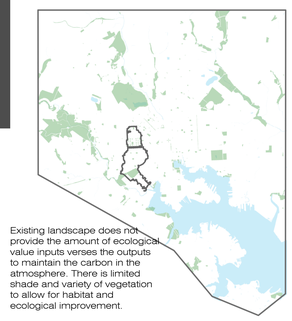
BES
Baltimore Ecosystem Study

Verticulture
Harlem Park Elementary Middle School

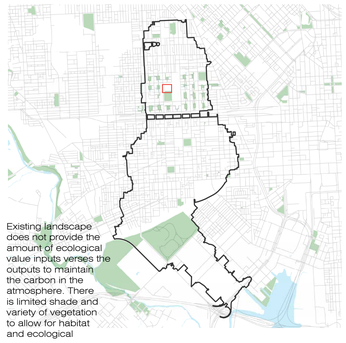
Concept
The concept of the design is to create an interactive landscape that improves upon the classroom material actively engage the community on how Baltimore's ecosystem can be improved and show them how they can make changes in their own community. With the use of modulars this can be achieve very rapidly and allow for people to learn how to build and maintain the modulars. Also, there is an understanding of how much change can be made. The module can be tested and allow for students and community members to actively participate in BES's and Baltimore's efforts to increase canopy and thus increase the amount of carbon sequestration from the atmosphere.

Baltimore Context



Existing landscape does not provide the amount of ecological value inputs verses the outputs to maintain the carbon in the atmosphere. There is limited shade and variety of vegetation to allow for habitat and ecological improvement.

Watershed 263 Context



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Existing Site Context

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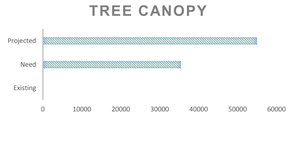
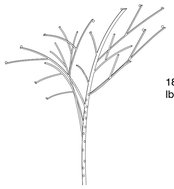
Precedent

Getty Museum rebar metal trellis' are the inspiration for the design. They provide a canopy like feel, with the ability for the vines to grow up the structure and out the top to create a colorful array of plant interest. The metal rebar provides support and color interest and during the off season they are a sculptural

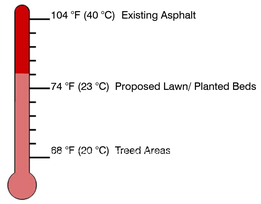
Ecological Change

1,113,150 gallons treated and avoided each year with Baltimore's average annual rain fall of 41 inches.

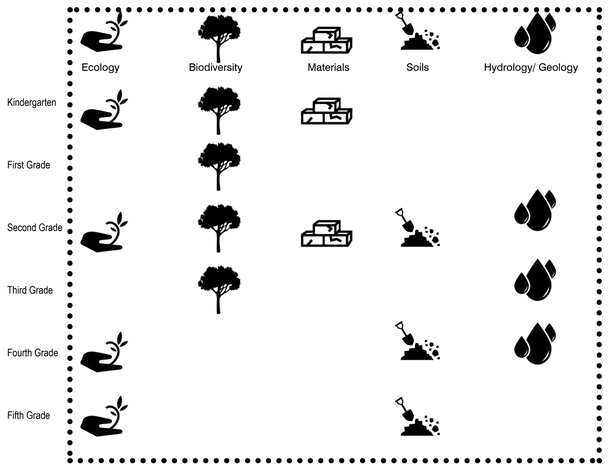




18200 square feet of tree vine coverage to provide 5550 lbs of carbon sequestration per year.



Experimental Learning



One of the drivers of the design was to understand the current curriculum of the Elementary school and understand the sequestering of learning. This would allow to build program, materials, layout and spatial quality of the space. The highlighted subjects are part of the Verticulture sculptures

BES GOALS MET

Educating the students and teachers and to take action on their own makes the knowledge stick to them long term and increases the likelihood that they carry that knowledge with them.

