GREENING THE PAPER CITY

Prepared for **the Pioneer Valley Planning Commission** & **the City of Holyoke**

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The Conway School ~~~Winter 2017

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PARSONS HALL

EXECUTIVE SUMMARY

Holyoke harnessed the power of the Connecticut River through its canal system and established itself as an economic powerhouse in the mid 1800s. Since post-industrial decline, Holyoke's infrastructure remains while the prosperity it once brought is absent. These industrial remnants have become fertile grounds for arts, culture, and urban revitalization efforts and a catalyst for infrastructural overhaul.

One example of outdated infrastructure in Holyoke is the combined sewer system (CSS). A CSS channels stormwater runoff and sewage into the same underground pipe network and on to a wastewater treatment plant. Under dry conditions and during an average rain event, the system functions well and all wastewater is treated. However, in heavy rainfall events, the system is overwhelmed by the volume of runoff and discharges into the Connecticut River in a combined sewer overflow (CSO). Many New England cities are challenged with the issues that CSOs bring, namely pollution of water bodies. In response, the Environmental Protection Agency (EPA) is requiring the separation of the CSS and has issued Holyoke an Administrative Order to reduce CSO events.

Holyoke is in a period of change. The Center City Vision Plan, Urban Renewal Plan, and various other measures propose redevelopment and improvements across the city. The Conservation Commission has recognized green infrastructure as an important tool for urban revitalization and stormwater management. Green infrastructure is a sustainable approach to managing stormwater by reducing and treating stormwater at its source. To incorporate green infrastructure into preexisting streetscape redevelopment plans, the city has proposed Green Streets on segments of Newton, High, and Center Streets.

Green Streets are designed streetscapes that infiltrate and filter stormwater runoff from streets and sidewalks using green infrastructure while also creating more lively, livable communities. Green Streets not only beautify the city and increase the tree canopy, but are also associated with improved mental and physical health, increased safety, and decreased stormwater, heating and cooling costs. This book provides an overview of Holyoke's need for green streets, analyses of the city and three designated streets, a toolbox of green infrastructure solutions, and spacial recommendations for the city to present to an engineering firm for construction details.

Holyoke has an opportunity to redefine itself as a pioneer of sustainability and resilience. With a changing climate and subsequent increase in heavy rainfall events, stormwater and CSO issues will only worsen. Green Streets are a vital step toward a sustainable future for the City of Holyoke.

Our deepest thanks to Jaimye Bartak, Senior Planner at the Pioneer Valley Planning Commission; Christopher Curtis, Chief Planner at the Pioneer Valley Planning Commission; Andrew Smith, Conservation Director at the City of Holyoke; Michael McManus, Superintendent of the Department of Public Works for the City of Holyoke; Mathew Cahill, Ahron Lerman & Rachel DeMatte, Urban Foresters with the Massachusetts Department of Conservation and Recreation; David Bloniarz, Executive Director at ReGreen Springfield; Jharikem Borrero and the entire Nuestras Raices community; Pablo Baez our wonderful and gracious translator; and the citizens of Holyoke.

INTRODUCTION


oke, Mass.
FAIR
ALLING RUBBER Co
SAVINGS BANK

Holyoke's booming industry powered by hydro in the mid 1800s

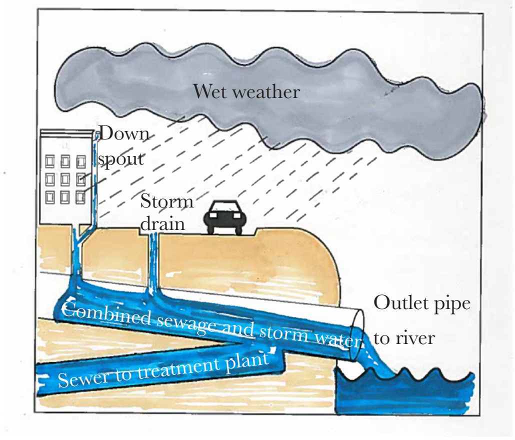
Holyoke was the first planned industrial city in the United States, built to harness the power of water. In 1847, merchant investors took advantage of a natural fifty-seven-foot drop in the Connecticut River to build a large dam and a four-and-a-half-mile-long canal system. During its peak from the late 19th century to the mid-20th century , Holyoke was home to over twenty-seven paper mills, eleven textile mills, and various other manufacturers (Thibodeau), and the "Paper City" supplied 70 percent of the world's paper. Holyoke's population grew rapidly from 5,000 in 1890 to over 60,000 in 1920 with an influx of workers from Ireland, Quebec, Germany, and Poland.

The Paper City was home to the National Blank Book Company

With the decline of the industrial era in the 1920s, mills and factories closed and residents began leaving the city, but the mills, housing stock, streets, and other infrastructure of that earlier era remain, as do the canals and the walkable rectilinear grid of city blocks. Holyoke is a gateway city and its Puerto Rican and Latin American population brings vibrant culture and diversity. Between the 1990s and today, Nuestras Raices, a grassroots urban agricultural organization whose mission is to create healthy environments and celebrate agriculture, obtained fifteen vacant plots in the city and turned them into community gardens. A Canal Walk has been built along the city's historic canals and mills, creating a pedestrian-and-bike-friendly pathway in the heart of the city. Holyoke has completed an Urban Renewal Plan and an urban tree canopy assessment, both of which aim to revitalize Holyoke while bringing trees back into downtown to manage stormwater, improve air quality, and improve quality of life (Holyoke Urban Tree Canopy Assessment).

Holyoke Dam, 1907

One challenge facing the city, however, is its aging combined sewer infrastructure. These combined sewers usually bring stormwater and sewage to the wastewater treatment plant, where it is treated and then discharged into the Connecticut River. But the plant does not have the capacity to treat all water, especially during heavy rainfall, and in those circumstances some combined sewage and stormwater overflows untreated to the Connecticut River, affecting habitats, plants, animals, and people. The projected increase in storm severity associated with climate change has made the issue of combined sewer overflows (CSOs) even more pressing.



A combined sewer system, combines rainwater and sewage in same pipe

According to the Massachusetts Department of Environmental Protection, "every year 1.8 billion gallons of combined sewer overflow are discharged into the Connecticut River or its tributaries from seventy-eight different discharge pipes" (CSO fact sheet). Holyoke, along with Chicopee, Springfield and other nearby cities, contribute significantly to this volume. Under an Environmental Protection Agency Administrative Order, these cities are required to abate combined sewer overflows. The City of Holyoke is facing an estimated $45 million in costs to implement its plan for CSO control, which will raise local sewer rates by 61 to 81 percent, to over $500 per household—a substantial burden for many families (CSO fact sheet).

Seeking a cost-effective way to meet the EPA mandate and the city's goals, the Pioneer Valley Planning Commission (PVPC) and the City of Holyoke contacted the Conway School to develop street designs that manage runoff with green infrastructure, natural and engineered systems that mimic natural processes, slowing, cooling, infiltrating, and filtering stormwater before it enters the Connecticut River. City planners hope that green streets will help to lessen the amount of water entering the combined sewer system, decrease water pollution, create more comfortable and pleasant public spaces, and bring the residents of Holyoke many other social and economic benefits.

GOALS AND OBJECTIVES

1. **Decrease and slow stormwater runoff entering the stormwater system**
   - Use green infrastructure to filter and slow stormwater entering the system
2. **Increase the urban tree canopy and green space**
   - Incorporate trees into green infrastructure solutions
   - Utilize vacant parcels where appropriate
3. **Increase safety and usability of streets**
   - Design green streets to be more suited for biking and walking
   - Create gathering spaces

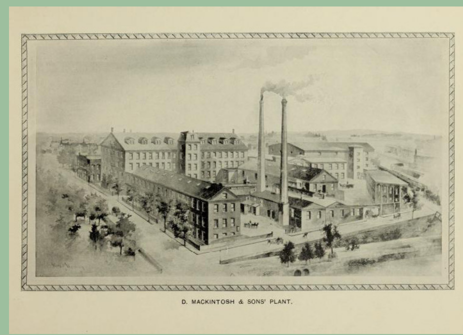
A CSO outlet empties into a stream

A CSO system being constructed in Philidelphia in 1883

CAN HOLYOKE REPLICATE SOME OF THE NATURAL FUNCTIONS OF A FOREST?

Downtown Holyoke is nestled in a valley, with the Mount Tom range to the west and Mount Holyoke to the northeast.

In downtown Holyoke, rain falls onto sidewalks, rooftops, roads, vacant lots, parking lots and other impervious surfaces. Impervious surfaces cannot absorb water; it is shed as runoff, flowing to storm drains, and eventually into the Connecticut River. Rain that falls on impervious surfaces and into the sewer system it not filtered by plants and trees before replenishing the groundwater and river.

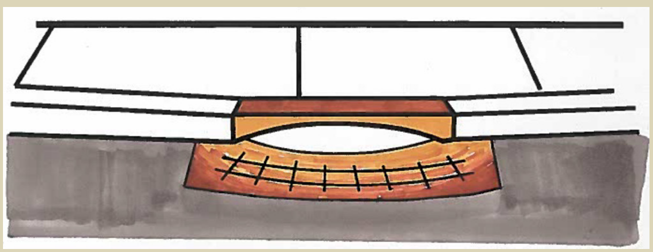


Trees line the Mackintosh Plant in the late 1800s. Using trees for stormwater management and beautification is not a new concept

As rain and melting snow sheets off, it can pick up and carry various pollutants like pesticides, fertilizers, oils, pet waste, soap, and heavy metals (Sources and Solutions: Stormwater). Runoff can also cause localized flooding and erosion. Stormwater runoff is a major concern as it may pollute wildlife habitat and our drinking water supplies, and may expose humans, plants, and animals to carcinogens. There are many negative effects of this untreated overflow: health problems, flooded basements, unpleasant odors from the rivers, decreased property values, dying fish other and wildlife in and around rivers, loss of scenic beauty and economic loss from flooding and contamination of polluted waters (CSO fact sheet).

In a natural setting like Mount Tom, trees and forests play a critical role in creating healthy watersheds. When it rains, trees, soil and other plants act like a sponge and absorb a significant amount. Trees filter the water, absorb what they need and the process replenishes the groundwater and aquifer or releases the water back into the atmosphere through evapotranspiration. This is the type of system green infrastructure seeks to replicate within the urban landscape. Adding trees to the landscape provides critical the ecological functions of storing and filtering water.

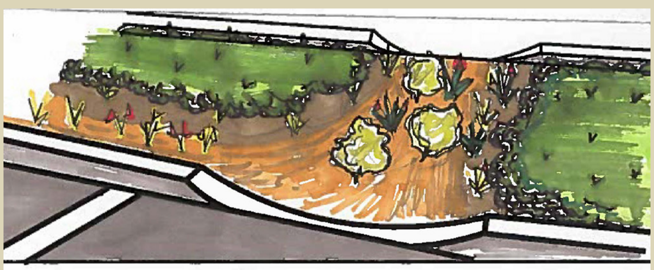
GREY INFRASTRUCTURE



Manages runoff with sewage mains, tunnels and wastewater treatment plants

Polluted overflow enters the connecticut river

GREEN INFRASTRUCTURE



Manages runoff with natural and engineer systems that mimic nature

Filter contaminants from stormwater before entering the Connecticut River

WHAT ARE GREEN STREETS?

Green streets are a strategy of managing stormwater and reducing pollution while incorporating design elements to improve human use of streets. This strategy aims to create a design that integrates the street network with the surrounding natural systems while respecting the existing natural and built environment. The goal is to create harmony between stormwater management, people and transportation networks by emphasizing walking, creating green spaces and connecting communities and places (Erickson).

This strategy uses various green infrastructure tools to accomplish these goals: bioswales, rain gardens, tree box filters and tree trenches for example. These various strategies serve dual purpose of slowing and filtering water, and creating pedestrian friendly neighborhoods, shade and beauty.

Green streets effectively manage stormwater and improve the human experience.

> *"American Society of Civil Engineers gives U.S. water infrastructure a "D" grade" (Fetterman)*

GREEN STREETS IN THE NORTHEAST

Biorention. DDOE 1st Street NE. Washington, D.C.

Greening D.C. Streets

Washington, D.C

The city aims to reduce stormwater runoff and make the District the "greenest city" in the nation. The city is 43% impervious and roughly half the city is still on combined sewer.

There are approximately 10 sites in the Klingle Watershed identified for design and implementation

Tools used in this project: Bioretention, Street Trees Landscaping, Permeable Pavement, and Remove Unnecessary Pavement

Elmwood Ave. Largest permeable parking lot in New England

Rain garden at the Cogdon House in Providence

Save the Bay Center has a bioswale, green roof & bioremediation pond

Green Infrastructure Coalition

Providence, Rhode Island

The city has a vital tree canopy and a functioning CSO abatement system but wants to solve stormwater problems close to the source. The city experiences flooding and bay contamination. Rhode Island is 12% impervious, and the urban/ suburban core close to the ocean is 25% with urban soils.

The city has used rain gardens, constructed wetlands, green roofs, permeable pavement, and bioswales as tools.

The city has completed more than 75 projects since 2008.

BENEFITS OF GREEN STREETS

BENEFIT	EXPLANATION
Improve Air Quality	Trees uptake gaseous air pollution, remove C02 from the atmosphere, store carbon and filter particles out of the air, using their leaves and bark to trap them. This improves air quality and reduces respiratory illnesses, such as asthma, bronchitis, and lung infections. (Feldman).
Increase Public Space	Access to green space has proven to increase walkability, physical activity, and chances for social interaction. Green streets help physically and mentally by decreasing obesity and stress.
Increase Energy Savings	Trees and green infrastructure are able to harvest and use water, reducing the energy needed to pump it to treatment facilities (American Society of Landscape Architects). They also provide shade and therefore decrease need for air conditioning in the warmer months.
Decrease Greenhouse Gases	As trees grow, they remove C02, the leading cause of global warming, from the atmosphere, store it in the trees and soil, and release oxygen. A mature tree can consume up to forty-eight pounds of carbon dioxide a year. By reducing electricity costs, there is a decreased use of fossil fuel, which inherently decreases carbon in the atmosphere.
Decrease Urban Heat Island Effect	Trees and vegetation can help reduce urban heat island effect by shading buildings, deflecting sunlight and releasing moisture back into the atmosphere.
Increase Property Value	Increased access to green space has been linked to increased property values. A study in Philadelphia demonstrated that a neighborhood with newly planted trees had a 2% increase in property values (American Society of Landscape Architects).
Create Community Cohesion	Increased vegetation encourages the use of outdoor spaces, which leads to increased neighborhood interactions and therefore higher social capital. These spaces provide a space for people to meet, interact and enjoy their neighbors (Platt et al).
Safety	Green infrastructure can separate pedestrians and bikers from cars to increase safety, and green streets have also led to decreased crime rates as neighborhoods appear that they are cared for.
Increase Wildlife Habitat and Biodiversity	Vegetation creates habitats for birds, mammals and insects. Slowing stormwater decreases erosion and sedimentation, which helps stabilize habitats (EPA).

Adapted from Demonstrating the Benefits of Green Streets, Jennifer Dill et. al.


Para nuestra salud
NO DRUGS
HEALTHY FOOD
SAFE SEX
VACUNAS
TOBACCO-FREE

METHODOLOGY

Where could green infrastructure solutions go?

