in the Boston area

- Some are city-owned properties

- Some are privately owned with no plans of development

There are many uses for these lots, including different types of farming.

Incorporating farming into urban areas has many benefits, including:

- Plants reduce the amount of CO_2 in the atmosphere through photosynthesis, helping minimize the effects of global warming

- allowing children to learn about farming and develop a connection with nature from a young age if the farms are established in connection with schools

Each farming option has its own set of advantages and challenges to keep in mind when deciding the best option for Grove Hall.

There are many different farming options that the Grove Hall community can choose, from the most simplistic methods to the most technologically advanced, including:

- Community Gardens

- Urban Farms

- Urban/Rooftop Greenhouses

- Bioshelters

- Hydroponics, Aeroponics, and Aquaponics

- Vertical Farming

Community Gardens

Community Gardens- are single plots of land that are tended to by a group of people. Each gardener has a small portion of the land to grow their choice of plants.

They help to enhance the city's appearance and connections among community members, while offering an opportunity for people to get outdoors to better their mental and physical well-being.

The objective isn't necessarily to grow produce for commercial use, though it isn't uncommon for the garden to sell their crops.

Examples






Advantages

- Low start up and running costs, especially with donations of tools and materials

- They can also help mitigate Urban Heat Islands, or urban areas with higher temperatures than less developed areas, especially if there is tree cover within the garden

- Improve both the community's connections to nature and interpersonal connections

- Improve appearance and aesthetics of urban areas

- Increase surrounding property values

- Allows people to grow their own fresh produce

Disadvantages

- The gardeners tend not to be paid

- Not structured with commercial use as the main goal, so does not produce as high of a yield as other farming methods

- Conflict and theft of crops and tools between gardeners can happen

- There can be competition among different gardens for resources, grants, donations, and local business sponsorships, and the scarcity may diminish each project

Other Notes

- Often use raised beds to help the plants grow successfully, especially if the lot has contaminated soil

- This would likely be the case with Grove Hall

- Not able to be used during winter or early spring in Boston due to snow cover and ice

Community Gardens - Other Notes

- Often use raised beds to help the plants grow successfully, especially if the lot has contaminated soil

- This would likely be the case with Grove Hall

- Not able to be used during winter or early spring in Boston due to snow cover and ice

Case Study: Massachusetts,United States

Nightingale Community Garden

- Started in the 1970s by residents who reclaimed an empty lot and turned it into a community garden

- As of 2011, there were 134 plots shared by over 250 gardeners who grow over 25,000 lbs of fresh produce each year

Pictured: Elnora Thompson and Karen Chaffee, 2011

Urban Farming

Urban farming is the practice of cultivating and distributing produce to and around urban areas. They are run by paid farmers to commercialize their produce.

Urban farms grow fresh and local produce that can be sold to the community.

Fewer community members get involved with the growing process in urban farming, but those involved tend to be paid. However, the community gets access to fresher and more local produce since the farms are within their neighborhood, giving people healthy food options.

Urban Farming Advantages

- Urban farms can look many different ways and employ many different techniques that can be more environmentally friendly than traditional farming techniques

- They can be an efficient use of vacant land, whether it be raised beds or shipping containers on brownfields or greenhouses on flat rooftops

- They can ensure communities have access to fresh produce

- Local produce minimizes transportation, and in turn pollution

- Scalable, so the farm can be as large or as small as desired

- Skill-building and job training options

Disadvantages

- Fewer members of the community get involved than would with a community garden

- Larger investment and more expensive than community gardens

- Any use of pesticides could harm the community and environment

- Depending on the method used, could have high running costs, including high labor costs due to higher wages in urban areas

Case Study:
Massachusetts,United States

Urban Farming Institute (UFI):operates five farms in Boston, including in Dorchester. They use in-soil techniques with raised beds and dig out the top 18-inches to ensure the soil is not contaminated, while implementing crop rotation to ensure the soil is not overworked. They started the first official urban farm under Article 89 that allowed commercial urban agriculture.

They operate a full farmer training program with over 230 graduates, and they had over 750 volunteers annually prior to the COVID-19 pandemic.

UFI stresses the importance of community involvement at all stages of the implementation process, because the community needs to want the farm there in order for it to be run successfully.

In addition to running the five farms, they also started the Urban Farming Conference where different urban farmers are able to attend interactive panels and discussions about varying urban farming topics.