Soil and Air Quality Research by using modular tree sculptures that will allow for over 1300 pounds of carbon alone to be sequestered into the air from the vine trees.

PARKS AND PEOPLE GOALS MET

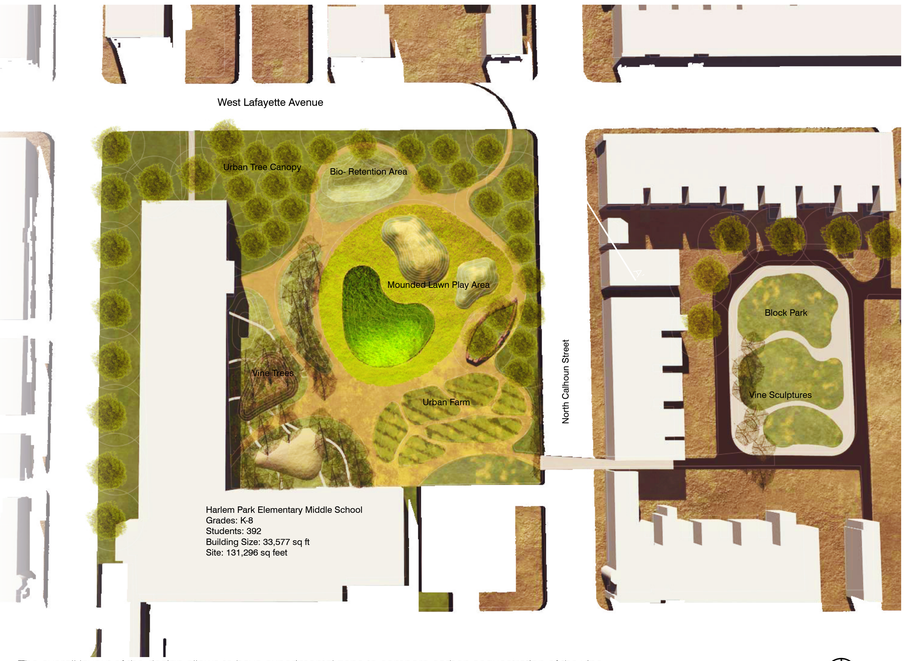
Educating the youth about the natural environment and molding them into the future urban planners and stewards.

One Park- Working towards reaching the goal of having the city by connecting to new sites with the modular tree to become a datum throughout the city.

View from Classroom to Landscape

Views from the classroom was important to consider because the students can have a great view to look and motivate them to learn about their surroundings. Better views outside has been proven to increase productivity and creativity. It can also serve as an aid in the classroom for teachers to point things out the window when they cannot go outside in the landscape.

Site Plan



The overall layout of the design allows to have experimental zone to compare carbon sequestration of the vine structures to treed areas. Also, it provides as a canopy for early in the development of the site as the trees will take several season in order to grow to their full potential. The measurements can be taken by the students and compared year to year to see the evolution of the design and its effectiveness. This is a relatively new concept and this can be linked to BES's research on how carbon sequestration through urban canopy can change the quality of the air. Also, the temperature changes between areas can be tested and compared to one another to monitor change from the existing conditions.