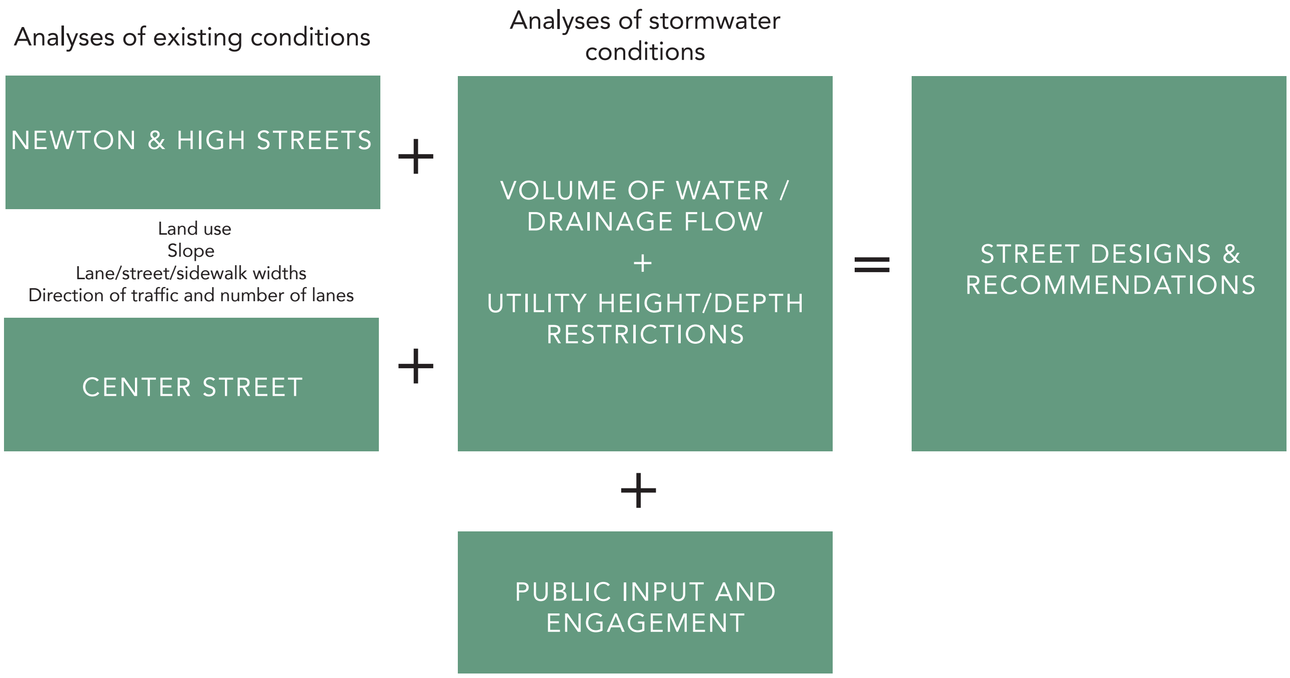
First, right-of-way typologies (including width, number of lanes, directionality and presence of on-street parking), and existing characteristics of the streets (slope and land use) were examined at each of the three focus areas. These helped determine any excess space on the street that could be converted to green infrastructure.

What type would be appropriate according to site conditions?

To decide what green infrastructure tool would be most appropriate for the spaces identified, site patterns such as land use and circulation were considered. Other considerations, overhead and below-ground utilities, existing trees, structures, facades of commercial buildings, crosswalks locations, and connections to the stormwater system were also analyzed to pick the most appropriate green infrastructure tool.

Each tool was chosen based on the space available and the restrictions present in each location. Parallel goals to optimize pedestrian and cyclist safety and usability also influenced the choice. With public input, a greater understanding of the community needs and desires shaped the placement and type of green infrastructure chosen.

The following section analyzes broad patterns as well as site specific conditions. Canopy cover, land use, drainage, circulation, and utilities will guide the placement of green infrastructure and the types of green infrastructure used.



NEWTON, HIGH & CENTER

Newton and High Streets lie within the downtown Holyoke neighborhood, which is a mixed commercial and residential area, while Center Street is in the Flats, a residential neighborhood.

The City of Holyoke selected these streets, informed by the Urban Canopy Assessment, the existing CSO separation plans, and the DPW's allocation of Chapter 90 funds for roadwork.

- The Canopy Assessment, conducted by the Davey Resource Group, showed that all three streets have a lack of urban tree canopy. UTC is composed of the leaves, stems, and branches of all public and private trees. Newton and Center street have no public trees, and High has three.

"Street trees planted in urban areas offer a low-cost way to address stormwater runoff into the Connecticut River, while at the same time providing more attractive neighborhood environments for walking and biking, and thus reducing car use and improving property values. We are enthusiastic about the multiple benefits that will come out of this project for the region."

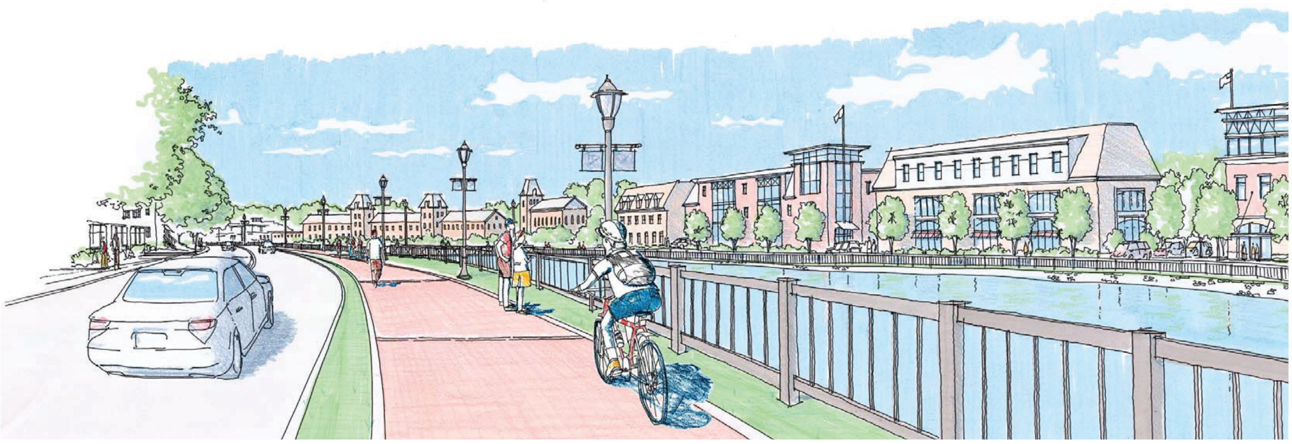
Chief Planner, Chris Curtis of PVPC

"Making Holyoke greener will make it a more attractive place to live and visit, and we are excited that residents will have the opportunity to learn how to care for urban trees and provide input on the design of green streets for areas in downtown Holyoke."

Felix Machuca, Director of Operations at Nuestras Raices

- All three streets are in areas where CSO separation has began, but the streets are still currently on a combined sewer. For this reason, reducing the amount of stormwater entering the system on these streets would mitigate effects of combined sewer overflow.
- Chapter 90 funds are federally granted to improve roadways, and Holyoke's DPW has existing plans and funding for these streets.

Funded by a grant from the U.S.D.A. Forest Service, project partners also include the Pioneer Valley Planning Commission, Massachusetts Department of Conservation and Recreation, and Nuestras Raices, with the common goal of planting more street trees, and incorporating green infrastructure to reduce combined sewer overflows and stormwater runoff into the Connecticut River.



Holyoke's City Center Vision Plan, future improvements on Canal

PUBLIC ENGAGEMENT

An initial meeting was held at the Green High Performance Computing Center to collect community input about the neighborhood and engage the community.

The January 2017 meeting began with a brief presentation explaining the problems associated with combined sewer systems, the benefits of green streets, and a description of the existing conditions on each street chosen by the city. The participants were then asked a series of questions about their relationship with Holyoke and these neighborhoods.

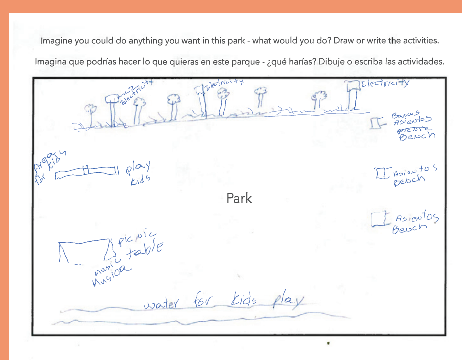
Participants shared their concerns about safety, poorly lit areas, vast vacant lots cluttered with trash, the lack of shade, and a lack of community gathering spaces and green spaces in these neighborhoods. They were interested in more bike- and pedestrian-friendly streets, and in more community interaction.

The second meeting, conducted in early March 2017 at the Holyoke Public Library, introduced the public to green infrastructure tools and presented preliminary street designs.

Participants expressed interest in the bike lanes and pedestrian-friendly roads presented in the designs, and the increase in green spaces in the neighborhoods, but were concerned about who would be responsible for maintaining the trees and potential vandalism.

The meeting included a design charette for a pocket park located in a city-owned vacant lot on High Street. Participants' designs had various elements, including community gardens, seating, play spaces for kids, water elements, a stage, space for music, and stormwater catchment systems. They aimed to create a safe, tranquil place for all members of the community.

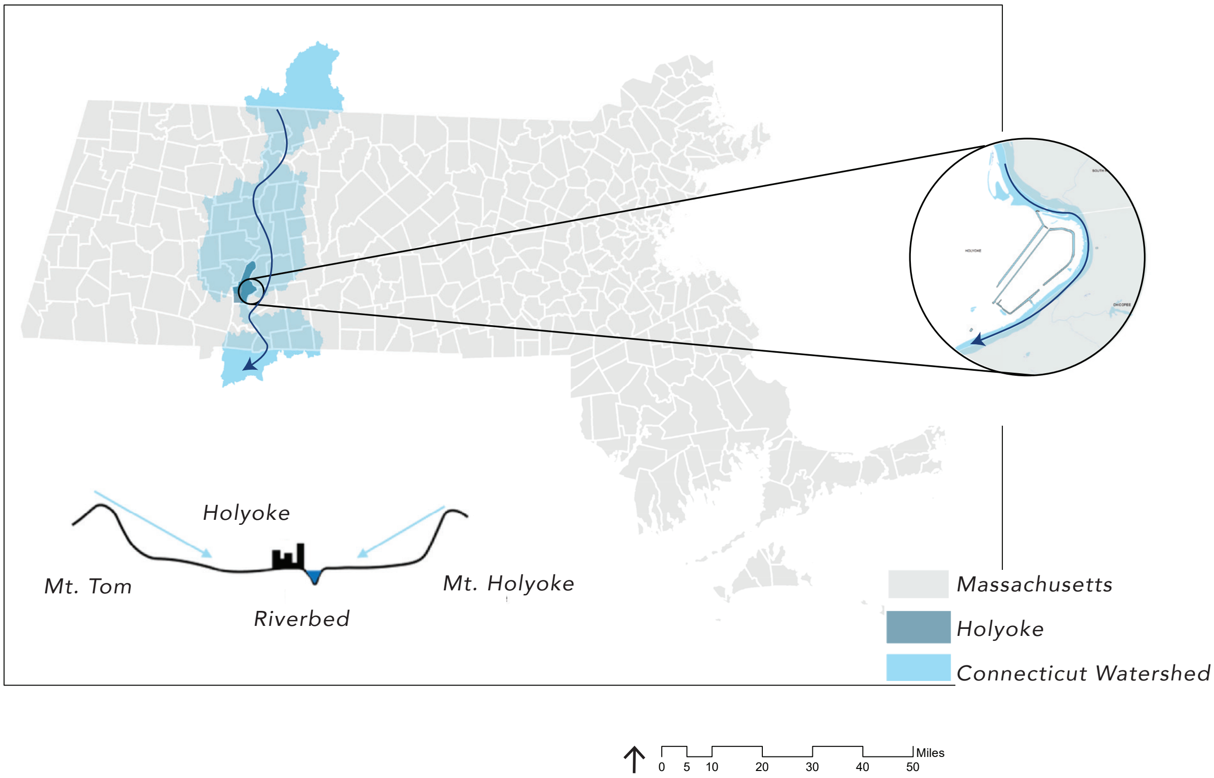
Public participants mapped their ideas and wrote Post-It notes of what they'd like to see in a park space.



A "pocket park square" activity allowed participants to draw how they would use a park space.

ANALYSES

WATERSHED

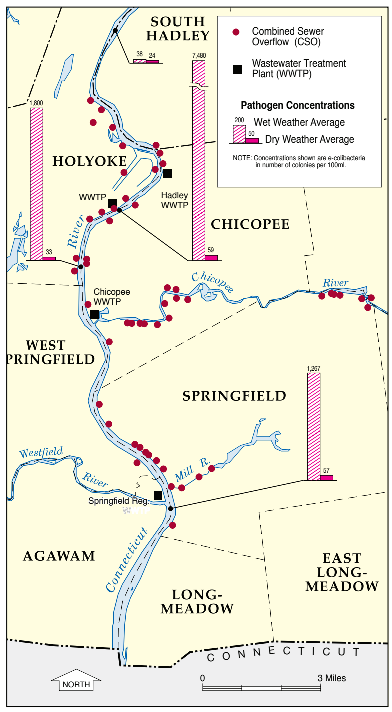


Downtown Holyoke is situated within the lower portion of the Connecticut River watershed, bordered to the east by a twelve-mile bend in the Connecticut River (Green Streets Guidebook).

The Connecticut River Watershed encompasses the entirety of the Connecticut River and it's tributaries. It extends roughly four hundred miles from the Canadian border to the Long Island Sound. Approximately 150 tributaries make up the watershed, draining from 11,000 square miles of New England's farmlands, historic sites, and industrial cores. Annually, this area contributes 70 percent of the Long Island Sound's fresh water (Connecticut River Watershed Council).

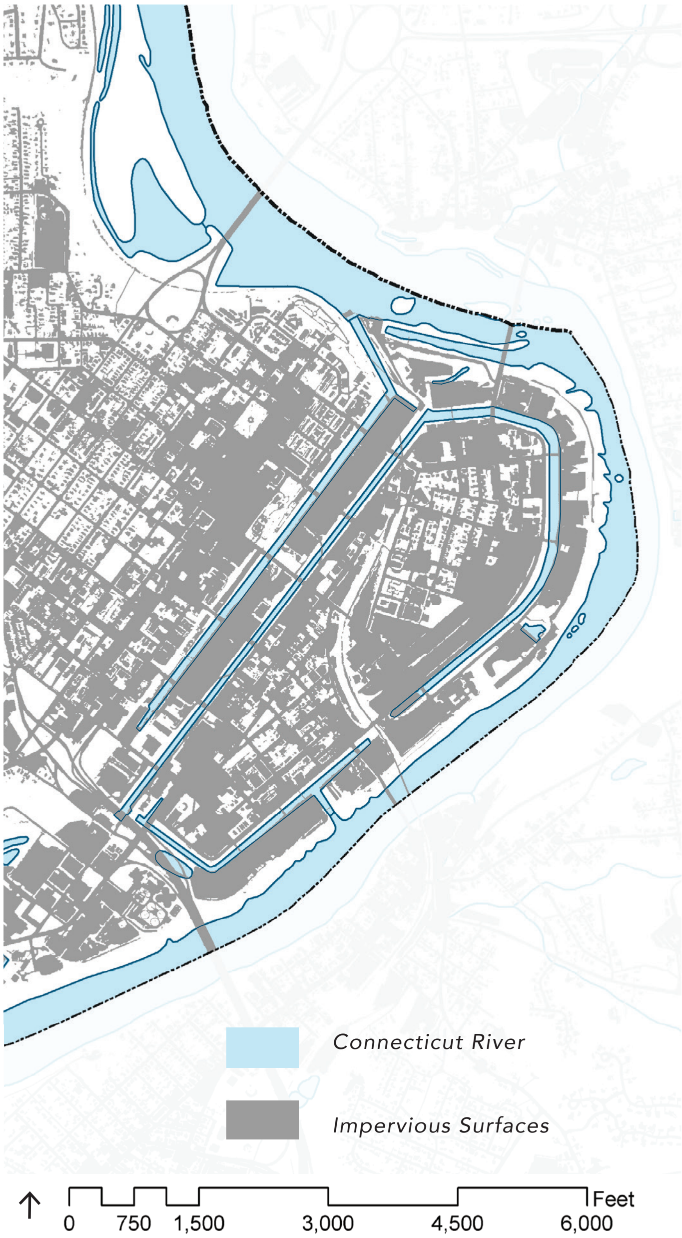
In Downtown Holyoke, an intricate dam and canal system divert part of the Connecticut River through Holyoke's urban core. The City of Holyoke contributes polluted runoff to the canal and river, affecting the health and vitality of the watershed.

Green Streets techniques can mimic a natural system by filtering, slowing and capturing stormwater within the urban core reducing the occurrence of polluted water in the Connecticut River and improving ecological function to the watershed.



Pathogen concentrations in Holyoke can rise as much as 12,678% during wet weather.

