

Celebrating Stormwater Alternative Management Practices





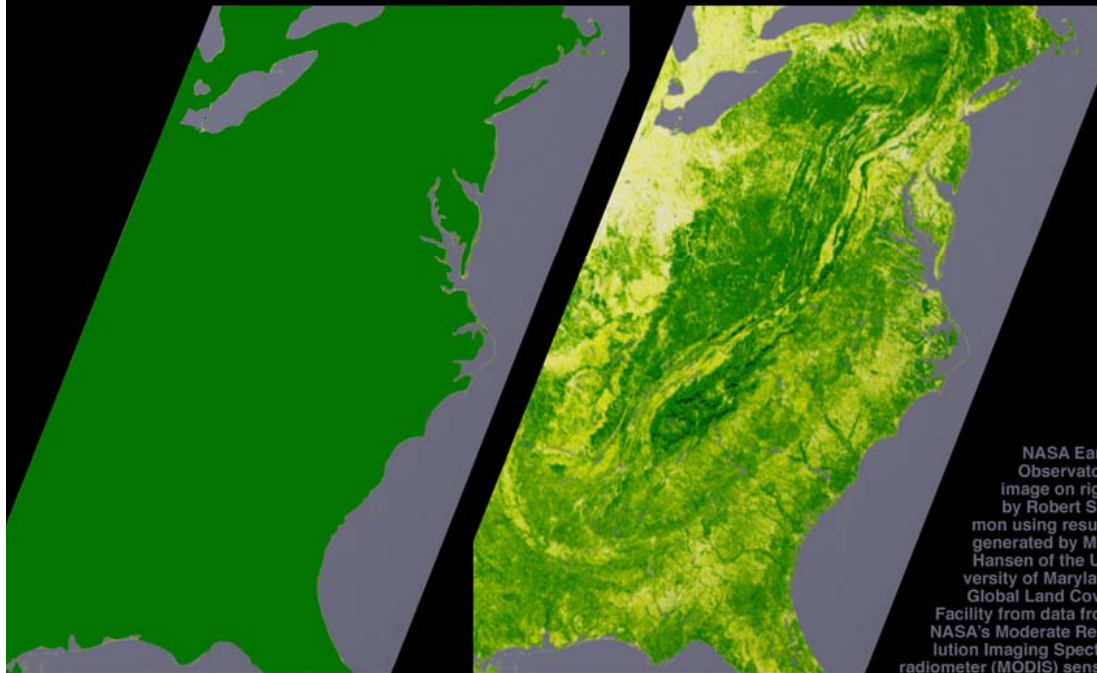
The Way Things Worked

How we altered the Way Things Worked

Case Studies: Creating Rich Habitats

It wants to be a forest

99% of North America was covered by forest from the Atlantic shoreline to the prairies of the Great Plains.
Today only fragments remain.



Pre-European settlement

Present

NASA Earth Observatory image on right by Robert Simon using results generated by Matt Hansen of the University of Maryland Global Land Cover Facility from data from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) sensor.



<http://earthobservatory.nasa.gov> 14 October 2003



Ecological management vs. managing it to death...

Cherokee Park, Louisville, Kentucky



1909



1999

Iroquois Park

Louisville, Kentucky



1900



1999

It looked like everywhere and nowhere all at once . . .