UFI’s mission is to “develop urban farming entrepreneurs and to build healthier and more locally based food systems that contribute to stronger communities.”

Case Study:
New York,United States

Brooklyn Grange Rooftop Farms: World’s largest rooftop farm (one acre) located on top of borough in Queens, New York

- Across all locations (2.5 acres of farm), they produce about 50,000 lbs of crops annually

Case Study:
Vancouver,Canada

Sole Food Street Farms:using an abandoned gas station as an urban farm to provide jobs, agricultural training, and inclusion to individuals who are managing addiction and chronic mental health problems.

- Since 2009, Sole Food Farms has transformed acres of contaminated urban land into street farms

Case Study:
Maryland, United States

Baltimore Urban Gardening with Students (BUGS):a farm that works with underserved Baltimore city communities by offering an after-school and summer program to elementary school children who would otherwise have little access to green space and few extracurricular activities

- The students learn about healthy eating and cooking habits, while helping improve their community

Urban/Rooftop Greenhouses

Greenhouses are structures that have transparent materials for the walls and roof in order to regulate climatic conditions for plants.

The transparent material allows the sun's rays to enter and get trapped, warming the greenhouse.

Greenhouses can be used for urban farms or community gardens on different scales, from a single greenhouse covering a few raised beds to large commercial greenhouses covering entire roofs.

Examples

Advantages

- Greenhouses can extend seasonal growing periods, since the air temperature stays warmer for longer

- Can be used on flat building tops that would otherwise be vacant

- The yield is more stable and secure since the conditions are more controlled

- More pests, weeds, and disease control/prevention

Disadvantages

- They require a sizable initial investment, especially for larger-scale greenhouses

- Higher operational costs than traditional farming if using electricity and gas

- Greenhouses that do not use electricity and gas may not extend the growing period of crops through the entire winter

- The warmer conditions inside the greenhouse are optimal for diseases

Case Study:
New York, United States

Gotham Greens: places greenhouses on building tops (such as grocery stores)

- Their largest farm based in Brookline, NY

- 15,000 square feet --one of the “most iconic” urban agriculture projects worldwide

- Uses Hydroponics

- 9 locations around the country

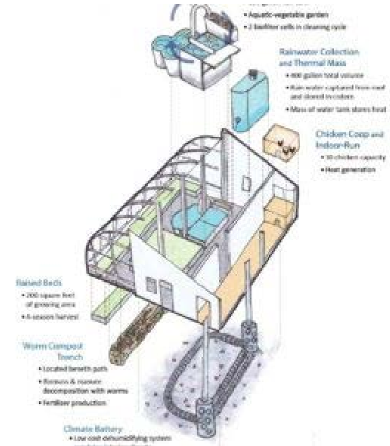
Bioshelter

A bioshelter, or a passive-solar greenhouse is a high-performance greenhouse that uses the sun to heat and power an indoor ecosystem.

- It mimics a natural environment by including both plant and animal communities--like chickens or fish--that support each other’s growth.

- Uses biological, passive storage (natural heating/cooling from the sun), and mechanical systems to extend the growing season as opposed to mechanical means and combustion like a typical greenhouse

Smart City Approach



Bioshelters Disadvantages

- Large startup costs

- They require more up-front research than traditional greenhouses

- For example, determining the orientation of the bioshelter to maximize the solar energy or figuring out which plants and animals would work best together

- There are growing season limitations, such as having less sunlight in the winter

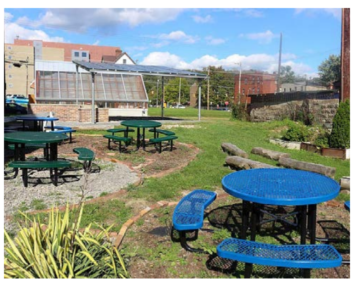
- But bioshelters are often able to get around this problem by incorporating passive solar energy systems with a thermal mass to store heat

Case Study: Pennsylvania, United States

Oasis Farm and Fishery: a Black-owned and led off-the-grid bioshelter in Homewood, Pittsburg that is powered by solar energy and uses some of the newest and most sustainable farming technologies to teach people of all ages how to grow their own fresh produce.