IMPERVIOUS SURFACES

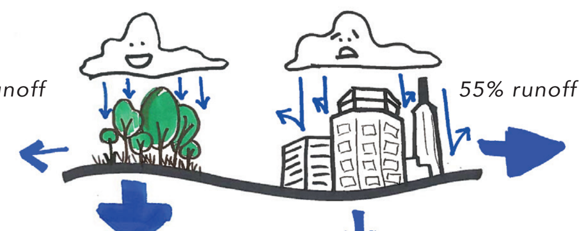


The City of Holyoke's land cover is 10% impervious surface and 90% pervious surface. However, the Mt. Tom range makes up a large portion of Holyoke, contributing most of the pervious surface area. North, west, and south Holyoke are also predominantly pervious.

In contrast, roads, sidewalks, buildings, and parking lots dominate downtown Holyoke. This area is a mostly impervious, made up of 63% impervious surfaces.

Runoff from the project sites, located in the urban core, contributes to flooding and pollution of the Connecticut River. The Center Street focus area is 58% impervious; the Newton and High Street focus areas are 89% impervious. This amount of impervious surface can cause localized flooding, combined sewer overflows, and water pollution. Pollutants in stormwater runoff often include oils and heavy metals from automotive fluids, bacteria and nutrients from pet waste, salt, and debris. In heavy rainfall events, water is unable to infiltrate impervious surfaces and runs off into the stormwater system. When the system is overwhelmed by runoff, combined sewer overflows occur, spilling polluted stormwater and sewage into the Connecticut River. To decrease the amount of stormwater entering the combined sewer system, Holyoke must reduce the amount of impervious surfaces in these areas, or slow and retain runoff from these surfaces.

Using green infrastructure would allow water to infiltrate on site, filter and remove pollutants picked up from impervious surfaces, and temporarily retain runoff



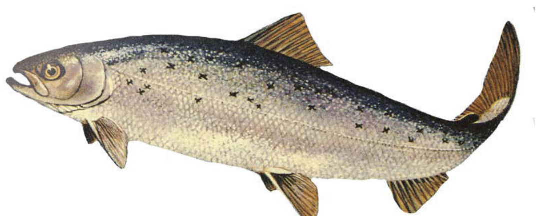
COMBINED SEWER OUTLETS & NHESP

Newton, Center and High Streets are all connected to the city's combined sewer system. The system conveys stormwater and sewage into the river during large wet weather events when flows exceed the treatment plant's capacity. This outflow compromises the health and vitality of many species in the river. The Natural Heritage and Endangered Species Program classifies the Connecticut River as rare species and wildlife habitat. The Connecticut River is home to 142 fish species, 9 federally listed endangered species, over 200 bird species, and numerous mammals and reptiles. All of these species and more are affected by pollutants in stormwater and increased water temperatures (Wildlife & Habitat).

When stormwater sheets off impervious surfaces, the temperature of the water can increase. Warmer water overflowing into the Connecticut River alters which organisms thrive and which will diminish. Warmer water alters oxygen availability for aquatic species and promotes the growth of detrimental bacteria and funguses. The presence of excessive nutrients from fertilizers and pet waste alters aquatic nutrient cycles, creating algal blooms that deplete oxygen, killing fish and other water dependent organisms.

With global climate change increasing the chances of heavy rainfall events and amount of annual precipitation, it is critical that Holyoke improves its stormwater management practices for the sake and vitality of the Connecticut River and the species that call it home.

To create a more resilient system, some green infrastructure tools can filter stormwater before it enters the Connecticut River, thereby removing pollutants from runoff and supporting a healthy aquatic environment in the Connecticut River.



Atlantic Salmon

Shortnose Sturgeon

Eastern Brook Trout

TREE CANOPY COVER

Canopy cover serves a vital role in cities. Trees help to regulate climate: they combat the urban heat island effect by providing shade and moderating temperatures. By shading impervious surfaces, trees reduce the temperature of stormwater runoff which can minimize thermal shocks to water bodies (Center for Watershed Protection).

Trees can also improve air quality by absorbing pollutants from the atmosphere, cooling the air, and storing carbon.

An important tool in stormwater management: they take up stormwater pollutants such as nitrogen from soil and groundwater. They can also intercept rainfall in their canopy, reducing the amount of rainfall reaching the ground, thereby reducing the volume of runoff. Trees also promote infiltration by increasing soil drainage capacity and also reducing volume.

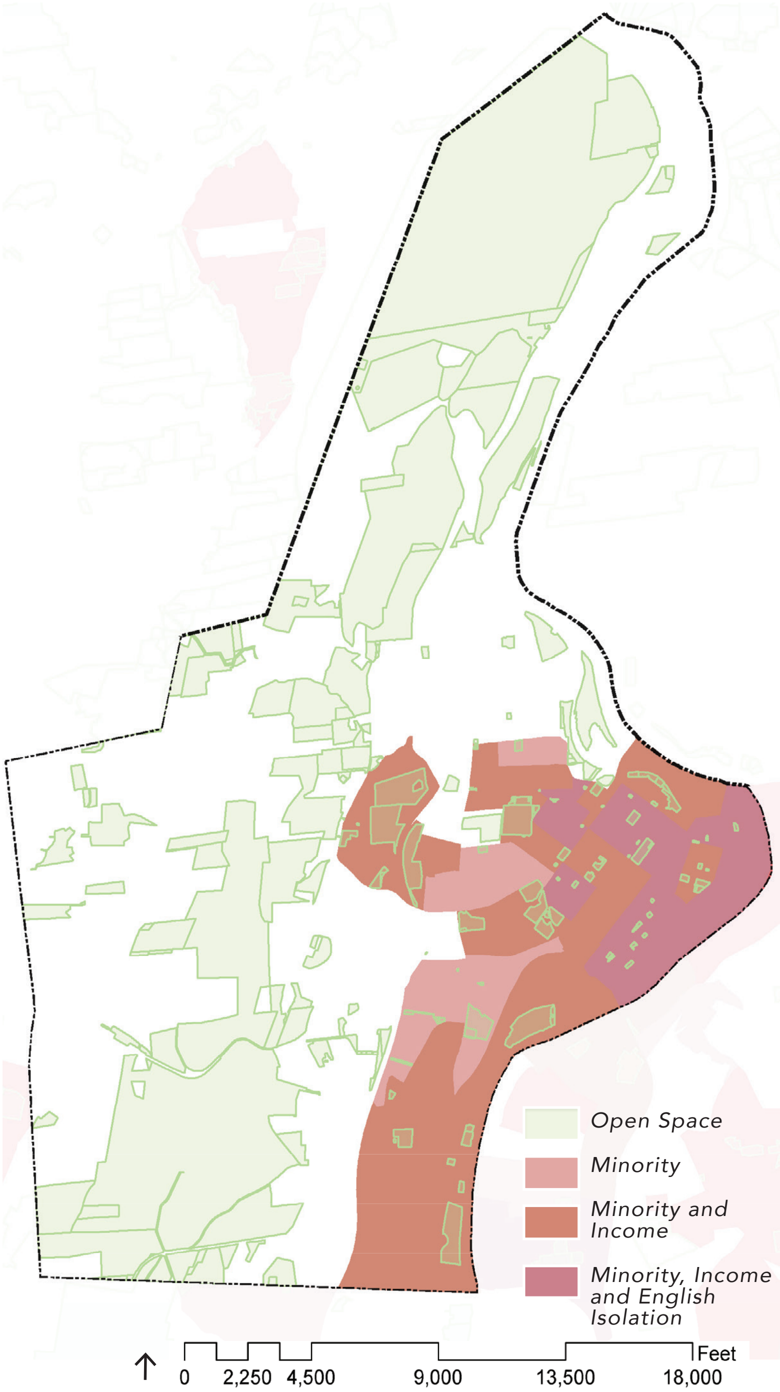
There is a close correlation between tree canopy cover and watershed health. According to American Forests, at least 40 percent tree cover is recommended to maintain the ecological functioning of local streams and rivers (City of Holyoke). Holyoke's Urban Tree Canopy Assessment determined downtown Holyoke's tree canopy cover is 26.5%, nearly 15% below recommended standards. Center and Newton have no street trees, and High only has three. These focus areas could experience the urban heat island effect, a higher rate of air pollution, and increased flooding hazards as a result of the lack of tree canopy cover.

Incorporating trees into these areas of downtown Holyoke could decrease the amount of untreated stormwater entering the Connecticut River, and restore canopy cover, improve air quality, reduce heat island effect and supply shade.

Six paved over tree grates line High Street

A maple adds canopy cover to Center Street

ENVIRONMENTAL JUSTICE AND ACCESS TO OPEN SPACE



The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) established an Environmental Justice Policy "to help address the disproportionate share of environmental burdens experienced by lower-income people and communities of color who, at the same time, often lack environmental assets in their neighborhoods. The policy is designed to help ensure their protection from environmental pollution as well as promote community involvement in planning and environmental decision-making to maintain and/or enhance the environmental quality of their neighborhoods." (Mass Government)

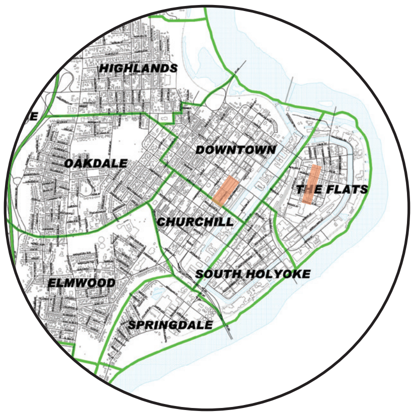
Downtown Holyoke's dense urban core, and vacant lots, a lack of canopy cover, and high percentage of impervious surfaces, coincides with a portion of Holyoke's population that experiences a disproportionate share of environmental burdens within the community. Environmental Justice Populations (EJPs) are defined by populations with less than $30,000 annual household income, greater than 25 percent minority population, or greater than 25 percent non-English speaking households (US Census Bureau). EJPs are concentrated within downtown Holyoke, while north and west Holyoke have no EJPs. Downtown Holyoke's population is majority low income and minority, with few native English speakers.

There is a denser environmental justice population in downtown Holyoke and more sparse open space. Access to open space has been linked to a higher level of physical activity, increased social interaction, improved mental health and decreased health care costs (Kathleen Wolf). Twenty to thirty percent of Holyoke's children have pediatric asthma, compared to a nationwide average of 10.6 percent. Car-centric cities with a lack of open space have been linked to childhood obesity, which can lead to serious health consequences such as diabetes and cardiovascular disease (U.S. EPA, Creating the community) .

By increasing open space in downtown Holyoke, the environmental justice population will benefit from increased access to green space, and increased tree canopy. This will decrease asthma rates, increase physical activity, mental health, and social interaction. These improvements could lessen the amount of disproportionate environmental burdens within the community and improve overall health.

"Race and class are extremely reliable indicators as to where one might find the good stuff, like parks and trees, and where one might find the bad stuff, like power plants and waste facilities." Majora Carter

SITE: EXISTING CONDITIONS



The following analyses are zoomed in to the focus areas of this project: Newton, High, and Center Streets. High and Newton street are located within the Downtown neighborhood while Center is further east, in The Flats neighborhood. These streets were chosen by the City of Holyoke to be redeveloped. They're eligible for federal redevelopment funding, have a lack of urban tree canopy, and are connected to the combined sewer system, making them good candidates for redevelopment into green streets.

NEWTON STREET

The focus area on Newton Street encompasses two blocks between Appleton and Cabot Streets. The northern block of Newton is a commercial area. The east side of this block is bordered by a large U-Haul storage facility and along the west side runs a large city owned lot that is currently functioning as a make shift parking lot. The southern residential block of Newton is lined by colorful row houses and a paved city owned vacant lot that also serves as an unofficial parking lot for residents. City owned alleyways run behind Newton Street, dividing it from High Street.

A vacant, city-owned lot stretches the length of the western side of Newton's commercial block.

Colorful row houses line the residential Newton block.

HIGH STREET

The focus area on High street includes one block running between Appleton and Essex Streets. The street is one-way, four lane, and heavily trafficked. Shops and restaurants line the east side of the street, interrupted by a collapsed building. This gated off vacant lot is city owned and connects High and Newton. The United Congressional Church stands prominently at the northern corner adjacent to large parking lots, spanning most of the western side of High. Remnants of trees dot the sidewalks, while three street trees remain.

The United Congregational Church stands prominently on the northwestern corner of the High Street block.

High Street is lined with beautiful, historic, brick architecture.

CENTER STREET

The focus area on Center Street stretches three blocks between Ely and Samosett Streets. It lies within a residential neighborhood of fenced-in duplexes with predominantly impervious front yards. This one-way, 35' wide street has parking on both sides. Sidewalks connect residents to a community park, a ball-field, and a community garden. They are inconsistent, with areas that have little delineation between road and sidewalk.

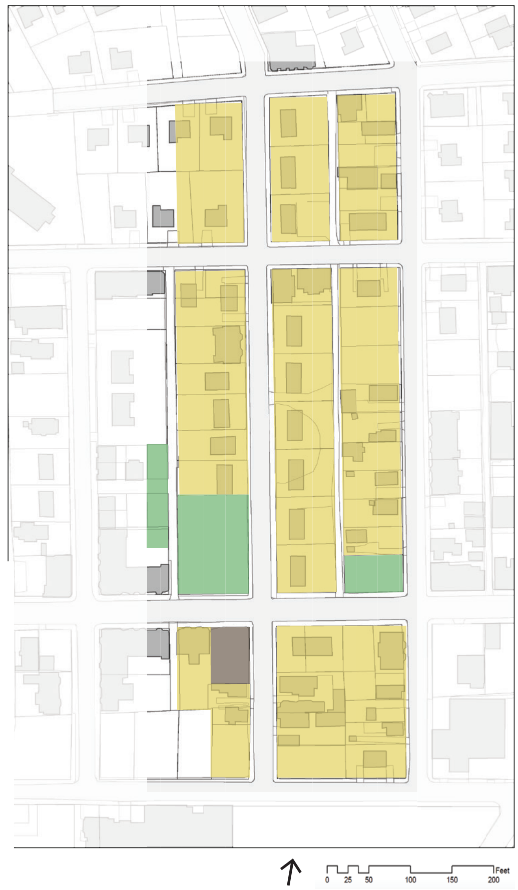
Many front yards are paved over, leaving little permeable space.

Center Street is lined with fenced in duplex housing with a sprinkling of historic, brick buildings.

SITE: LAND USE

HIGH & NEWTON

CENTER



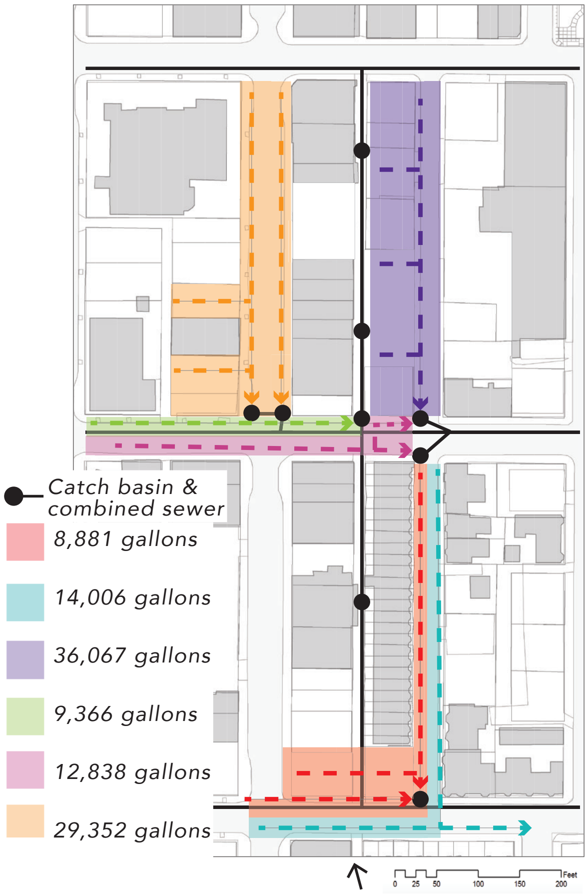
Newton and High Streets include a mix of commercial, residential, and vacant lots. The focus area encompassing Newton and High includes two churches, shops, restaurants, and is close to the public library. Newton backs up to the Boys and Girls Club and Girls Inc, two integral parts of the local youth community. This area also contains seven vacant city lots. A vacant lot on High Street is nestled between two eateries: Old San Juan bakery and Deli and Salsarengue. These streets are heavily trafficked by cars and people. There is a vacant lot on High that connects to expansive open space, currently used for parking.