Oregon high desert



Sitka, Alaska



Anchorage, Alaska



Tennessee mountains

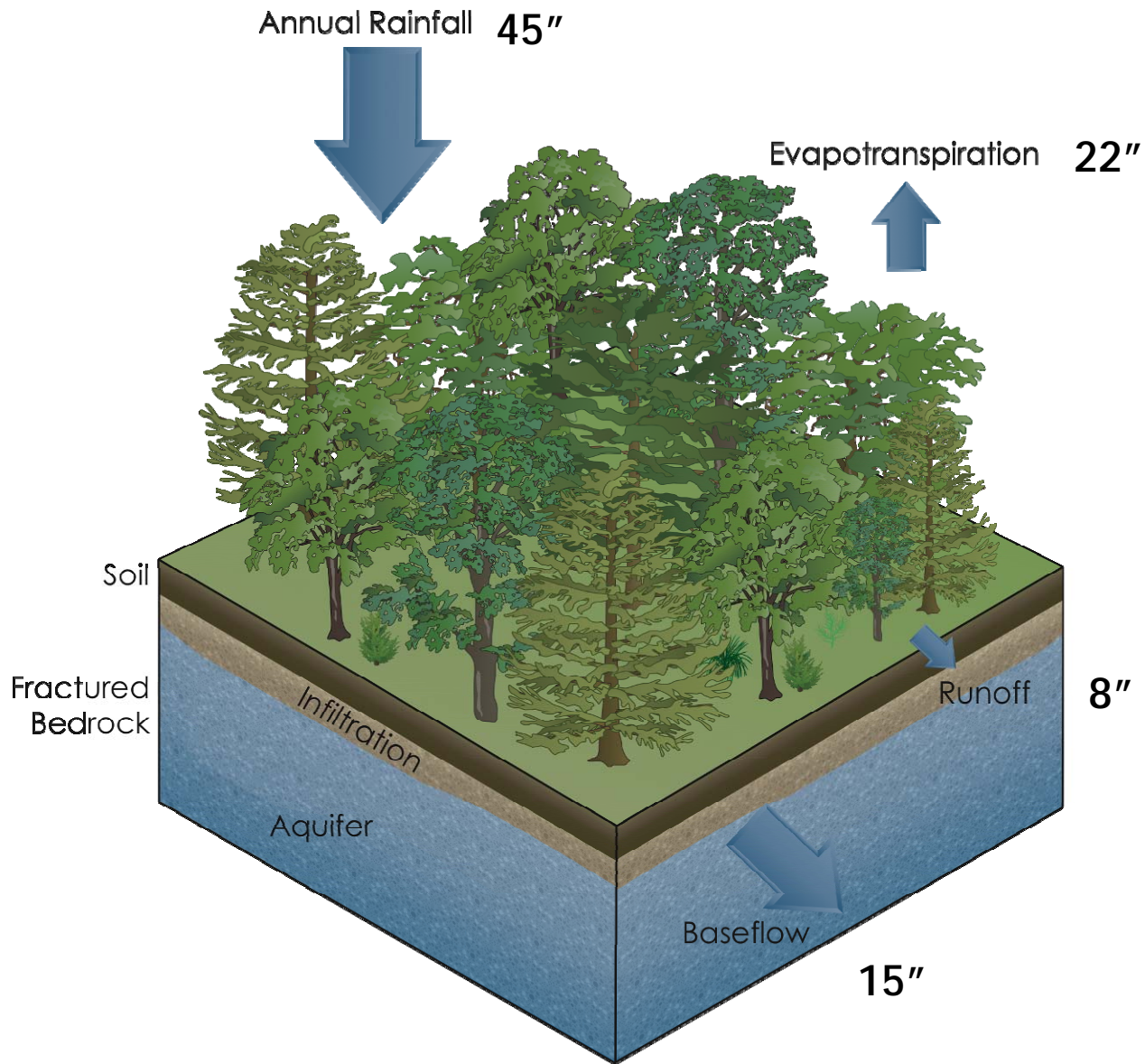


IHM Front Lawn



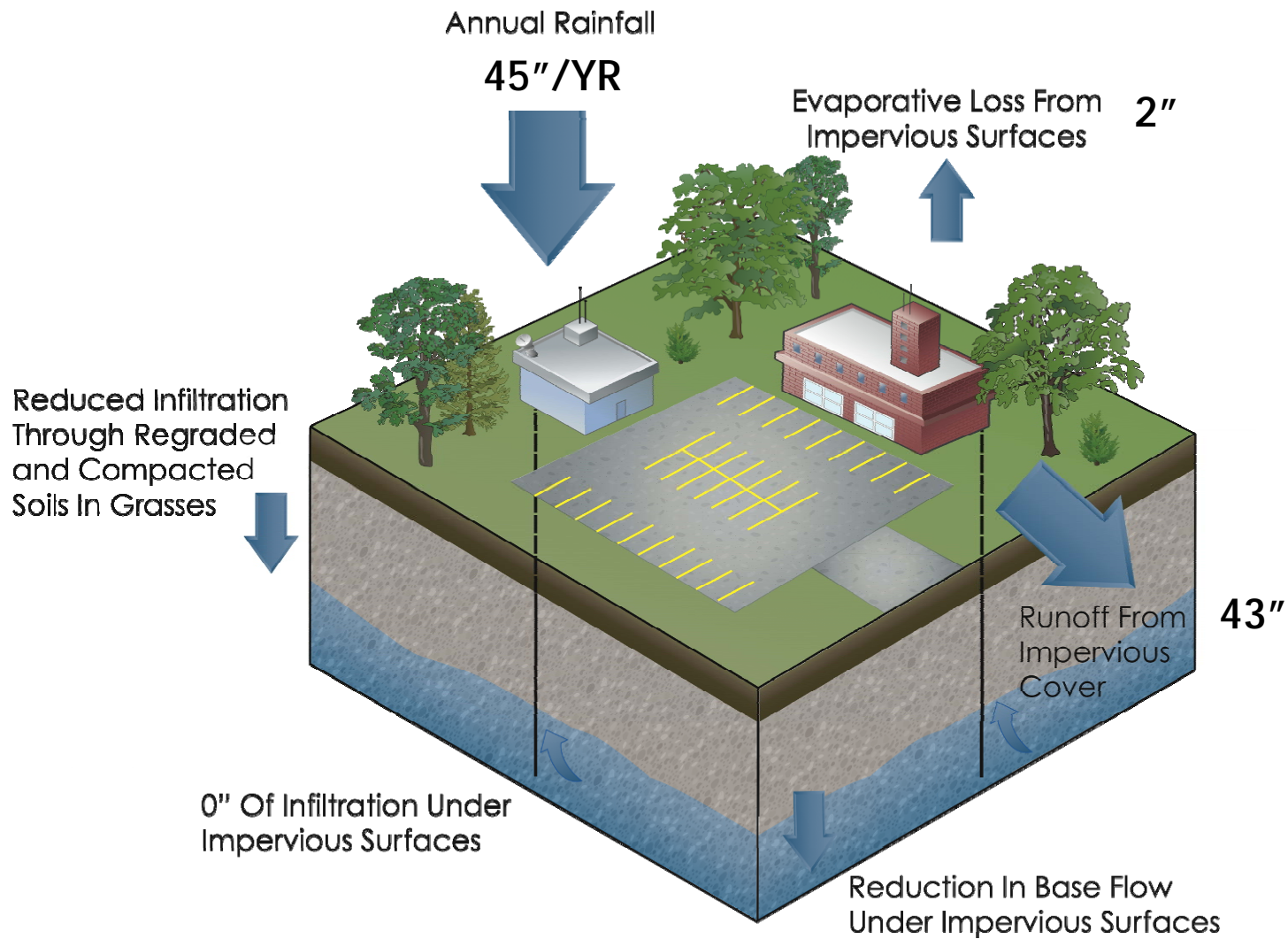
A European Mansion

Annual Water Cycle for an Average Year