Aerial View of New Playground

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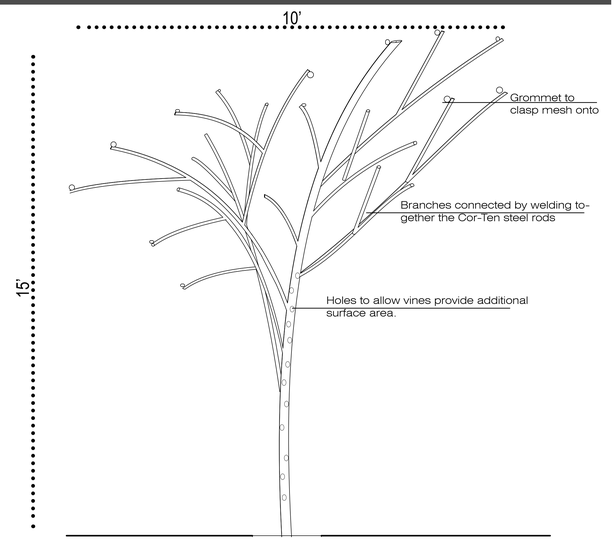
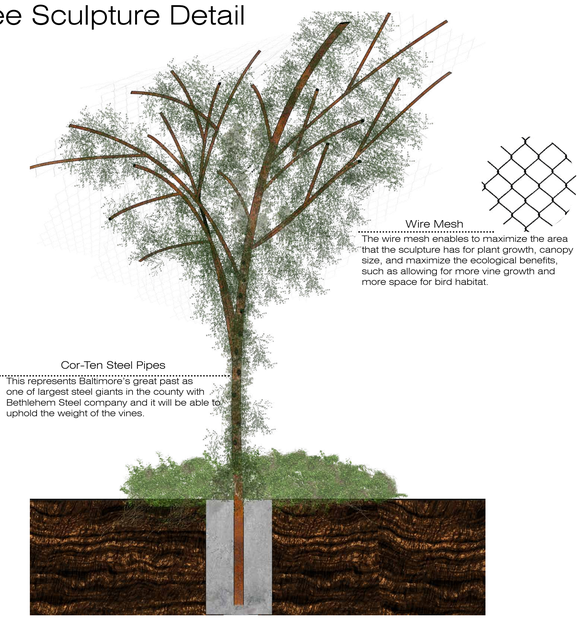


Tree Sculpture Detail



Cor-Ten Steel blends into the landscape and allows the vines to clasp onto the structure.

Vines uptake carbon 2 times the rate of trees and allow for canopy to provide habitat and shade relief.

Perforated Pipe: to filter unused water down into a cistern

Concrete Footer

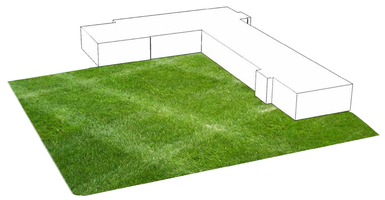
Compacted Soil

Coarse Aggregate

The section shows that structures are supported by concrete footings and the plantings are watered by a cistern system that allows for minimal maintenance and for research of temperature change, biodiversity, carbon sequestration and water quality.

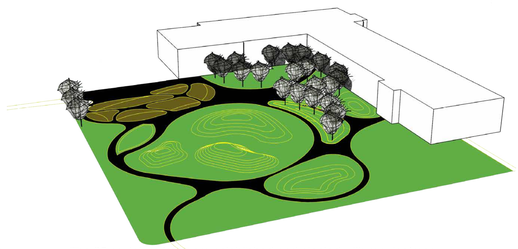
Change Over Time

Existing



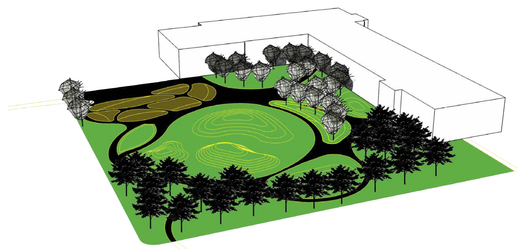
Lawn provides only minimal ecological impact because the amount of energy required for every acre of lawn adds carbon back into the atmosphere than what it uptakes because of mowing, watering and fertilizing.

Year 1



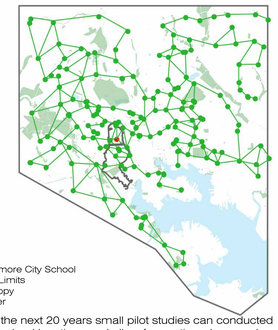
The 25 sculpture trees are established and planted with regular trees to begin the experiment on carbon sequestration and urban heat island effect. The vines are immediately able to grow and build a canopy of protection and uptake carbon at peak levels. Permeable pathways to allow students to have a variety of experiences and labs to work in. A centralized lawn to give people a place to relax and gather, while surrounded by test plot spaces for individual grades.