Center Street is located within a residential neighborhood in The Flats neighborhood of Holyoke. The Flats are characterized by prominent structures built in the mid-19th century and proximity to the canal system. Center Street is lined predominantly with fenced duplexes and a few old brick mill houses. A school and large park meet the end of Center Street, Piña Park and a community garden border Center Street, while a health center and another park enclose the focus area on the north end of Center Street. Commercial buildings are on the periphery of the neighborhood area.

These neighborhoods have space to incorporate pedestrian and bike traffic infrastructure to connect common destinations. The vacant lot serves as an opportunity for storm water catchment and recreation. Parking lots could serve dual function by adding storm water catchments and parking while simultaneously adding beauty to the neighborhood. These sites could be a mix of cultural, civic and recreational spaces, where people can live work and play within walking distance of each other.

SITE: DRAINAGE

HIGH & NEWTON



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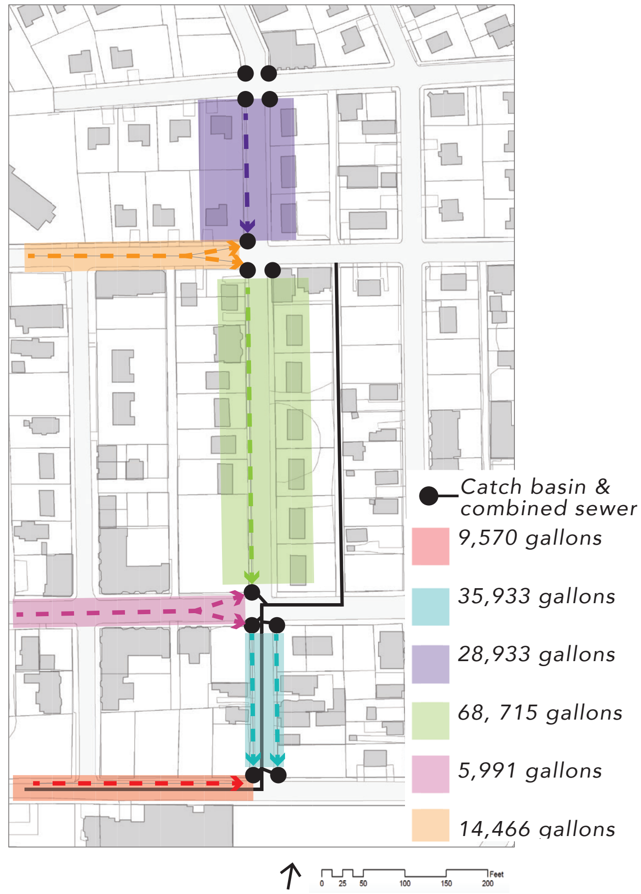


High, Newton, and Center Streets are connected to the outdated combined sewer system. The nine catch basins on Newton and High empty directly into the combined sewer main that runs through the alley behind Newton and High and west to east down perpendicular roads. No storm drain line runs directly under Newton or High and no catch basins exist on the streets themselves, rather, catch basins are concentrated at intersections and in the alley that runs between High and Newton Streets. Water in this focus area is generally running off north to south down Newton and High, and west to east down perpendicular roads. Since roads are crowned, and curbs border roads, water generally sheets to either side of the street before flowing towards a catch basin.

Center Street has a mix of separated sewer mains and combined sewer mains. The combined sewer mains flow east to empty into the stormwater treatment plant or the Connecticut River during wet weather events. Twelve catch basins are situated along Center street at intersections. Water flows to these catch basins, draining north to south down Center Street and west to east down perpendicular streets. Two blocks of Center Street have a separate sewer pipe, and one block is still on combined sewer. Catch basins in the lower portion of Center Street, between E. Dwight and Samosett, connect to the combined sewer system. Separate systems decrease the chance for overflow, though it is still crucial to filter the pollutants and slow peak flow.

During a one-inch rainfall event, Newton and High Streets drain about 110,000 gallons of stormwater, and Center Street drains about 164,000 gallons. A one-inch rain fall is known as the “first flush” and is the initial surface runoff of a rainstorm, which contains the highest concentration of pollutants compared to the rest of the storm (EPA).

Green infrastructure placed along these streets, can retrofit existing catch basins to filter stormwater before entering the storm drains.

SITE: TREE INVENTORY

HIGH & NEWTON

CENTER

Center, High, and Newton Streets are located in a portion of Holyoke that significantly lacks tree canopy cover.

High Street has remnants of six former tree grates, which are now paved over. There are three trees in grates that remain; a linden, a silver maple, and a honeylocust. One tree on High Street has outgrown its grate and its growth has been significantly altered due to suffocation from the grate. The trees on High Street are mostly deciduous and vary in age and size. The church adds a significant amount of green space to the focus area, with older deciduous trees in front, and a coniferous tree bordering High Street.

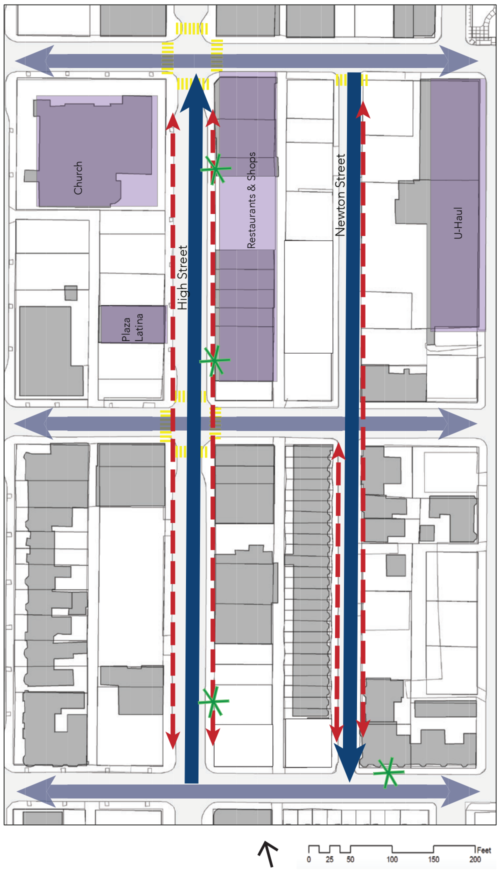
Newton Street has no street trees, and one block lacks trees on adjacent lots. There is only one pocket of trees, located in the residential area of Newton bordering a parking lot, intertwined with fencing, about 25' tall. These trees are mostly boxelder volunteers.

Center Street has no street trees but there are twenty-nine trees adjacent to the street on residential and city properties. The block between Mosher and E. Dwight have no trees on the eastern side of the street. The trees on this street vary in size and age, and are only deciduous.

There is a significant lack of tree canopy in all three of these focus areas. More street trees could add shade, clean air, decrease the heat island effect from the significant amount of impervious surface here, and beautify the street. Street trees and other green infrastructure could slow, filter and store runoff. Beautifying the street could soften the harsh urban land forms, and offer a place for neighbors to interact.

SITE: CIRCULATION

HIGH & NEWTON



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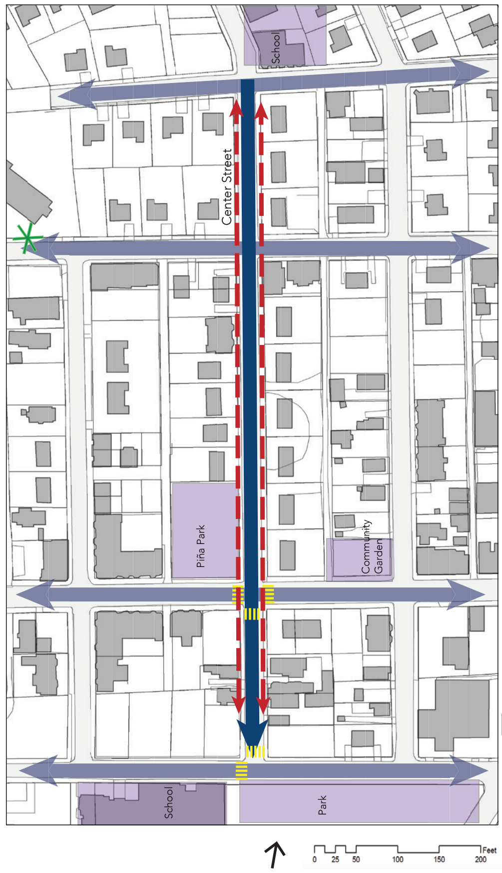
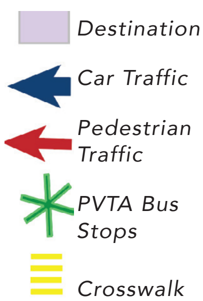




High Street is trafficked by cars and people going to shops, restaurants, and church. High Street is dominated by cars, with two lanes of traffic and parking on both sides and contains no bike lanes. Large sidewalks and crosswalks at intersections accommodate pedestrians. There are two bus stops on this block of High Street, at the intersection with Essex and Appleton.

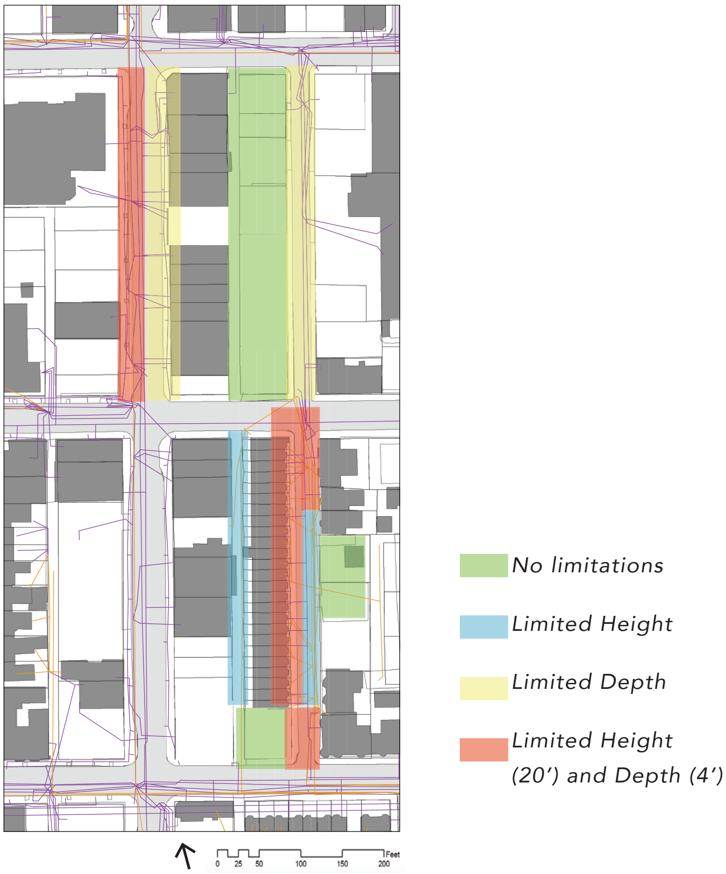
Newton Street is comprised of a large U-Haul store, vacant city-owned lots and a residential block. Newton Street's inconsistent sidewalks on the eastern side of the road, in conjunction with parking cars on the eastern side, create a safety concern for pedestrians. An alleyway behind Newton appears to function as a back entrance to homes and a lane for trash pick up.

Center Street, a residential neighborhood, is a one way street with parking on both sides. Sidewalks are present, but some lack a curb, creating a safety concern for pedestrians. The schools, health center and parks along Center Street are assets in this neighborhood and are frequently trafficked by cars and pedestrians alike.

Creating a pedestrian friendly road to connect the residents to the various destinations would support people's ability to live, work and play in the neighborhood.

SITE: UTILITIES

HIGH & NEWTON



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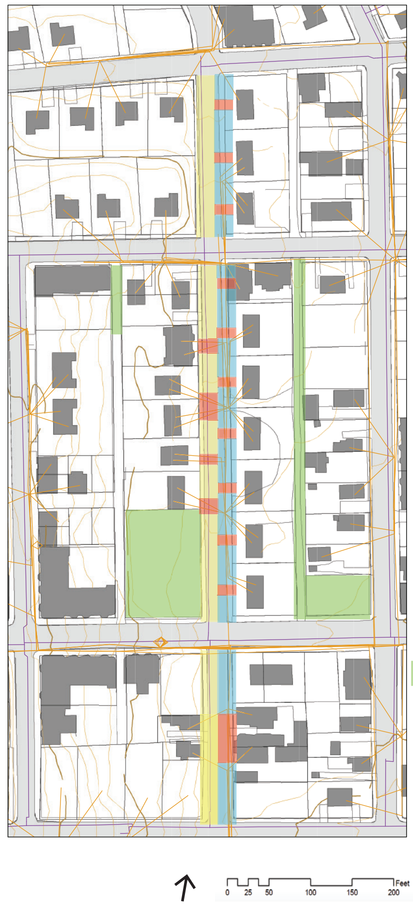


The utilities on site create height and depth restrictions for placement of green infrastructure. Underground utilities are located roughly four feet underground. To prevent damage to pipes from heavy weight, or tree roots, the type of tool placed above underground utilities must be carefully chosen.

Overhead wires limit tree growth to roughly twenty feet. Trees can be placed below, as long as they are species that have a maximum height of less than twenty feet.

High Street and one block of Newton are limited on their northwest sides by both height and depth restrictions. A large portion of the vacant lot that connects Newton and High has no limitations imposed by utilities. Lastly, a small portion of the lower block of Newton is limited on the southeast side of the road by utilities.

On Center Street, overhead utilities are primarily on the east side, and underground on the west, with isolated areas that have both restrictions shown on the map in red, and no restrictions in green.

Existing overhead and underground utilities can interfere with placement of green infrastructure siting. The location of utilities has implications for the selection and placement of green infrastructure, and each green infrastructure tool contributes to the human use and experience of the streetscape in a different way.

The Holyoke canal walk

TOOLBOX

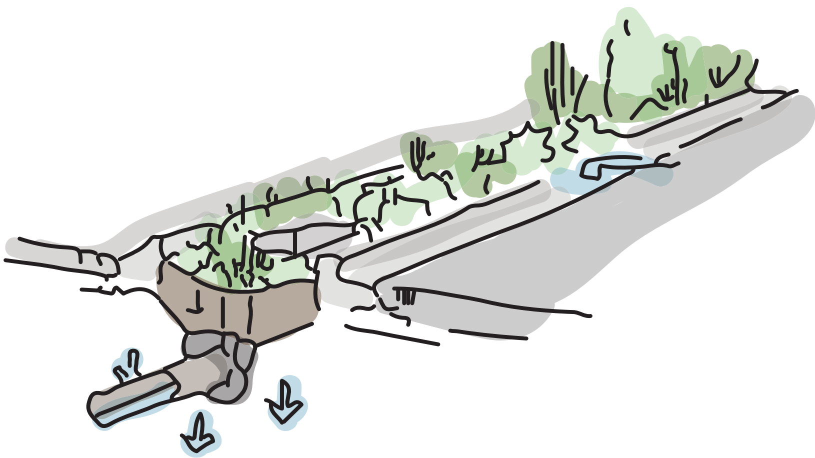
WHAT IS THE TOOLBOX?

The toolbox is a selection of tools and strategies to achieve the goals of this Green Streets document: water quality improvement, peak flow reduction, and improved pedestrian and cyclist movement and use. Section 1 outlines a number of green infrastructure tools for stormwater management. Section 2 includes streetscape design tools for improving safety and increased usability. The tools chosen are a compilation of the most appropriate engineered systems for Holyoke based on current research and on the 2014 *Green Streets Guidebook* by Michele Carlson, Willa Caughey, and Nelle Ward.

The table below outlines the conditions necessary for each green infrastructure tool. The tools are introduced individually throughout this section, but the following chart explains where and under what conditions each tool can be applied.