Altered Water Cycle for an Average Year



The way we have been designing for stormwater does not prevent flooding.



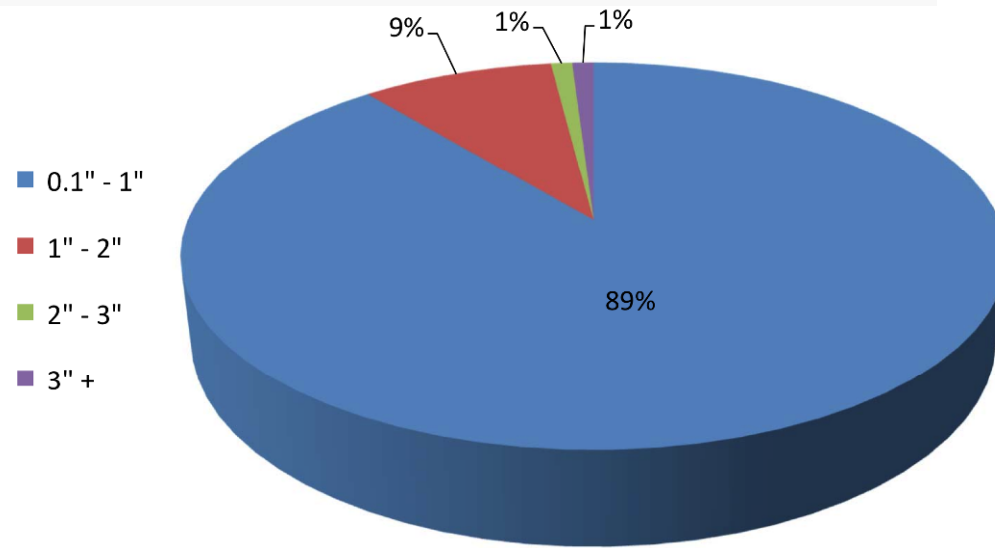
And wastes a resource:
Too much water erodes streams
Very hot / very cold runoff
destroys stream life
Loss of baseflow