Year 10



The trees have grown to a mature height and now farther comparison year to year of vines and trees to their peak levels of carbon uptake.

Year 20



Over the course of the next 20 years small pilot studies can conducted at other of the 188 school locations and allow for continued research. Also an implementation of the modulars across the city and in vacant lots to boost the canopy and reap the benefits of better air quality, water quality, urban heat effect reduced and enhance the sense of place. This will help to unify Baltimore as one city, within One Park.

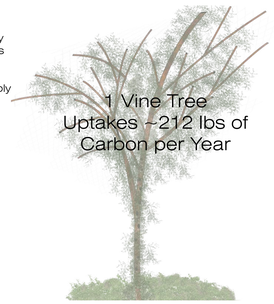
Section A-A' of School Yard

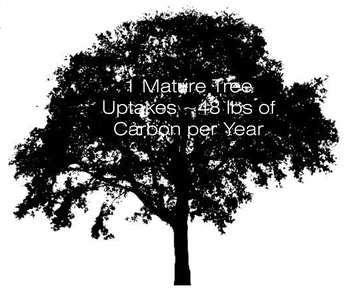
BES Baltimore Ecosystem Study

Verticulture

Harlem Park Elementary Middle School

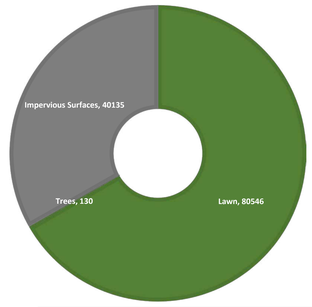
The Vine Structure modulars can be used throughout the city as a way to increase the overall tree canopy coverage and enhance the benefits of trees, but in these sculptural form. These can be tests on how different vines can be used and tested to see the difference between species and varieties. The trees can be maintained by the city by simply pruning every year. Vines have a better toleration to rough conditions than trees do and can be more reliable to last longer throughout the year.



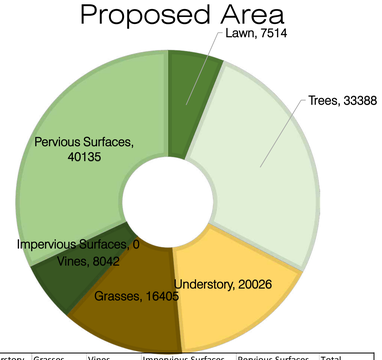


Nearly 4.5 trees would have to be planted in order to do as much as 1 Vine structure tree. Vines can grow for a longer portion of the year, which allows for more photosynthesis. Also, vines focus more energy on carbon uptake and producing more leaves where as trees focus more carbon uptake on building the hardwood, which happens in the younger years, but once mature it uptakes less carbon as it slows down its growth.

Existing Area



Proposed Area



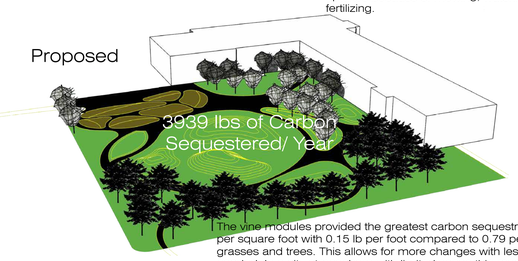
	Lawn	Trees	Understory	Grasses	Vines	Impervious Surfaces	Pervious Surfaces	Total
Existing	80546	130	0	0	0	40135	0	120811
Proposed	7514	33388	20026	16405	8042	0	40135	125510

Ecosystem Services

Existing

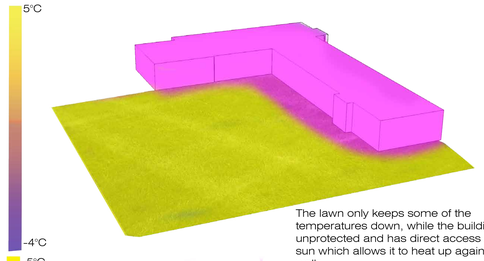
Lawn provides only minimal ecological impact because the amount of energy required for every acre of lawn adds carbon back into the atmosphere than what it uptakes because of mowing, watering and fertilizing.