CONDITIONS NECESSARY

GREEN INFRASTRUCTURE TOOL	SLOPE	DIMENSIONS	SPACING	OVERHEAD UTILITY CONFLICT	UNDERGROUND UTILITY CONFLICT
Bioswale	1-6%	Min 2′ wide; min 3.5′ deep without tree; 5′ deep with tree	Recommended space between trees of 20′	Trees should be less than 15′	Yes
Green roof	1-57.7%	Dependent on roof	N/A	No	No
Open tree trench	<5%	Min 2.5′ wide; min 3′ deep	Recommended space between trees of 20′	Trees should be less than 15′	No
Permeable pavers	N/A	N/A	N/A	No	Yes
Rain garden	<1%	Size and shape is dependent on volume of water to be caught; 18″ depth to allow for 6-12″ of pooling water	At least 20′ from structures with foundations	No	Yes
Tree box filters	<5%	5′ x 5′ x 5′ to 10′ x 10′ x 10′	Recommended space between trees of 20′	Trees should be less than 15′	Yes
Stormwater planter	<5%	Dependent	N/A	N/A	No
Rain barrel	N/A	Dependent	N/A	No	No



BIOSWALE

A linear vegetated depression that uses vegetation and soils to infiltrate and filter stormwater as it moves through the depression. Strategic placement between sidewalks and roads can separate pedestrian and car traffic.

Benefits:
- Can be incorporated into urban settings
- Creates habitat for wildlife
- Reduces standing water that can attract mosquitoes
- Removal of multiple pollutants

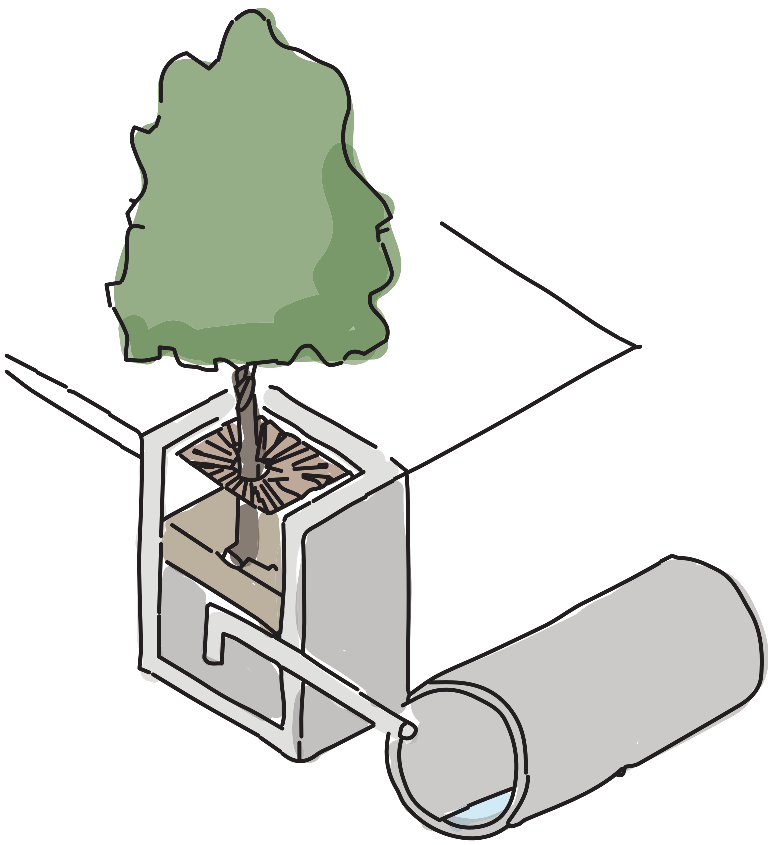
Considerations:
- Vegetative maintenance required
- Conflicts with below-ground utilities

TREE BOX FILTER

Tree box filters are contained systems filled with soil and planted with trees or shrubs. They are placed along roads and capture road runoff through catchment basin inlets. The soil and trees filter pollutants and overflow enters a perforated pipe at the bottom of the box connected to the stormwater system. Tree boxes require little space and are often used to retrofit existing storm drain infrastructure in urban areas.

Benefits:
- Smaller footprint required
- May be used as pretreatment device
- Ideal for redevelopment or in urban settings

Considerations:
- Vegetative maintenance required
- Treats small volumes
- Treats small tributary areas



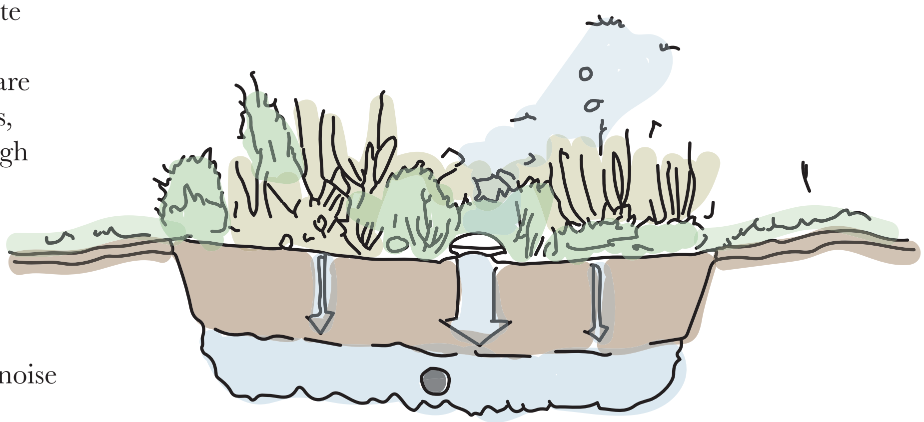
Sources cited: "Stormwater Best Management Practices: Guidance Document." by Geosyntec Consultants

RAIN GARDEN

A rain garden is a shallow, vegetated depression used to capture, pool, and gradually infiltrate stormwater runoff within 72 hours. These devices, if designed and installed properly, are capable of removing nitrogen, phosphorous, metals, hydrocarbons, and pathogens through filtration, sedimentation, plant uptake, and biological processes.

Benefits:
- Can provide groundwater recharge
- Removal of multiple pollutants
- Provides shade, windbreaks, and absorb noise
- Reduce urban heat island effect

Considerations:
- Requires frequent and consistent plant maintenance
- Not suited for large drainage areas
- Not suitable where groundwater is within 6 feet of ground surface

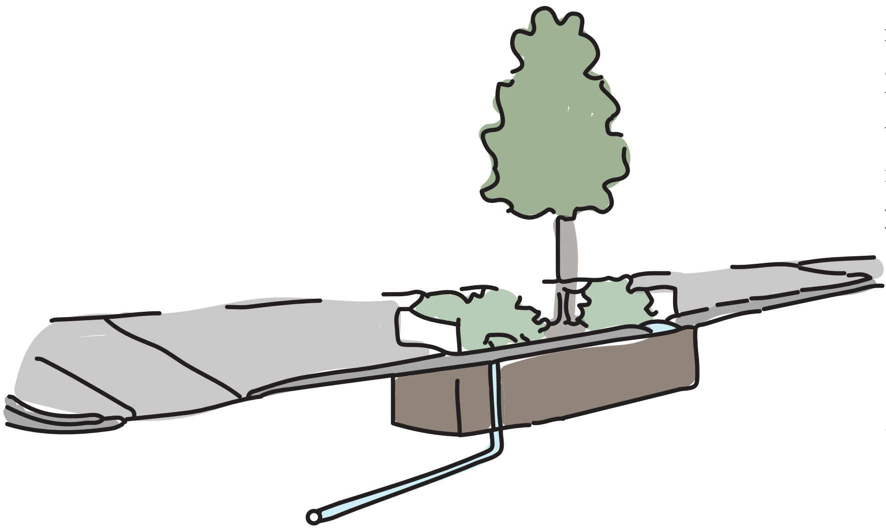


OPEN TREE TRENCH

A tree trench is a linear system of one or multiple trees connected by soil, filled with vegetation. Because of their compact nature, tree trenches are suited to small urban spaces and are often incorporated into sidewalks. They are bound by vertical walls, and have either an open or closed bottom. Stormwater flows into tree trenches via inlets such as curb cuts and slowly infiltrate into the soil before entering the stormwater system via an overflow pipe. Trenches can separate pedestrian or bicycle traffic and car traffic. These differ from bioswales because they are more often used in urban road settings.

Benefits:
- Can fit into compact, urban settings
- Reduces the volume and rate of runoff
- Filters multiple pollutants
- Can be sized according to volume needing to be treated

Considerations:
- Vegetative maintenance required



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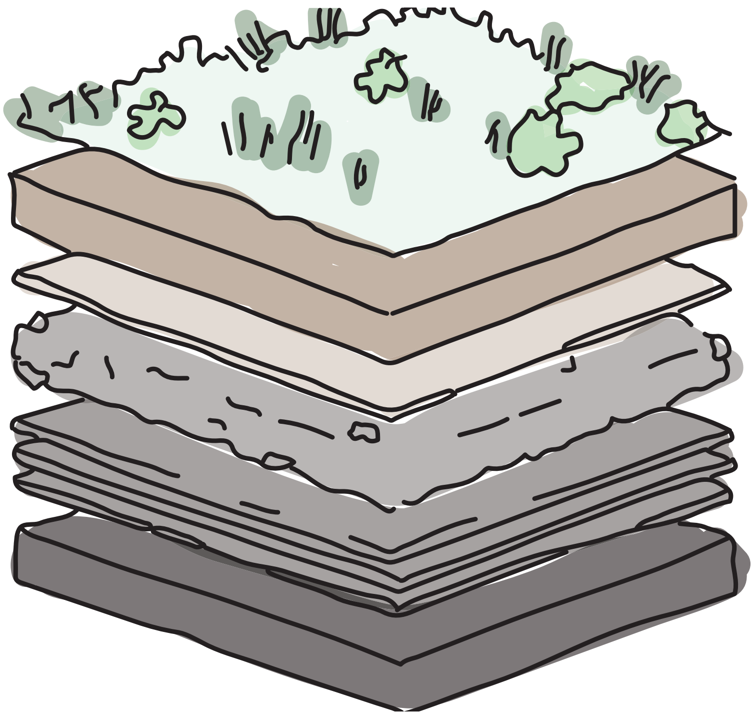


GREEN ROOF

Green roofs are placed on structurally sound roofs of varying pitch. They intercept and retain stormwater, slowly releasing excess. On conventional roofs, roof downspouts often drain into the street; green roofs intercept the water before it can enter the streetscape. Green roofs can be used on new construction of housing and commercial development as well as to retrofit structurally sound roofs.

Benefits:

- Reduce stormwater volume and flow rates
- Reduce heating/cooling cost of building
- Conserve space in highly urbanized areas

Considerations:

- If retrofit, requires additional structural analysis of building
- Does not increase groundwater recharge
- May require additional water for irrigation of plants

PERMEABLE PAVERS

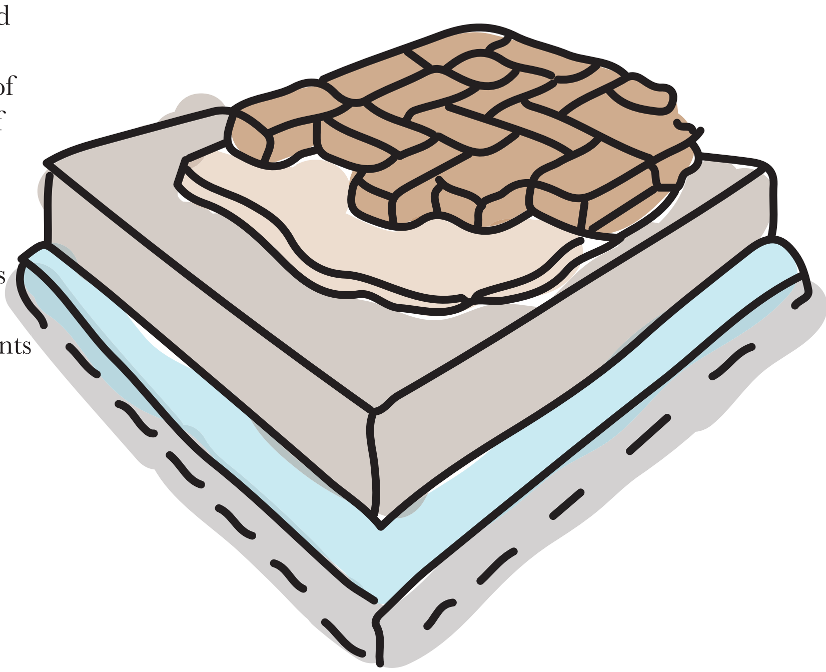
Permeable pavers are pavers laid on a layer of sand and gravel that allow runoff to flow through and infiltrate the ground below. The volume and type of traffic needs to be considered prior to the design of these systems. If a path needs to meet ADA standards, pavers must be selected accordingly.

Benefits:

- Reduces stormwater volume and peak flow rates
- Used as a retrofit in parking lots and sidewalks
- Reduce sediment and particulate bound pollutants

Considerations:

- No sanding in winter
- Compacting of underlying soils is common
- Limited removal of dissolved constituents when underdrains are used



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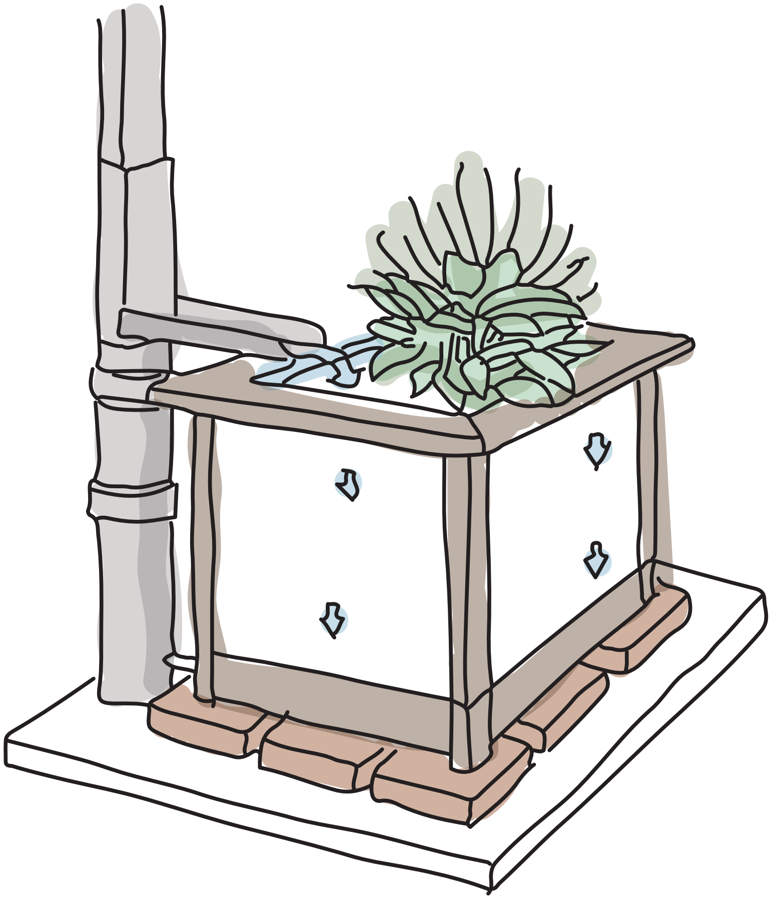


STORMWATER PLANTER BOX

Planter boxes are bioretention tools that are completely contained within an impermeable structure with an underdrain (they do not infiltrate into the ground). As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, and broken down by the soil and plants.