*Valley Creek: 200 Detention
Basins*



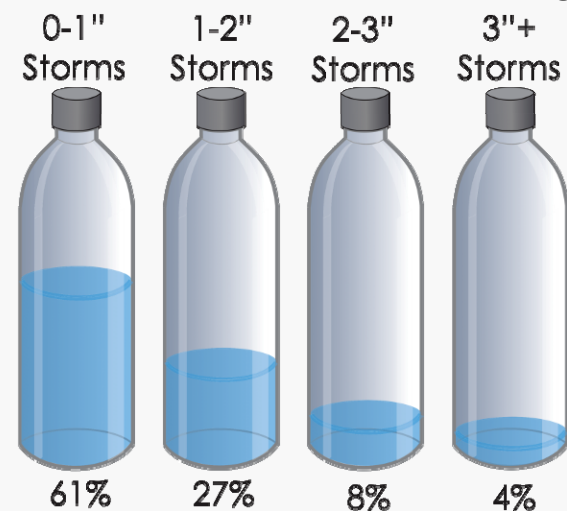
Two important rainfall observations:

Annual Frequency from Storms



Frequency:
Most of the time,
it rains 1 inch or
less

Volume: Annual Percentages from Storms



Volume:
Over 96% of the
annual rainfall of
45 inches is from
storms 3 inches or
less

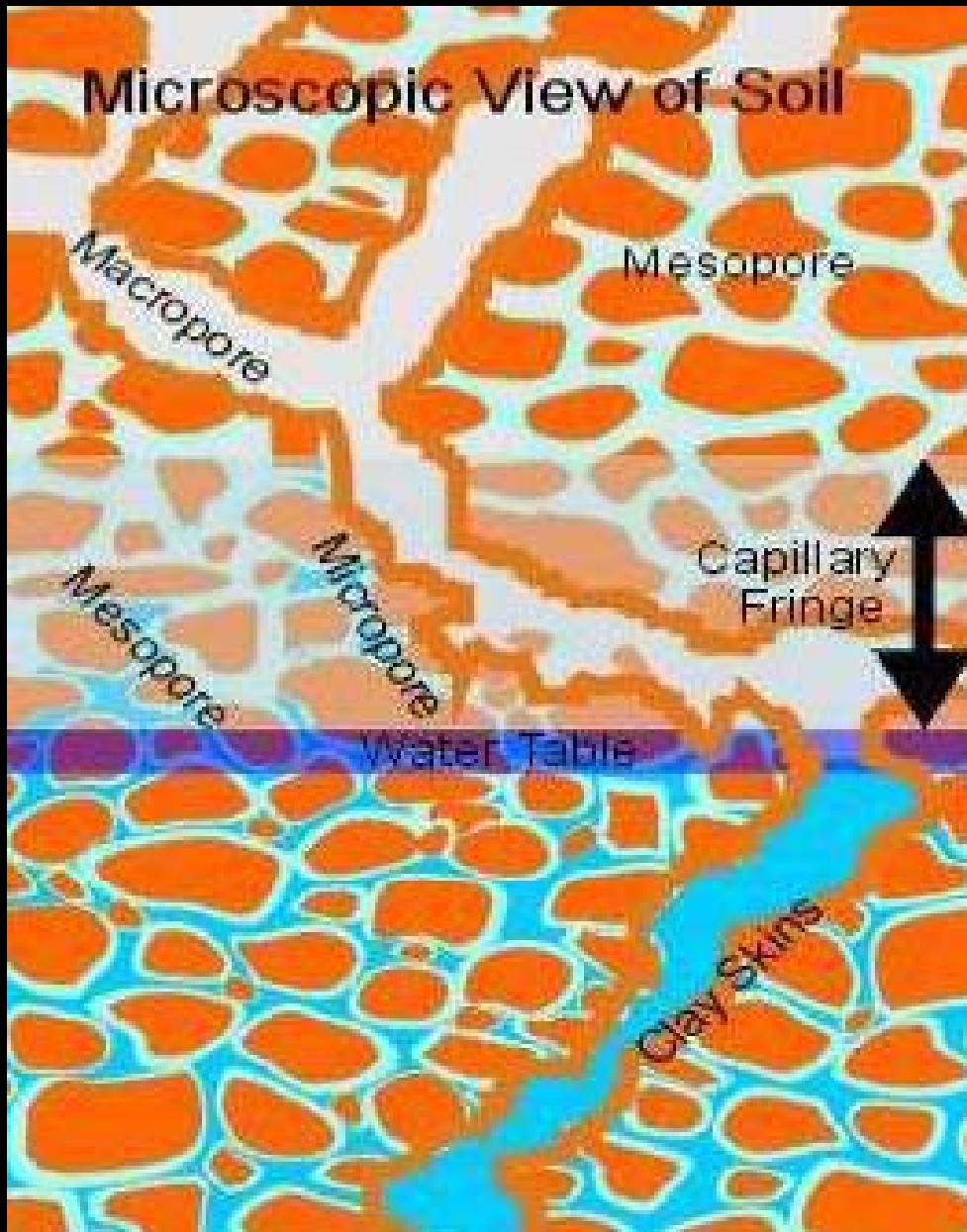
Common Bulk Density Measurements or How compacted is this soil?