Proposed

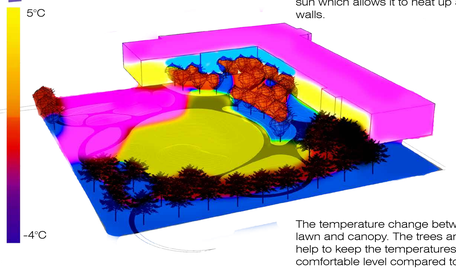


The vine modules provided the greatest carbon sequestration per square foot with 0.15 lb per foot compared to 0.79 per foot of grasses and trees. This allows for more changes with less room needed. In a city atmosphere with limited space this module can be utilized to maximize change for very little cost.

Temperature



The lawn only keeps some of the temperatures down, while the building is unprotected and has direct access to the sun which allows it to heat up against the walls.



The temperature change between building, lawn and canopy. The trees and lawn help to keep the temperatures at a more comfortable level compared to just lawn.

Habitat

Turdus migratorius

Cardellina canadensis

Icterus galbula

Sialia sialis

Because of the increase in canopy and the year round support it will allow a place for birds to inhabit during the winter and summer months. It will provide as a place of refuge and a place for food.

Ecological Calculations

Average canopy radius of 15 ft= 72 trees per acre	X	48 lbs. sequestered per tree	=	3456 lbs per acre of tree canopy (0.079lbs/ sq ft/ year)
1 Acre of Lawn 920 lbs of Carbon/ year	X	482 lbs/ acre/ year due to mowing, watering, and fertilizer	=	Sequesters only 438 lbs of carbon per year (0.01 lbs/ sq ft/ year)
Vines take in on average of 2 times the carbon as mature trees	X	6912lbs/43560 sq ft	=	1 sq ft of vines provides 0.15 lbs of carbon per year

Planting List

Lonicera sempervirens
Coral Honeysuckle
Semi- evergreen
Grows: 20 ft.
Color: Red

Calystegia sepium
Hedge Bindweed
Deciduous
Grows: 20 ft.
Color: White

Celastrus scandens
Bittersweet
Deciduous
Grows: 30 ft.
Color: Green

Choosing the plant pallet was important because all of these vines met the criteria of being native to Maryland and they could bring a diverse set of birds, insects and other living organisms to help diversify the landscape. This helps to build habitat and food sources for them and give them a place to rest.