Benefits:
- Small footprint and simple design and construction
- Combines stormwater treatment with runoff conveyance

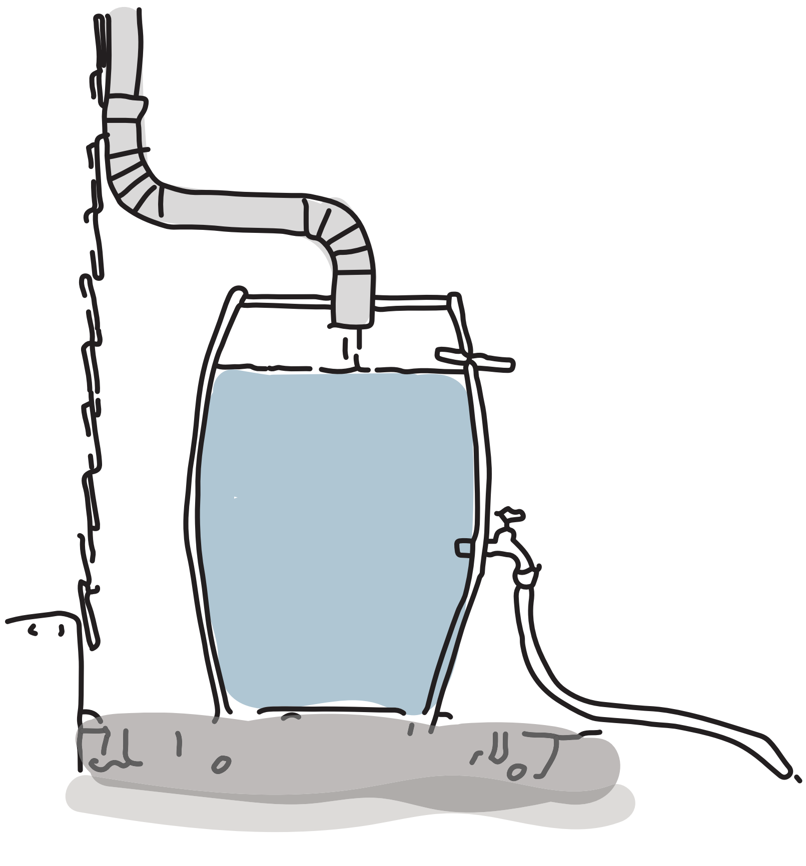
Considerations:
- Vegetative maintenance required
- Treats small volumes and contributing area
- Must be constructed with underdrain system to convey excess water

RAIN BARREL

Rain barrels capture roof runoff flowing from downspouts and allow water to be held and used later. They are an inexpensive way to capture and direct water and keep it from entering the stormwater system.

Benefits:
- Use for irrigation and non-potable uses to save money on water utility bill
- Reduce runoff volume entering stormwater conveyance system for small storms
- Simple design and construction
- Small footprint

Considerations:
- Provides habitat for mosquitoes if not properly sealed
- Seasonal use only - not viable in freezing temperatures



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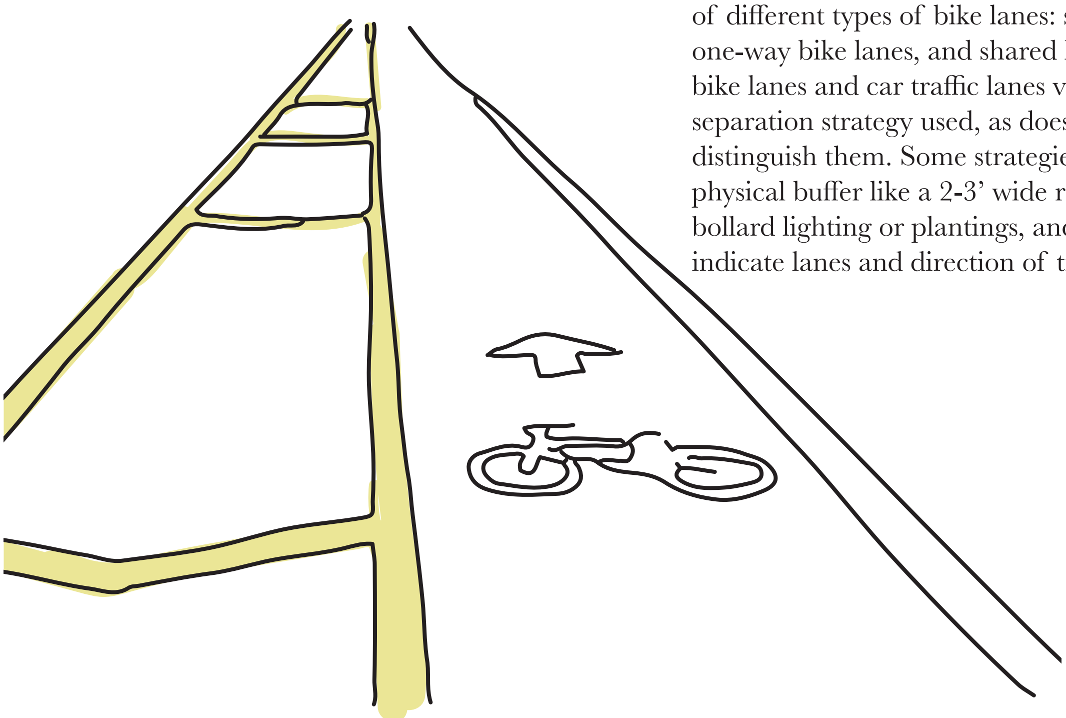
SECTION 2 PEDESTRIAN AND CYCLIST SAFETY

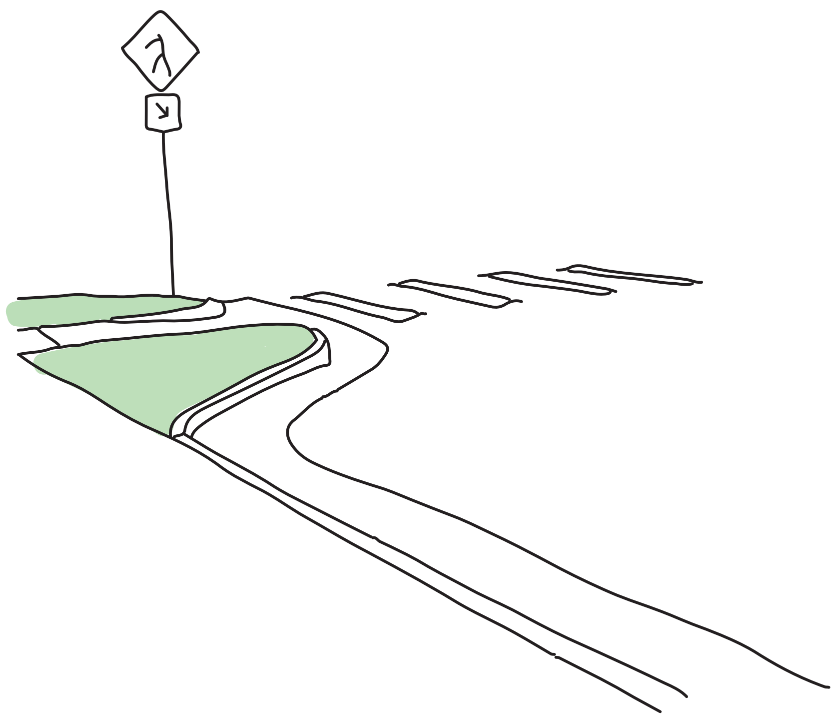
BIKE LANE



Bike lanes are dedicated lanes for cyclists. There are a number of different types of bike lanes: separated two-way bike lanes, one-way bike lanes, and shared lanes. The distance between bike lanes and car traffic lanes varies according to the separation strategy used, as does the symbology used to distinguish them. Some strategies for separation include a physical buffer like a 2-3' wide raised strip, barriers like bollard lighting or plantings, and painted lines and symbols to indicate lanes and direction of traffic.

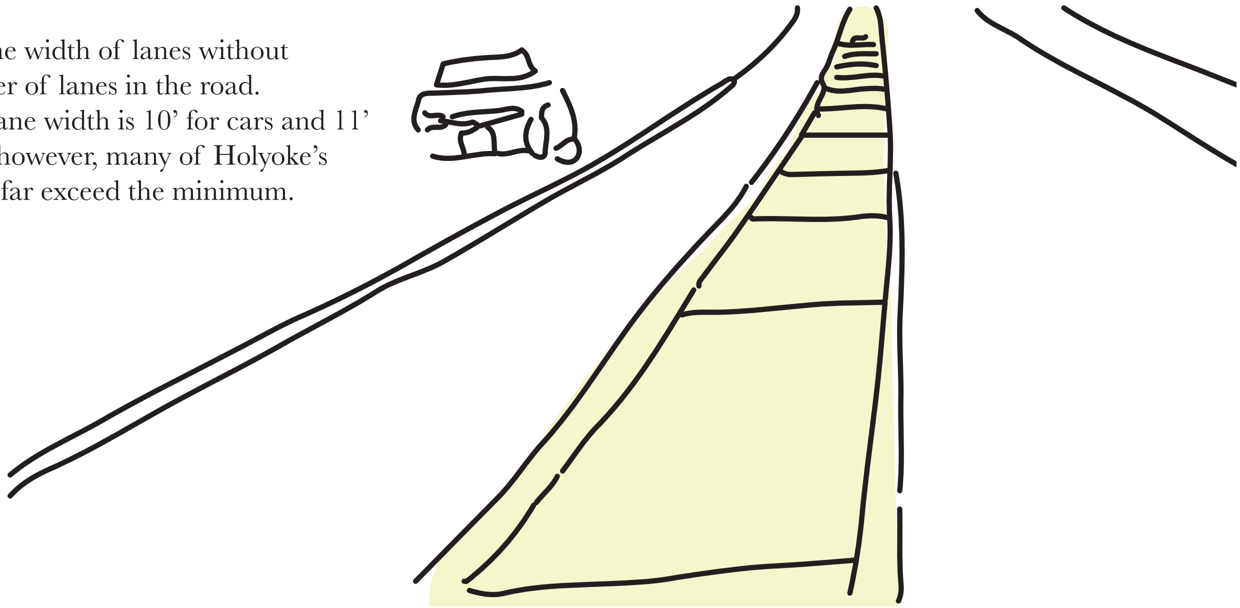
CURB BUMP-OUT

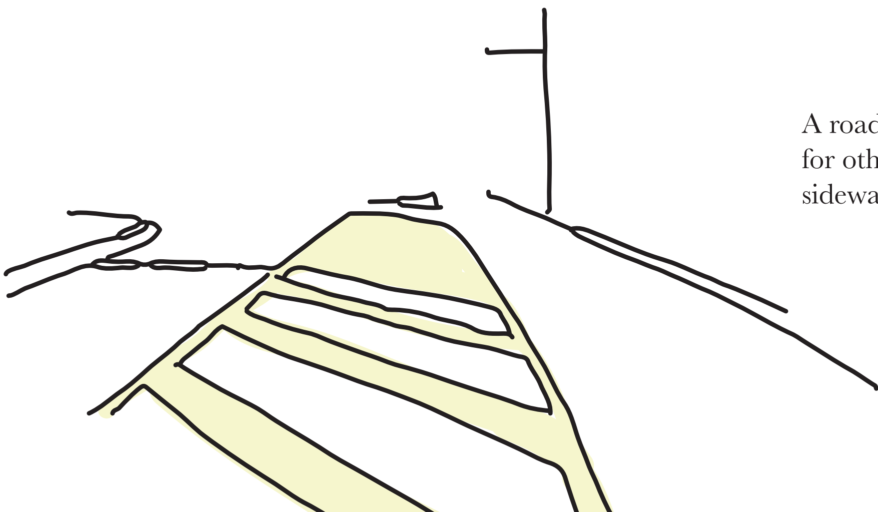
A curb bump-out is an extension of the sidewalk that narrows the roadway and provides additional space for pedestrians and, potentially, for green infrastructure. They decrease the crossing distance for pedestrians, but can also be used at bus stops as "bus bulbs" to increase efficiency of bus travel, and at intersections to increase pedestrian visibility. For bus travel, the bump outs eliminate the need for buses to pull in to a bus stop and allow them simply to stop at the bulb.



LANE DIET

A lane diet reduces the width of lanes without decreasing the number of lanes in the road. Standard minimum lane width is 10' for cars and 11' for trucks and buses; however, many of Holyoke's roads have lanes that far exceed the minimum.





ROAD DIET

A road diet removes vehicular lanes to make room for other uses such as bike lanes, green infrastructure, sidewalks, or parking.

All plants listed below are salt-tolerant, hardy, and suited to urban environments. They were selected from New York City's *Standards for Green Infrastructure* and from the Department of Conservation and Recreation's "Greening the Gateway Cities" tree list. A horticulturist or urban forester should be consulted for further plant recommendations.

Healthy, well established plants are necessary for effective green infrastructure. For this reason, a planting plan and maintenance schedule should be incorporated into an Operations & Maintenance Plan. Urban soil testing and amendment should also be considered prior to planting to create the best possible conditions for plants. Avoiding soil compaction during street reconstructions will also help plants survive and thrive, reducing replacement costs.

PLANT RECOMMENDATIONS

SCIENTIFIC NAME	COMMON NAME	HEIGHT & SPREAD	SUN NEEDS	BLOOM TIME & COLOR	MOISTURE TOLERANCE	NATIVE STATUS
Amelanchier canadensis	Serviceberry	15-25′; 15-25′	full sun to part shade	April/white	FAC	NATIVE
Carpinus caroliniana	Hornbeam	20-35′; 20-30′	part shade to full shade	insignificant	FAC	NATIVE
Cercis canadensis	Eastern Redbud	15-30′; 25-30′	full sun to part shade	April/pink	FACU	NATIVE
Celtic occidentalis	Hackberry	50-60′; 40-60′	full sun to part shade	insignificant	FACU	NATIVE
Gleditsia 'Skyline'	Honeylocust	40-80′; 30-60′	full sun	insignificant	FAC	NON-NATIVE
Liquidambar styraciflua	Sweetgum	60-75′; 40-50′	full sun	insignificant	FAC	NATIVE
Ostrya virginiana	Hophornbeam	25-40′; 20-30′	full sun to part shade	insignificant	FAC	NATIVE
Prunus sargentii	Sargent Cherry	20-30′; 20-30′	full sun to part shade	April/pink	FACU	NON-NATIVE
Ulmus parvifolia	Lace Bark Elm	40-75′; 35-45′	full sun	insignificant	UPL	NON-NATIVE
Quercus palustris	Pin Oak	50-70′; 40-60′	full sun	insignificant	FACW	NATIVE