David B. Friedman, District Director -- Ocean County Soil Conservation District

Bulk Density is defined as the weight of a unit volume of soil including its pore space (g/cc or grams/cubic centimeter). Water and air are important components of soil and we must frame our soil concepts so that factors affecting water and air dynamics are included. Thus, we are primarily interested in bulk density and pore space as they affect water and aeration status, and root penetration and development.

Not just perceived impervious surfaces

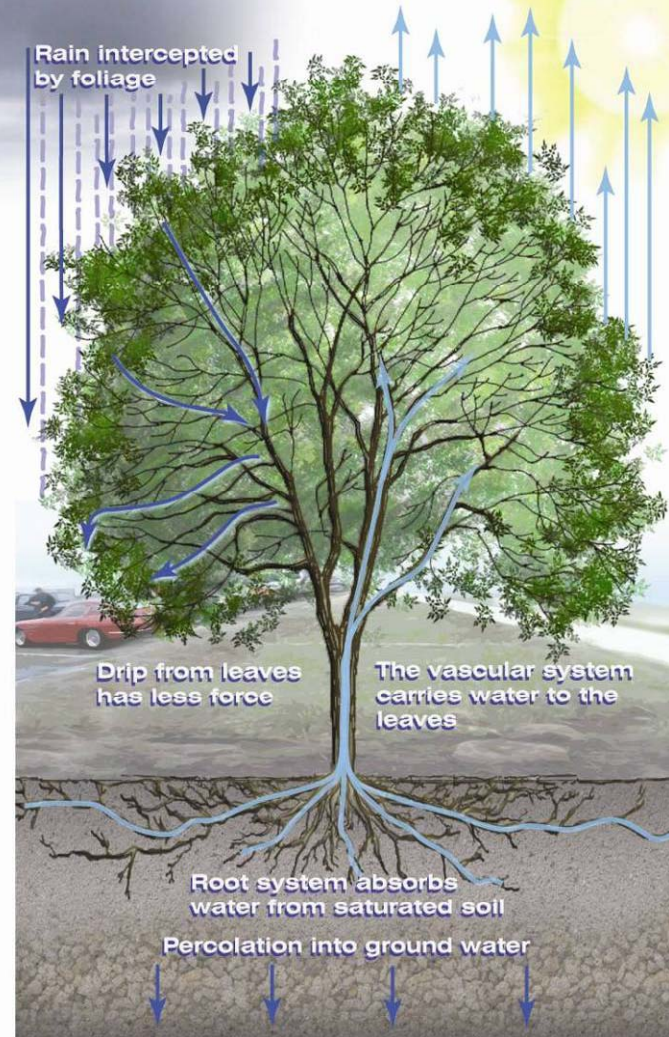


A Tree is the Best BMP. . .