- Uses hydroponic and aquaponic growing systems with reclaimed rainwater to grow lettuce, herbs, vegetables, and 40 fish

- Their surrounding property includes an outdoor classroom, a straw bale garden, a satellite farm, and African American heritage garden



Hydroponics, Aeroponics, and Aquaponics

Hydroponics, aeroponics, and aquaponics are alternative farming methods that do not use soil.

- Why use alternatives to traditional farming methods?

- Prevents deforestation and clear cutting that would be used to make room for larger farms

- Makes farming and fresh produce accessible in areas without usable soil, such as urban areas

- Using the proper technology, far more crops can be produced with fewer resources, which would help feed the growing population, especially in urban areas

Why are alternative farming methods good for urban areas?

- Many urban areas have contaminated soil or land unsuitable for farming (like brownfields or vacant buildings) that make traditional farming methods difficult or impossible

- In urban areas where traditional farming methods are used (like road medians), the plants have less than ideal living conditions because they are exposed to lead from gasoline and exhaust from cars

Hydroponics, aeroponics, and aquaponics allow for farming in urban areas by using techniques that work around the challenges.

Hydroponics

Hydroponics is a farming method that submerges roots of plants in nutrient-rich solution instead of using soil.

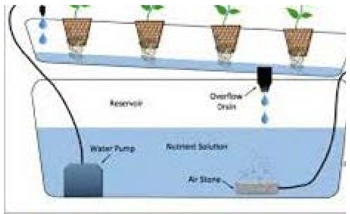
- In order to add physical support, the plant is either placed in inorganic growing medium like vermiculite, perlite, rockwool, coconut coir, an expanded clay substrate, or in a simple container where the roots have access to the solution

- It is the most cost-effective option of the three

Hydroponics Types

There are four different hydroponic techniques:

The **Nutrient Film Technique (NFT)** is where nutrient rich solution runs over the roots of the plants. They are popular for commercial use and are best for leafy greens, but because the roots are exposed to more air than water, the plants can be more vulnerable to temperature fluctuations.



NFT Advantages:

- Continuous supply of water, oxygen, and nutrients

- Space efficient

- Easy to access

- Lower labor inputs

NFT Disadvantages:

- Susceptible to clogging

- Higher possibility of water temperature fluctuation

- Not suitable for larger or flowering plants

NFT may be a good option for Grove Hall.

Deep water culture (DWC) is a method that uses floating rafts to suspend plant roots into a pool of nutrient rich solution. Since there is more water in the system, it is more resistant to large temperature fluctuations. Larger root plants can be used and are easy to remove.

DWC Advantages:

- Commercial scalability

- Productive

- Inexpensive

- Not as susceptible to large temperature and nutrient fluctuations

DWC Disadvantages:

- Filtration demands

- Labor demand and cost

- Space efficiency

Since DWC tends to work best in warmer climates where the water doesn't need to be heated manually, it may not be the best option for Grove Hall.

In **aflood and drain** or **ebb and flow** system, the plants are placed in large grow beds with a grow medium to support the roots of the plants. The bed is flooded with nutrient-rich solution by a pump and then drained to give roots access to the nutrients and oxygen that they need.

They also can grow large root mass plants like fruits or vegetables since the rock media mimics soil, but larger plants with long roots end up taking up a lot of room.

Flood and Drain Advantages:

- Grows larger crops well

- Good biofiltration

- Simple and inexpensive to implement

- Media acts as filtration

- Great for smaller scale system

Flood and Drain Disadvantages:

- Difficult to scale for large production

- Requires more cleaning

- Higher maintenance and labor

A flood and drain system may also be a good option for Grove Hall.

In a **drip system**, the nutrient solution is pumped through tubes directly to the roots of the plant. There are drip emitters that control the flow at the end of the tubes, saturating the grow medium.

They can be circulating, where the system drips more frequently and excess nutrients flow back into the reservoir, or non-circulating, that drip less often to provide the plants with nutrients at a constant rate.

Drip System Advantages:

Very versatile and scalable

Able to control exactly how many nutrients the plants are getting

Allow almost any type of plant to grow

Drip System Disadvantages:

Tubes can get clogged, so they need to be cleaned relatively often

Need to keep an eye on pH level of the water

Need to check nutrient saturation in the grow medium often

A drip system could be a good option to grow many different types of plants in Grove Hall.