Serviceberry

Pin Oak

Eastern Redbud

Hophornbeam

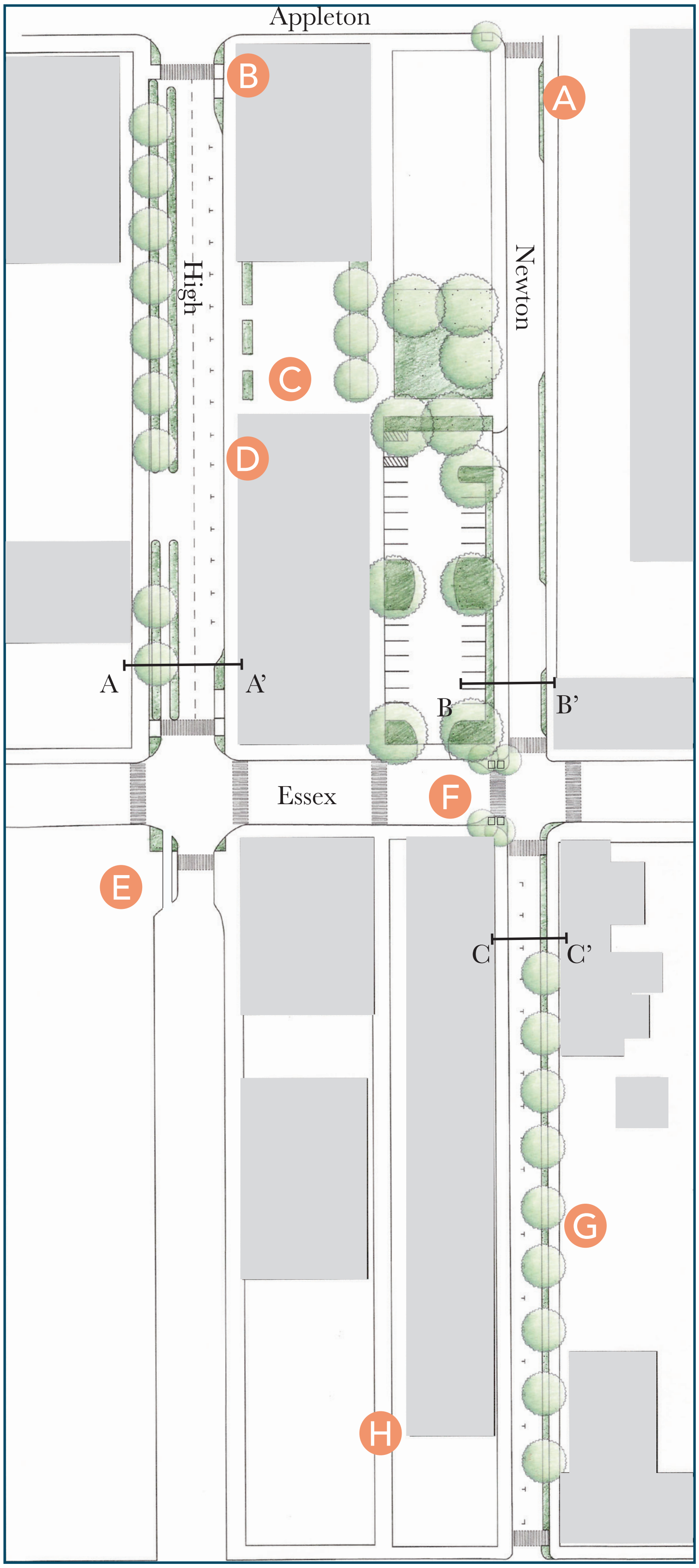
MAINTENANCE CHART

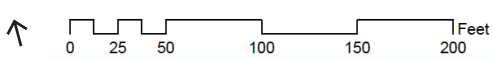
STORMWATER BMP	MAINTENANCE
Bioswale, Rain garden, Open tree trench	• Inspect pretreatment devices and bioretention areas regularly for sediment build-up, structural damage and standing water • Inspect for erosion and re-mulch void areas on a seasonal basis (or as necessary) ; evaluate options for preventing erosion • Remove and replace dead vegetation in spring and fall • Remove invasive species to prevent from spreading within bioretention area • Do not store snow in bioretention areas • Periodically observe function under wet weather conditions to ensure proper function; adjust to address issues as needed
Planter box	• Remove accumulated fine sediments, dead leaves and trash to restore surface permeability • Weed and prune back excess plant growth that interferes with operation • Periodically observe function under wet weather condition to ensure proper function; adjust to address issues as needed
Tree box filter	• Annually check tree • Rake media surface at least twice a year to maintain permeability • Replace media when tree is replaced (every 5 to 10 years) to restore permeability and pollutant removal efficiency • Remove accumulated trash and debris to restore permeability
Porous pavement	• Power wash and vacuum sweep area to prevent clogging • Do not sand or salt during the winter • Use snowplows with rollers on bottom to prevent damage to porous pavement • Periodically observe function under wet weather conditions to determine decrease in performance and clogging
Rain barrel	• Inspect seal of rain barrel to prevent mosquito breeding and leaks • Clean gutters and roof catchment to prevent clogging of downspouts • Inspect overflow pipe to provide proper draining of system during large events • If above ground, drain system before winter to prevent cracking of tank
Green roof	• If retrofit, requires additional structural analysis of building • May require additional water for irrigation of plants and regular weeding until plants are well established

Sources cited: "Stormwater Best Management Practices: Guidance Document." by Geosyntec Consultants

STREET DESIGNS

NEWTON & HIGH





A **3x3x3 tree trenches** line the commercial section of Newton, avoiding underground utilities.

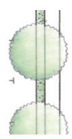
B **The existing bus bulb** on the northern end of High Street is turned into a bio-swale and bus shelter, easily tying back into the stormwater system on Appleton.

C **A pocket park** provides a space for gathering, playing, eating, and community engagement. A walkway through the park connects High and Newton. Stepped seating and moveable tables and chairs allow the community to make the space their own. (Pg. 24) (See detail p.46)

D **High Street is narrowed** to three lanes; one parking, one bus lane, and one car lane. The parking on the western side of the street is turned in to a protected bike lane, flanked by two 5-foot-wide tree trenches. By moving the tree trenches into the street, utilities along the western sidewalk are avoided. On-street parallel parking is along the east side of the street.

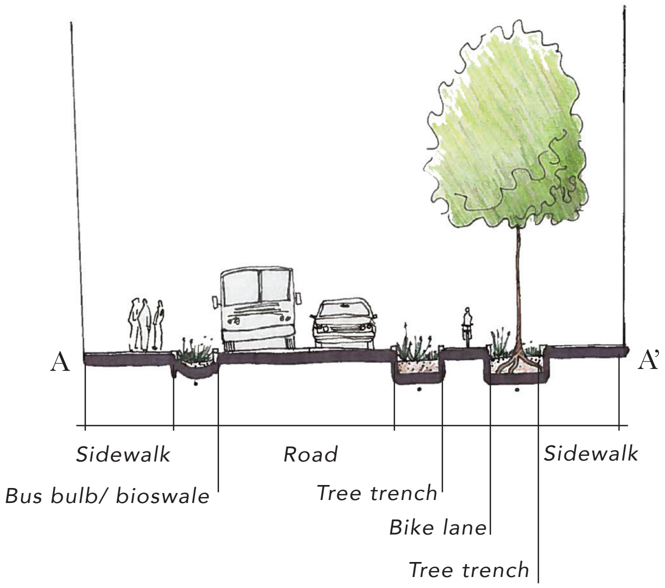
E **Bump-outs** necessary for narrowing traffic into High Street also serve as bioswales, filtering and slowing road runoff entering through curb cuts.

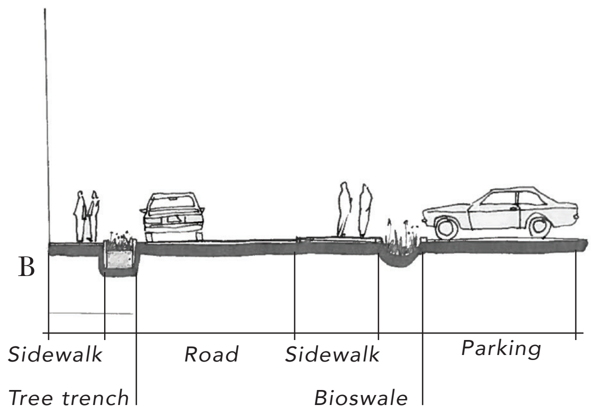
F **4 6x6 foot tree box filters** are placed at the corner of Newton and Essex to retrofit existing catch basins. Bump outs are required to incorporate these into the sidewalk as the width of the sidewalk could not, as it exists, accommodate the tree box. filters.

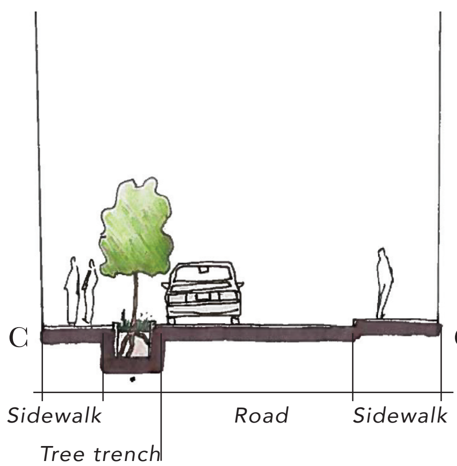


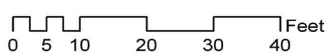
G **A 3 foot tree trench** runs along the east side of the residential Newton block. Overhead utilities require that trees are limited in height. Driving lanes are narrowed but both parking and driving lane remain.

H **The alley** that runs between Newton and High becomes a pedestrian way, paved with permeable pavers which will infiltrate the rain runoff that is currently being drained into a catch basin. The alley crosses the street and provides a path to the pocket park on High. This space could also be used by businesses on High Street for outdoor eating.









SUMMARY

- 36 trees added
- 21,510 square feet (0.5 acre) of impervious surface removed
- 488,070 gallons of runoff potentially filtered/slowed
- 5 cross walks added
- 14,730 square feet of pedestrian only area added

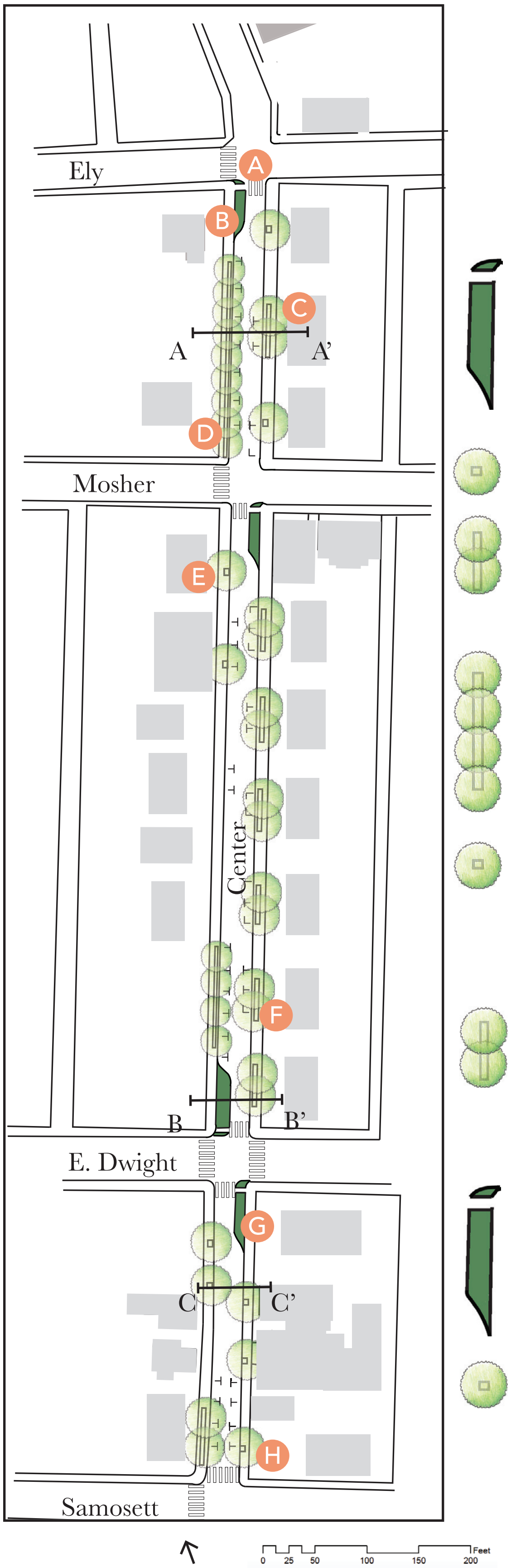
GOALS

- Increased opportunities for walking and biking
- Safer conditions for cyclists and pedestrians
- Decreased peak volume during rainfall events
- Increased urban tree canopy
- Increased access to open space and opportunities for recreation
- Lower rates of pollutants in stormwater
- Beautified streetscape

CONSIDERATIONS

- Narrowing of High Street between Appleton and Essex would need to extend beyond this focus block. There will also need to be a public input process for implementation of the narrowing.
- In order for the bike lane and tree trench on High street to work with current traffic flow, the intersection of High and Essex will need to be narrowed to funnel traffic and bicycles. For this reason, a curb bump-out has been added on the west side of High just south of the Essex Street intersection, just outside the focus area.
- In order to prioritize pedestrian safety and circulation, the parking lot on Newton Street has been designed to be accessible from Newton and Essex but not High Street. This decision was based on the pocket park design and the goal of prioritizing the human use of this space.

CENTER



A Center street is **narrowed** to 30' wide, maintaining one-way traffic with parking on both sides. The west sidewalk was increased to 10' wide, obtaining the extra feet from the road diet. This allows both sidewalks to be 5' wide, with 5' of extra space to place tree box filters, and other green infrastructure.

B **Curb bump-outs** alternate between east and west sides of the street, at intersections of Center. This method slows traffic entering the neighborhoods, but maintains consistency with driving lanes. This serves as a bioswale, it is 555 sq. ft. and catches all of the runoff from west side of Ely, from the crown to the south.

C **Two tree box filters** are placed on the west side of street, which adequately filter the 1/2-acre focus area. **A tree trench** with two trees 20' apart, supplements the tree box filters by reducing peak flow in this sub-basin area. A tree trench also separates pedestrians from cars.

D **A tree trench** along the west side of the street, is 3'x 137' with 9 trees, every 20' apart. It reduces peak flow and filters runoff from the crown of the road to the west. This bioswale separates pedestrians from cars.

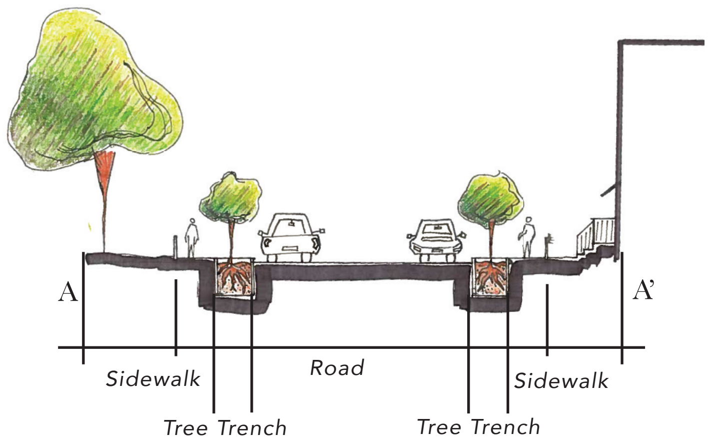
E **Two tree box filters,** adequately filter 1/2-acre focus area, a tree trench, that is roughly 300 sq. ft. with 4 trees, slows and filters stormwater runoff from the crown of the street to the west.

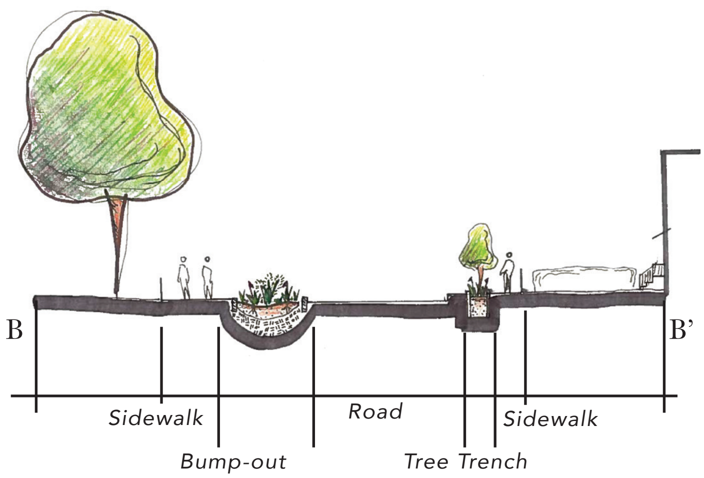
F **Enclosed tree trenches** run along the east side of Center. Each bioswale is 720sq. ft. with two trees per area. They filter and slow a little over half the stormwater runoff on the east side of the street. They are connected under driveways via culverts.

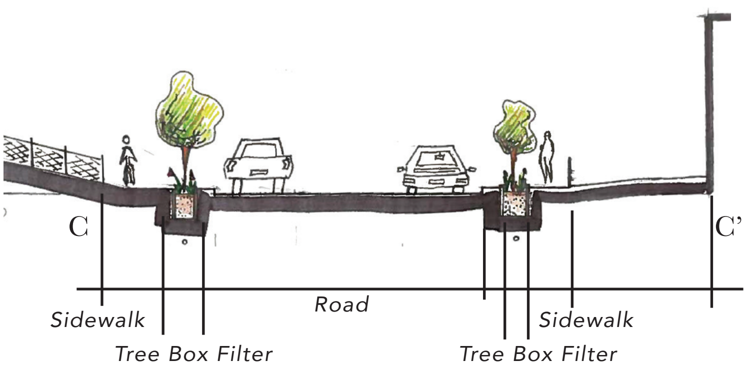
G **Curb bump outs**, slow traffic and serve as bioswales, both roughly 500 sq. ft. slowing and filtering runoff, while slowing traffic.

H **Five tree box filters** adequately filter, in addition to a 150 sq. ft tree trench, filters this 6 acre focus area. They are connected via piping that connect back to the stormdrains at the intersection of Samosett and Center

All trees on the east side must be species that are 20' or less.