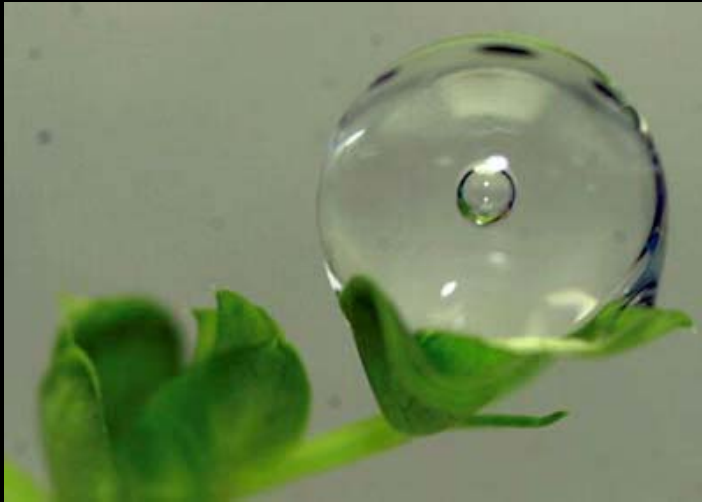


Reduces erosive force of rainfall

Evapo-transpiration from leaves



Is there a different approach?



*We forget that the water cycle
and the life cycle are one.*

- Jacques Cousteau

Manage the small Rainfalls

Recognize the importance of Soils

Recognize the importance of Vegetation

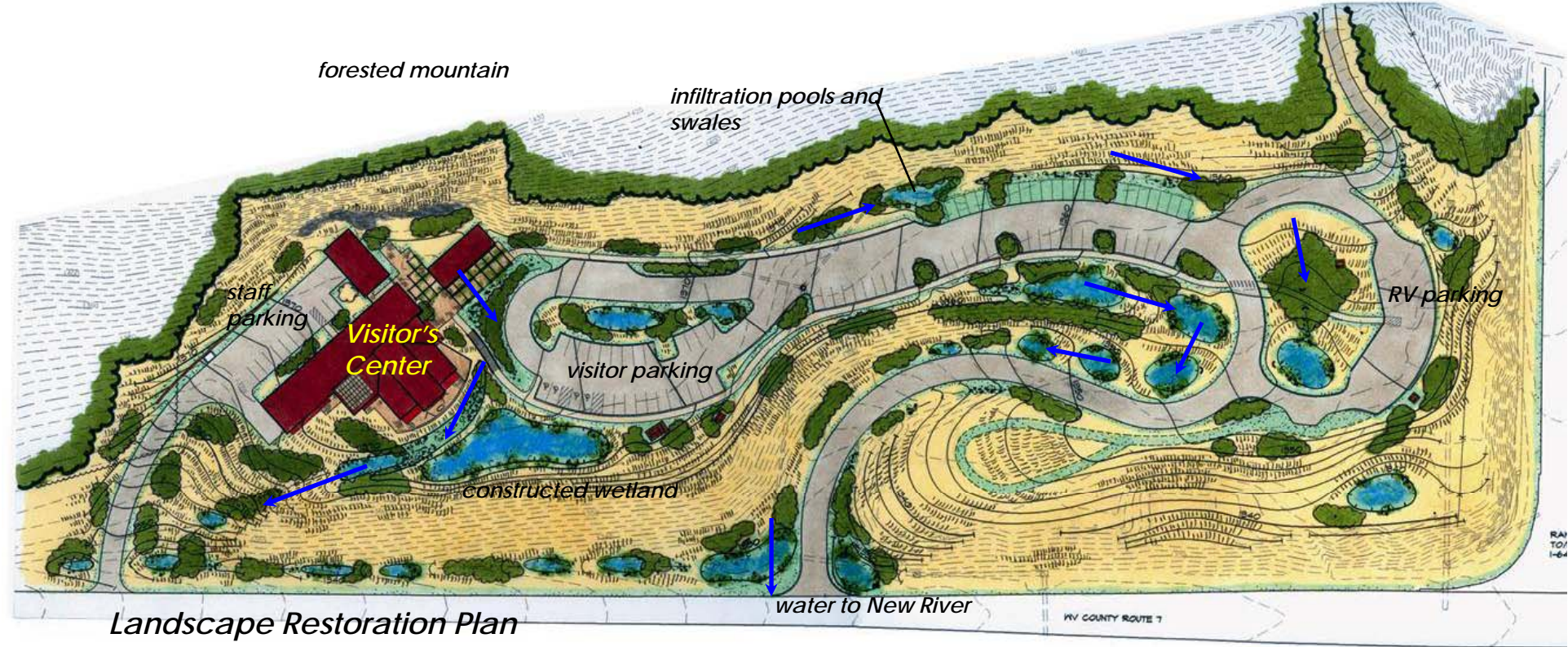
Change the perception of what it the
RIGHT landscape

We can restore the environment by
reconnecting
Water, Soils, & Vegetation



Restoring Disturbed Sites

Sandstone Visitor Center, Sandstone, West Virginia



Landscape Restoration Plan

Integrating Site Infrastructure & Civil Engineering with Landscape Restoration



Runoff from parking lots and roofs is captured in swales and pools...