Hydroponics - Examples

Case Study:
Maryland, United States

Karma Farm: a farm run by a father and his son that uses both traditional and hydroponic farming methods

- Uses a shipping container (also known as “freight farming”) for hydroponics

- Provides produce to restaurants in Baltimore

Aeroponics

Similarly to hydroponics, **aeroponics** uses a nutrient-rich solution instead of soil. However, the roots are suspended in air and misted by low pressure, high pressure, or ultrasonic fogger pressure pumps instead of being submerged in the solution.

- Has healthier root systems than hydroponics because there are fewer points of intersection

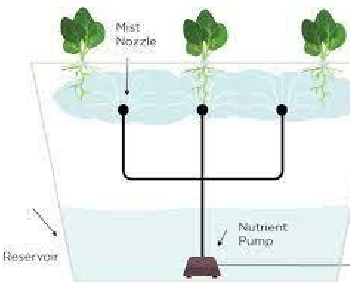
- It is a more delicate system than hydroponics, which is beneficial for sensitive roots.

- Allows propagation, or growing new plants from clippings, to be much more successful

Types

There are three different aeroponic techniques:

A **low-pressure aeroponic (LPA)** system is the most common type. It is easy to set up and has a relatively low cost. They require a pump system to mist the roots with small water droplets, though they are much larger droplets than in the high-pressure system.



LPA System Advantages:

- Easy to set up

- Affordable

- Common and available in almost every hydroponic shop

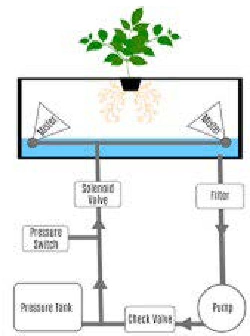
LPA System Disadvantages:

- Require constant supervision

An LPA system would be a good option for Grove Hall, as it would be the most affordable and easily-run aeroponics method.

A **high-pressure aeroponic (HPA) system** is much more advanced and costly to set up, though it is the most efficient type.

It must run at a very high pressure to atomize the water and turn it into droplets of 50 microns or less, creating more oxygen for the root zone than the LPA.



HPA System Advantages:

- Highly efficient

- Gives the plant roots more access to oxygen

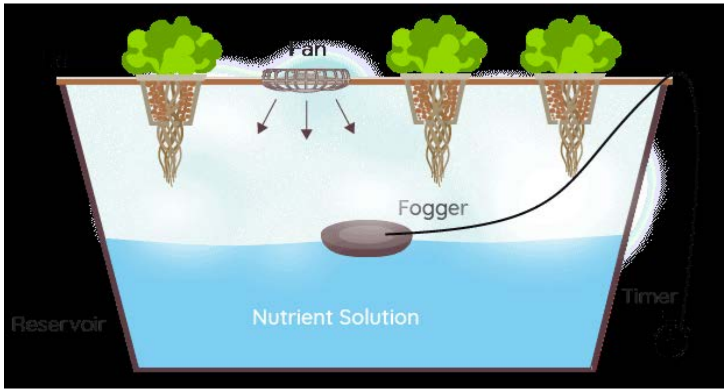
HPA System Disadvantages:

- Expensive to set up

- Sensitive system that could get easily clogged

This may be a good option for Grove Hall in the future, though a LPA would be better in the beginning to ensure it would work well.

Ultrasonic fogger Aeroponics or **fogponics** uses an ultrasonic fogger to atomize the water into super small water droplets--smaller than the HPA system would create--to make fog. The system must be closed so the fog doesn't escape.



Fogponics System Advantages:

- Plant roots find it easier to absorb the small water droplet size

Fogponics System Disadvantages:

- There's little moisture in the fog created, meaning the foggers can get clogged more easily because a salt forms when running over time

This system would require a lot of maintenance, so the LPA system may work best for Grove Hall.

Examples

Smart Cities

Opportunities and Cautions

Definition

“a Smart City is one that combines traditional infrastructure (roads, buildings, and so on) with technology to enrich the lives of its citizens.”

(CISCO CEO John Chambers)

Who Makes Smart Cities?