Campis radicans
Trumpet Creeper
Deciduous
Grows: 30 ft.
Color: Red

Clematis virginiana
Woodbine
Deciduous
Grows: 20 ft.
Color: White

Cynanchum laeve
Climbing Milkweed
Deciduous
Grows: 20 ft.
Color: White

Vision of Play Area

Harlem Park Elementary Middle School

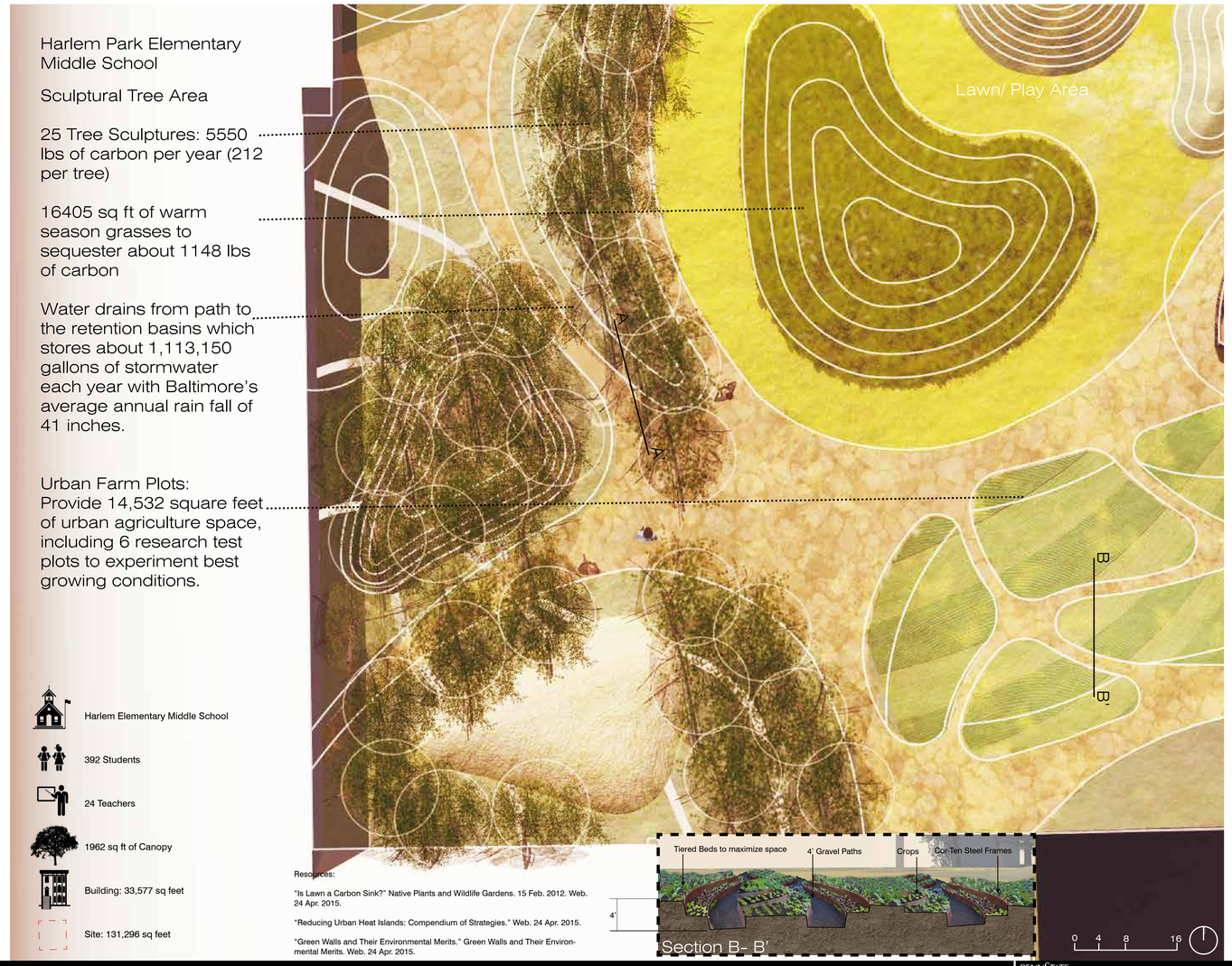
Sculptural Tree Area

25 Tree Sculptures: 5550 lbs of carbon per year (212 per tree)

16405 sq ft of warm season grasses to sequester about 1148 lbs of carbon

Water drains from path to the retention basins which stores about 1,113,150 gallons of stormwater each year with Baltimore's average annual rain fall of 41 inches.

Urban Farm Plots: Provide 14,532 square feet of urban agriculture space, including 6 research test plots to experiment best growing conditions.



Harlem Elementary Middle School

392 Students

24 Teachers

1962 sq ft of Canopy

Building: 33,577 sq feet

Site: 131,296 sq feet

Resources:

"Is Lawn a Carbon Sink?" Native Plants and Wildlife Gardens. 15 Feb. 2012. Web. 24 Apr. 2015.

"Reducing Urban Heat Islands: Compendium of Strategies." Web. 24 Apr. 2015.

"Green Walls and Their Environmental Merits." Green Walls and Their Environmental Merits. Web. 24 Apr. 2015.