... there it infiltrates the soil, is used by plants and is cleansed

A Partnership for Restoration

National Park Service: Denver Service Center
& New River Gorge National River Park,
Sandstone WV

USDA: Natural Resources Conservation Service, Plant Materials Center, Beltsville MD

Design Team

Growers



Grass plugs grown at North Creek Nurseries

Vegetated Swale & Stormwater Wetlands



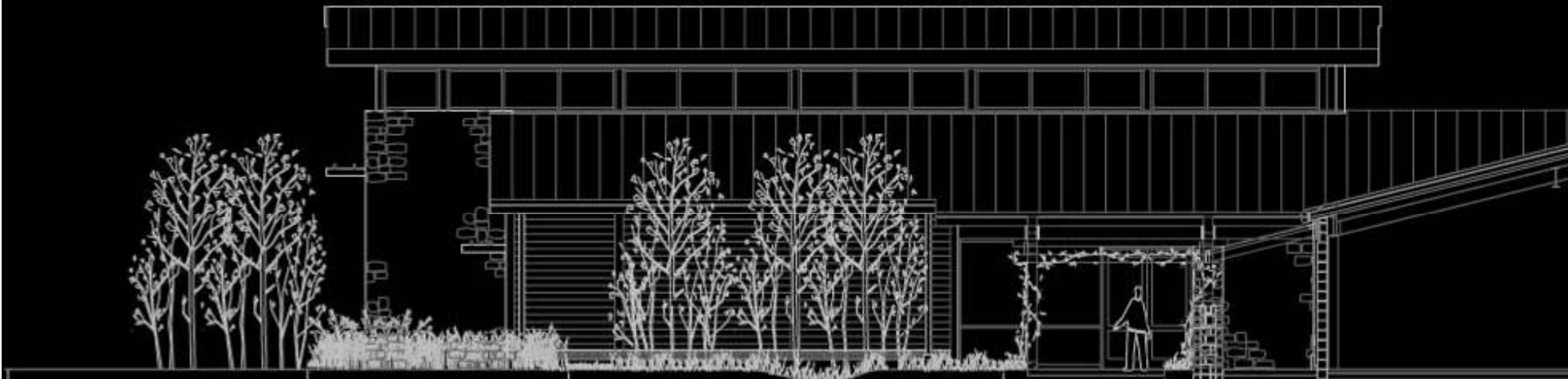
Sustainable Stormwater Management



Rather than piping water to inlets for direct release into the New River, infiltration swales collect it from downspouts. There it seeps into the soil and is taken up by plants.



How trees really grow . . . or this is not an English Park



Indigenous materials reflect place . . .



Native trees, shrubs and grasses, along with local sandstones used in exposed aggregate concrete walks, paving stones and boulders

Does this thing come with a manual?



View of the successional grasslands at the Sandstone Visitor/Orientation Center site prior to construction.

Overall Landscape Objectives

The Long-Term Maintenance Guidelines and Landscape Management Zones Plan for this site are meant to provide direction for the New River Gorge National River Staff to monitor, manage and dramatize the process of landscape restoration and its succession from open grasslands and old fields to early woodlands and forest.

The landscapes of the Sandstone Visitor and Orientation Center, the site of a former quarry and landfill, interconnects the themes of the park as a whole, particularly those of reforestation, watershed protection and the celebration of the dramatic landscape typical of the region.

The visitor center's landscape should heighten the visitor's perception of the dramatic story of change and reforestation over time in this region. Open landscapes, such as successional grasslands, are somewhat rare in West Virginia, usually occurring in mine reclamation and other disturbed areas. The development of the site's grasslands, with native plant species, demonstrates the ability to aid nature in healing and restoring the landscape from previous disturbance by man, whether from mining, quarrying, lumbering or landfills. The plantings of pioneer woody species of trees and shrubs match the existing, more mature woodlands of mixed oaks, maples and oaks.