Private Tech Companies

- such as Google’s Sidewalk Labs

- Public-Private Partnerships

Local Governments

- Often with the goal of “data-driven decision making”

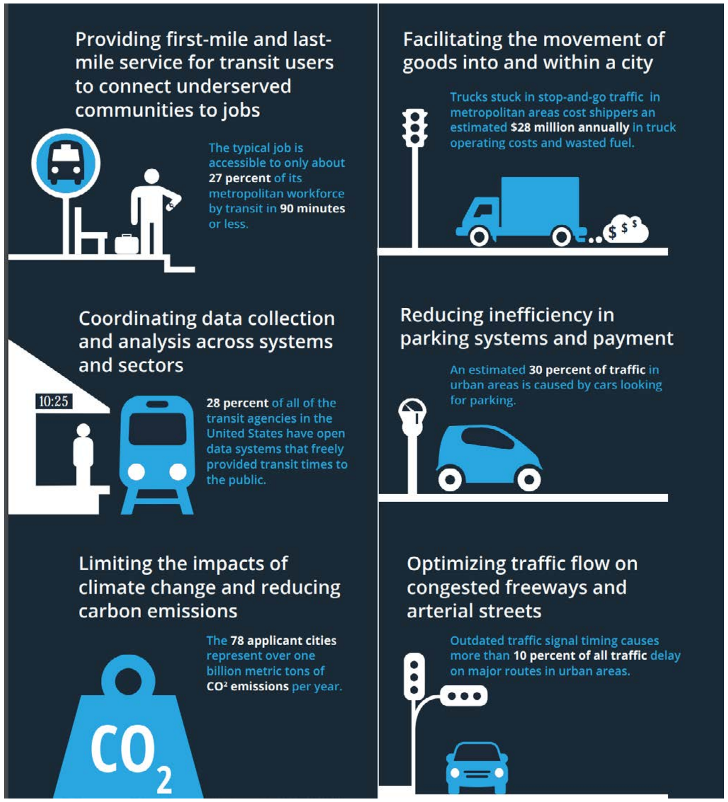
- Inter-governmental collaboration, planning and funding

regional, state, federal

Smart City Goals

- In 2015, the US Department of Transportation launched the “Smart City Challenge” where 78 US cities submitted proposals to address challenges with smart technology

- USDOT found these six common challenges cities want to solve with smart technology



Characteristics of Smart City Plans

Multiple Scales

- Regional
- City-wide
- Neighborhood

Types of Smart City

- Shared
- Electric
- Connected
- Automated

Targeted Outcomes

- Traffic Safety
- Environment
- Development
- Equity

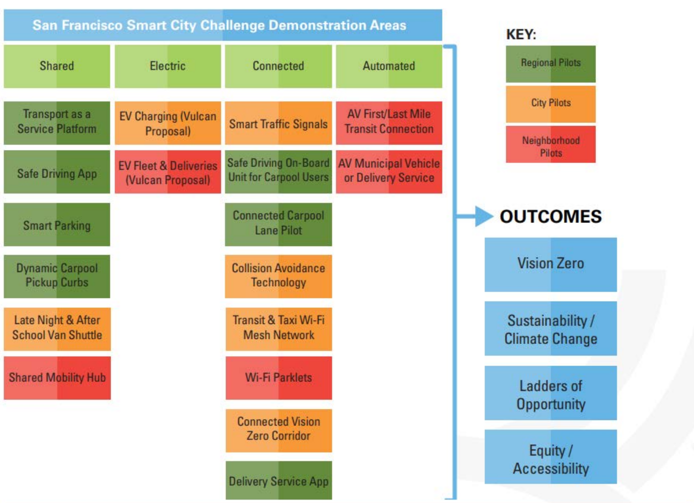


Figure 0.2 San Francisco Smart City Demonstration Areas

Smart City Tools

- Big Data and Data Collection

- Sometimes including public, free, open data portals

- Online Platforms for community engagement or service provision

- Often framed as methods of involving communities in planning processes

- Infrastructure that relies on/provides internet

- Also known as the “Internet of Things”

- Kiosks and Sensors

- Mobile Apps

- Automation/Optimization

- Often for Traffic/Transportation

- Virtual/Remote Services

- i.e311

Tech Company Smart Cities

- Free public wifiprogram in NYC converting phone booths to wifihotspots

- Paid for entirely by Google’s Sidewalk Labs

- Funded by the monetization of data from wifinetwork users

- Public backlash has cooled opportunities for expansion of this project

LinkNYC
(New York City)