SUMMARY

- 38 trees added
- 8,233 square foot of impervious surface removed
- 246,100 gallons of runoff potentially filtered/slowed
- 7 cross walks added
- 750 square feet of pedestrian only area added

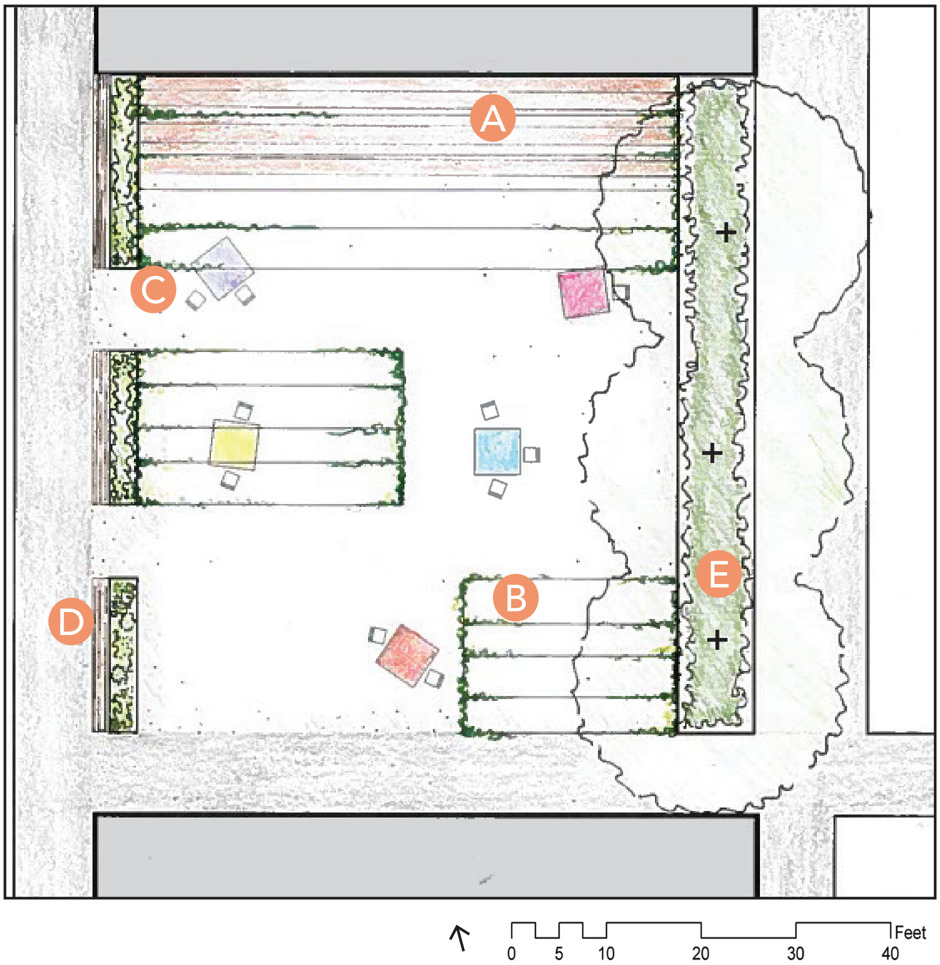
GOALS

- Increased opportunities for walking
- Safer conditions for pedestrians
- Decreased peak volume during rainfall events
- Increased urban tree canopy
- Increased access to open space and opportunities for recreation
- Lower rates of pollutants in stormwater
- Beautified streetscape

CONSIDERATIONS

- Engaging neighbors in intercepting and infiltrating stormwater with permeable pavers, stormwater planters, and tree plantings would decrease runoff from the predominantly impervious frontyards, and capture roof runoff on-site before entering the stormwater system.
- If there was only one lane for parking, there would be space to create a bike lane that could be separated by a tree trench or bioswale, protecting bikers and adding more stormwater management.
- To make sidewalks accessible to the street, tree trenches must be broken up by paths, and culverts can connect the flow of stormwater between these interruptions.

DETAIL DESIGN: HIGH STREET PEOPLES' PARK



A **Stepped seating** on the northern edge of the park to be used for lounging, people watching, or as audience seating for performances and projected movies.

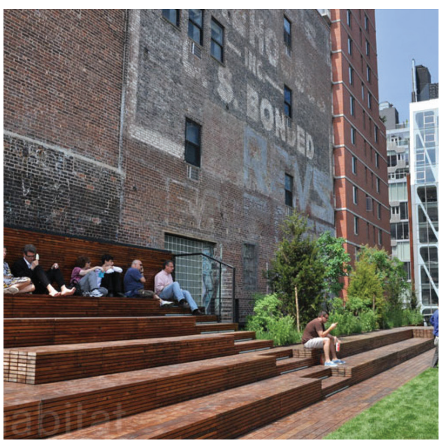
B **Cable trellises** systems overhead provide dappled shade and a sense of protection. Lighting could also be built into trellises for nighttime use of the space.

C **Moveable furniture**, potentially a community effort, allows the space to be adaptable to many uses.

D **Bench seating** on the western, sidewalk-facing edge allows people to use the space without entering and sit with a view of the bustling street. **Stormwater planters** along the western edge filter roof runoff or road runoff entering through runnels.

E **A bioswale with trees** along the eastern edge of the park, filters and slows roof runoff while providing shade and color.

The pocket park occupies a 7200 square foot lot between Newton and High Streets, previously the site of two commercial buildings. With pedestrian access from High, Newton, Essex, and Appleton Streets and parking directly adjacent on both sides, this space could be easily accessible by both pedestrians and drivers. As a central space, the pocket park could serve as a community hub for mixed uses. This space is designed to be adaptable and molds to the human uses that activate it. Some imagined uses include art installations, pop-up libraries and workshops, food carts and vendors, concerts, movie projections, farmers markets, and flea markets.

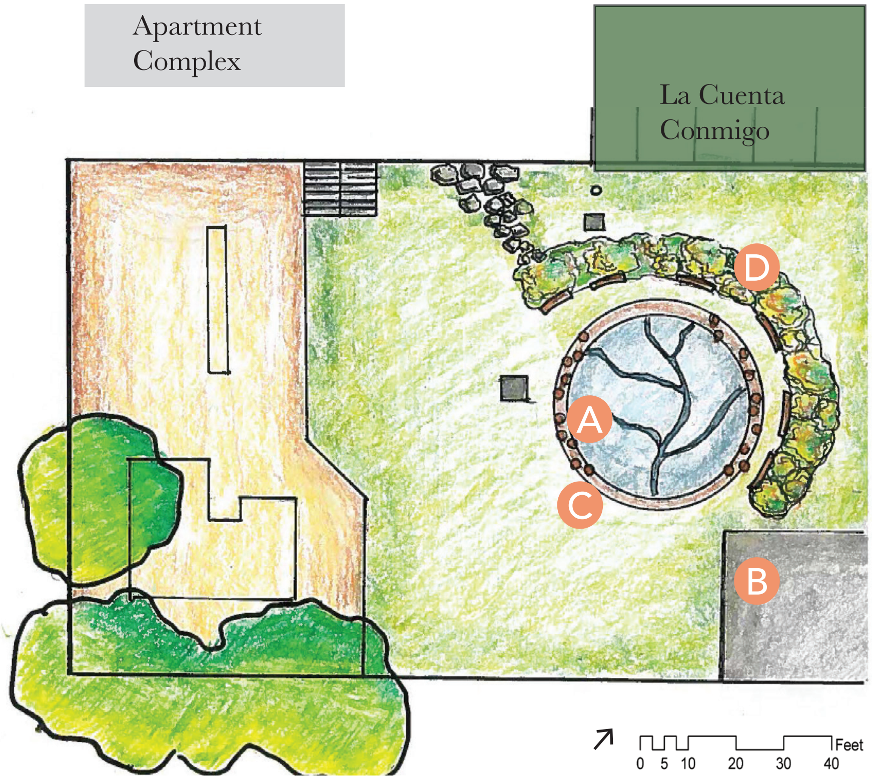


The High Line Park in New York City - stepped wooden seating

A cable trellis provides shade, beauty, and guides foot traffic

A pop-up park in Auckland, NZ with salvaged building materials for benches

DETAIL DESIGN: PIÑA PARK RAIN GARDEN



Pina Park occupies 30,000 square feet on the corner of Center and East Dwight Street. This bustling neighborhood park currently features a playground, a splash park and a paved four-square court. The park is bordered to the west by La Cuenta Conmigo, a community garden, and an apartment complex. The park is downhill from the complex, which sheds water from its five downspouts and impervious driveway. A raingarden surrounding the splash park filters and stores the runoff, recharging the ground water. It adds beauty, pollinator species, and can serve as an education opportunity. Signage can be used to explain the species and communities in the raingarden, and the watershed from the visual painted on the splash park.

A **Permeable paved splash park** retrofits the existing cement splash space. A runnel that moves water to the outer edge feeds into the rain garden, replicates the form of the Connecticut River.

B **Permeable pavers** replace existing cement place space. This will allow water to percolate

C **Stone edging with log stepping stones** border the splash park and have a dual purpose of a playful way to walk around the space, and slows water as it runs off the space towards the raingarden.

D **A raingarden** encompasses the splash park. Benches line the edge for easy viewing. The raingarden is a total of 1,700 square feet. The water flows east down from a building that contains five roof down spouts that empty onto an impervious driveway. A dry rock bed captures the water and leads it to the raingarden down hill. The raingarden can filter the water onsite and adds beautificaiton to the park.

A rain garden stores stormwater, adds beautification, create habitat and increases pollination

A channel that catches water and directs it to the raingarden.

A splash park, surrounded by gardens and a bench, a multi-functional space.

OTHER STRATEGIES

INCENTIVIZE BMPS

The City of Holyoke could further decrease the amount of stormwater entering the stormwater system by incentivizing residential use of green infrastructure solutions through offering rebates and tax credits. The nearby City of Northampton recently established a "Stormwater Enterprise Fund" that taxes property owners according to an estimated amount of runoff leaving their properties; the more impervious surfaces, the higher the tax ("Stormwater and Flood Control Utility" 280-6). The fund allows residents to reduce impervious surface or implement green infrastructure on their properties to decrease the tax. The city could encourage a number of green infrastructure types, keeping in mind that many residents are low income. Rain barrels could be encouraged as a cost effective strategy.

Stormwater fee discounts could also take an economic burden off the residents of downtown Holyoke. In Philadelphia, for example, apartment buildings face high stormwater bills due to high rates of water use while commercial parking lots, which generate significant runoff, often paid nothing because they did not use much water. Philadelphia's new stormwater fee system is based on impervious area as determined by geographic information systems (GIS). The EPA says, under the new system, "the polluter pays and properties can expect their charges to reflect their relative contribution to the problem," ("City of Philadelphia: Residential Stormwater Billing"). In Holyoke, this would mean that commercial, residential, industrial, and municipal areas that are highly impervious would pay a higher fee than lots with very little impervious surface. This might mean that the owner of a paved parking lot would pay a higher stormwater fee than a resident of Newton Street, in a small apartment lot with little impervious surface area.

Development incentives could also be effective for Holyoke as many vacant lots are slated to be developed. The City of Portland, Oregon used development incentives as part of the city's Grey to Green Initiative: the city's Ecoroof Incentive Program seeks to establish 43 acres of green roofs by offering property owners reimbursements of $5 per square foot of green roof. The roofs are expected to reduce runoff by 552,600 gallons an acre ("Ecoroof Incentive RSS").

Finally, awards and recognition programs are effective ways of motivating homeowners and expanding outreach. By certifying homeowners who are changing their behavior to be more watershed-friendly, they not only get the satisfaction of improving water quality but also get a stormwater utility discount. A great case study of this type of system is the Lake Champlain International BLUE certification in Vermont, which places "BLUE certified" signs in the front yards of certified homeowners. This strategy seeks to highlight residents who are managing their stormwater responsibly in the hopes that neighbors will feel inspired to become certified also.

MAINTAIN GREEN INFRASTRUCTURE BMPS

Maintenance will be crucial to ensure the success of BMPs installed. An official city Operation and Maintenance Plan would help ensure that O&M responsibilities are understood, undertaken by the appropriate group, and carried out to completion. Because each green infrastructure tool requires an individualized maintenance regime, education is important for all involved parties. City planners, policy makers, the Department of Public Works, laborers, and community volunteers should all be briefed and trained where appropriate on proper maintenance of the systems.

NPDES II requires public outreach and education as well as participation and involvement. For this reason, and to encourage a sense of ownership within the community, Holyoke citizens should be encouraged to contribute to maintenance of the green infrastructure. Community groups such as Nuestras Raices, are already working to address environmental issues. Nuestras Raices established a "Youth Watering Bike Brigade," a program developed to water the newly planted trees in Holyoke. Youth learn about tree physiology and maintenance, urban forestry, and canvassing, while acquiring valuable skills at their first job. Programs like this could expand to help maintain newly implemented green infrastructure solutions. In addition, new programs could be developed to support maintenance. Methods to encourage community engagement include:

- **Volunteer educators/speakers** could conduct workshops, encourage public participation, and staff special events to help train citizens looking to get involved;
- **Storm drain stenciling** could be a simple activity that concerned citizens, especially students, can do;
- **Community clean-ups** around storm drains and green infrastructure could help keep the BMPs functioning;
- **Citizen watch groups** can aid local enforcement authorities in the identification of polluters; and
- **"Adopt A Green Street" Programs** could encourage individuals and groups to keep drains free of debris and maintain plantings.

Brochures or fact sheets for general public and specific audiences could include:

- Alternative information sources, such as web sites,bumper stickers, refrigerator magnets, posters for bus and subway stops, and restaurant placemats;
- A library of educational materials for community and school groups;
- Volunteer citizen educators to staff a public education task force;
- Event participation with educational displays at home shows and community festivals;
- Educational programs for school-age children;
- Storm drain stenciling of storm drains with messages such as "Do Not Dump - Drains Directly to Lake;"
- Stormwater hotlines for information and for citizen reporting of polluters;
- Tributary signage to increase public awareness.

("Stormwater Phase II Final Rule Fact Sheet Series")

CREATE A MONITORING PLAN

Establish a system to monitor maintenance costs, survival rates of plants, dates of plant replacement, life spans of the green infrastructure, and performance standards. This will allow the city to adapt plans to species survival rates and ensure more effective green infrastructure systems. Recording costs will allow the city to assess facility cost savings due to green infrastructure. Local schools and universities could incorporate monitoring of water quality into their curriculum to create a task force that monitors the efficacy of the green infrastructure systems over time. The city should also establish goals for green infrastructure moving forward, including volume of water to be captured/filtered, a tree canopy goal, and impermeable surface reduction goal.

The Philadelphia Water Department's "Green City, Clean Waters" program has developed a monitoring system to evaluate performance and inform future designs. PWD conducts performance monitoring to collect water level data from green infrastructure systems and observes groundwater levels surrounding their systems. They also do performance testing, including infiltration and hydrant tests on their green infrastructure systems.

PHASE IN THE DESIGNS

Because Holyoke has a limited budget for the implementation of the Green Streets projects, we suggest phasing in parts of the design. Since the DPW has plans to redevelop the streets, the green streets designs should be implemented during the street reconstruction. Peripheral parts of the design, like the pocket park, parking lot, and proposed alley designs could be phased in as funds become available. This strategy of phasing also allows for changes in community needs and further research and engagement with the citizens of Holyoke and, specifically, the residents and business owners on Newton, High, and Center Streets. Phasing in the plans also presents and opportunity for the simultaneous development of green streets plans for adjacent streets.

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It's hard to imagine the vast tangle of pipes and infrastructure that run beneath the sidewalks where we walk and the roads we drive. It's also hard to imagine how water flows into these pipes, where it ends up, and what kinds of effects it has on our streams and rivers. This book seeks to explore these questions in Holyoke, Massachusetts where a combined sewer system and an expanse of paving has serious implications for the Connecticut River and beyond. The designs proposed in this book tackle the effects of polluted stormwater runoff and heavy rainfall events through green street designs for Newton, High, and Center Streets. These designs use green infrastructure to filter, slow, and retain water to reduce pollutants in stormwater and avoid sewage overflows into the river. This green streets plan is one of many efforts taken on by the City of Holyoke to encourage urban revitalization and aims to move the city towards a more sustainable and prosperous future.

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Graduate Program in Sustainable Landscape Planning + Design