Local Government Smart Cities

- City installed Electric Vehicle (EV) Charging Stations where residents or visitors could charge cars for free

- Created a draw to depressed downtown: drivers could stop for lunch or shopping while their car charged

- Private company offered to take over the program with their own proprietary charging stations

- City initially rejected them, but eventually reached a compromise

- Local control over smart city interventions is important

Electric Vehicle Charging Stations for Main Street
(Salida, CO)

- Winner of 2015 USDOT Smart Cities Challenge

- Addressing maternal health disparities with transportation infrastructure by creating an app that health care providers can use to assist patients get to appointments

- Still in development, in partnership with Sidewalk Labs

- Question of who has access to this data, if it is HIPAA protected, how it will work in practice

Public Private Partnership Smart Cities

- Consortium of local private companies and governments, as well as national companies

- Goal of traffic management with "Smart Spines" to encourage walking, biking, and public transit use

- LED streetlights that also do air quality monitoring and pedestrian detection

- Cross-sector collaboration can be difficult or a great resource

SmartPGH
(Pittsburgh, PA)

- City partnered with company (Propeller Health) to distribute smart inhalers to asthmatic residents

- Collected location and time data when inhalers were used to be able to map spikes and concentrations

- Raises questions of medical privacy

- Only one step towards identifying a problem and requires additional data to address risks

Data Driven Smart Cities

- Cities have increasingly relied on data analytics to "predict crime" as a policing tool

- Does not necessarily lead to equitable outcomes because over-policing in communities of color leads to their over-representation in data and predictive models

- Many companies are selling "predictive policing" software to cities with the misleading promise of using data to eliminate bias

- Smart Cities and new technology cannot on their own change policy outcomes

"Predictive Policing"

Sensor Monitoring Smart Cities

- Chicago embedded Air Quality Monitors in their energy efficient lightbulbs

- Using sensors that record air quality and can report pollution levels

- Ideally used to guide policy development or implementation

- Can help residents be aware of air pollution and make safer choices

- Good for data collection but limited in addressing root causes of air pollution

Array of Things
(Chicago, IL)

Sharing and the Smart City

- App that displays “privately owned public open space” or POPOS to a map

- Intended to guide residents and tourists to other parts of the city they might not know about otherwise

- Spread economic activity

- Only the downtown POPOS were available for free at the initial release in 2012

- Example of an app that combines difficult to find data with economic development goals
“SF POPOS”
(San Francisco, CA)

The Problem of Smart Cities

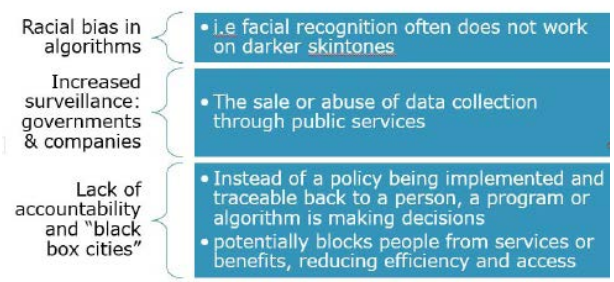
“Smart city technologies will have vast political consequences:

who gains political influence,

how neighborhoods are policed,

who loses their privacy.”
(Ben Green, The Smart Enough City)

Cautions



Boston Smart City Playbook
2016

1. Smart City Plays

2. Stop sending sales people

3. Solve real problems for real people

4. Don’t worship efficiency

5. Better decisions, not (just) better data

6. Platforms make us go ¯_(:/)_/¯

Towards a “public” privacy policy
from boston.gov

Smart City PHL

Framework for Building Tech Partnerships

Strategy 1: Build a strong foundation with policy and infrastructure

Strategy 2: Create a process for engagement and partnership

Strategy 3: Support and sustain implementation of projects and programs with funding

Start Up-in-Residence (San Francisco)

-Program where the city incubates start-ups to improve government services
2018

Smart City Approach
for Greater Grove Hall and Beyond

- What would “enriching the lives” of Grove Hall neighbors mean?

- Would a “smart city” amplify existing strengths and/or compensate for weaknesses?

- What policies and programs need reform or introduction?

- What existing goals and needs could technology be a part of working towards?

- How can stakeholders ensure that the technology is necessary, account-able, sufficient, and accessible?

- Smart Technologies are toolsnot solutions