The progression of storm water through the site tells the story of sustainable storm water management. Stormwater from paved areas and roofs flows into vegetated drainage swales and seeps that cleanse and retain and infiltrate the water before it makes its way to the river. These areas of retention and infiltration are complex habitats for a variety of flora and fauna.

The sandstone cliffs and carefully placed sandstone boulders speak of the site's history as a quarry, while the surrounding mountain and valley views speak of the role of water and rocks in forming the gorge.

Sandstone Visitor/Orientation Center Long-Term Maintenance Guidelines

Landscape Management Zones— see also Appendix A for plan

1.0 ENTRY LANDSCAPE— Focus long-term management on maintaining this area as closely planted groves of trees with a rich herbaceous layer.



Examples of herbaceous plants under grove of trees.

1.1 Trees and Shrubs

- Mow or spot spray weed outbreaks with glyphosate as recommended on the label. Keep a consistent 40-mow/40-weed cycle strip around tree trunks to avoid stripping and damaging bark.
- Allow leaf litter to remain on the ground below trees except near maintained firebreaks.

1.2 Herbaceous Plantings

- Mow entry landscape and entry swales once a year to a height of 6-8" in mid-spring before warm season grasses emerge, but when cool season weeds are actively growing.
- If swale areas are too wet to mow in spring, mow in late fall.



Example of herbaceous plants under a grove of trees.

- Finely chop dried leaf litter from the zone and re-distribute.
- When the site becomes partially shaded, plant shade tolerant native herbaceous plants. Ex. Lady Fern (*Athyria filix-foemina*) and Alumroot (*Heuchera americana*). For additional planting recommendations, park staff can consult with Teris Dockrill, Rob Sauer & Partners (215-540-1888), the Maryland National Plant Materials Center, Jennifer Kujawski (304-504-8175) and/or the West Virginia Plant Materials Center in Alderson, John Vandevender (304-445-3005). See also consultants listed under Section 4.0 letter i.

Sandstone Visitor/Orientation Center Long-Term Maintenance Guidelines

2.0 OPEN GRASSLANDS— Focus long-term management on maintaining open grasslands held permanently in this stage of succession.



Example of Open Grasslands— the predominant grass shown here is Little Bluestem (*Schizachyrium scoparium*).

- Maintain grasslands in conjunction with Landscape Management Zone 3.0 "Old Field with Copse and Swales."
- In 1st growing season, mow to height of 6" (or just above the height of emerging native grass seedlings) once/month. Remove or finely chop and redistribute mowings to prevent out weeds from smothering native grass seedlings. If swale areas are too wet for spring mowing, mow in late fall (after plants have set seed).
- In year 2, mow once to a height of 8" in the fall.
- Maintain monthly for invasives during the first 2 to 3 years, especially crown vetch. Spot spray with Trifluralin or Plateau as necessary. Try not to hand pull as this can uproot developing seedlings.
- In year 3 and after, mow to a height of 6-8" once every 2 years in early to mid spring prior to significant warm season grass re-growth, but when cool season weeds are actively growing. Remove cut material, or mow with a flail-type mower to finely chop residue. If dry leaf litter builds up, mow every year or b) pull out lower litter that a mower can't reach with a harrow.
- Divide maintained grassland areas in half and mow alternating halves once each year.
- Spray or pull herbaceous weeds.
- Pull or cut and stump trees with herbicide any woody plants succeeding onto open grassland slopes.
- In 2-3 years, when invasives are under control, particularly Crown Vetch, and the use of Trifluralin and Plateau has stopped, introduce wild flowers into this management area. Use locally native wild flowers. Plug plantings work well. Wild flowers can include, but are not limited to:

Sandstone Visitor/Orientation Center Long-Term Maintenance Guidelines

LEGEND

- ENTRY LANDSCAPE
- OPEN GRASSLANDS
- OLD FIELD WITH COPSES & SWALES
- OLD FIELD TO EARLY WOODLANDS
- MOW STRIPS/GRASSLAND EDGES
- PARKING ISLANDS
- FIRE BREAK

80 FT 0 80
SCALE OF FEET



Journey from car to building . . .

Sandstone Visitor Center, Sandstone, West Virginia



Places for people . . .





- Academic Walk & Farm Drive Allées
- Woodland Gardens
- Meadows
- Rain Gardens
- Riparian Restoration

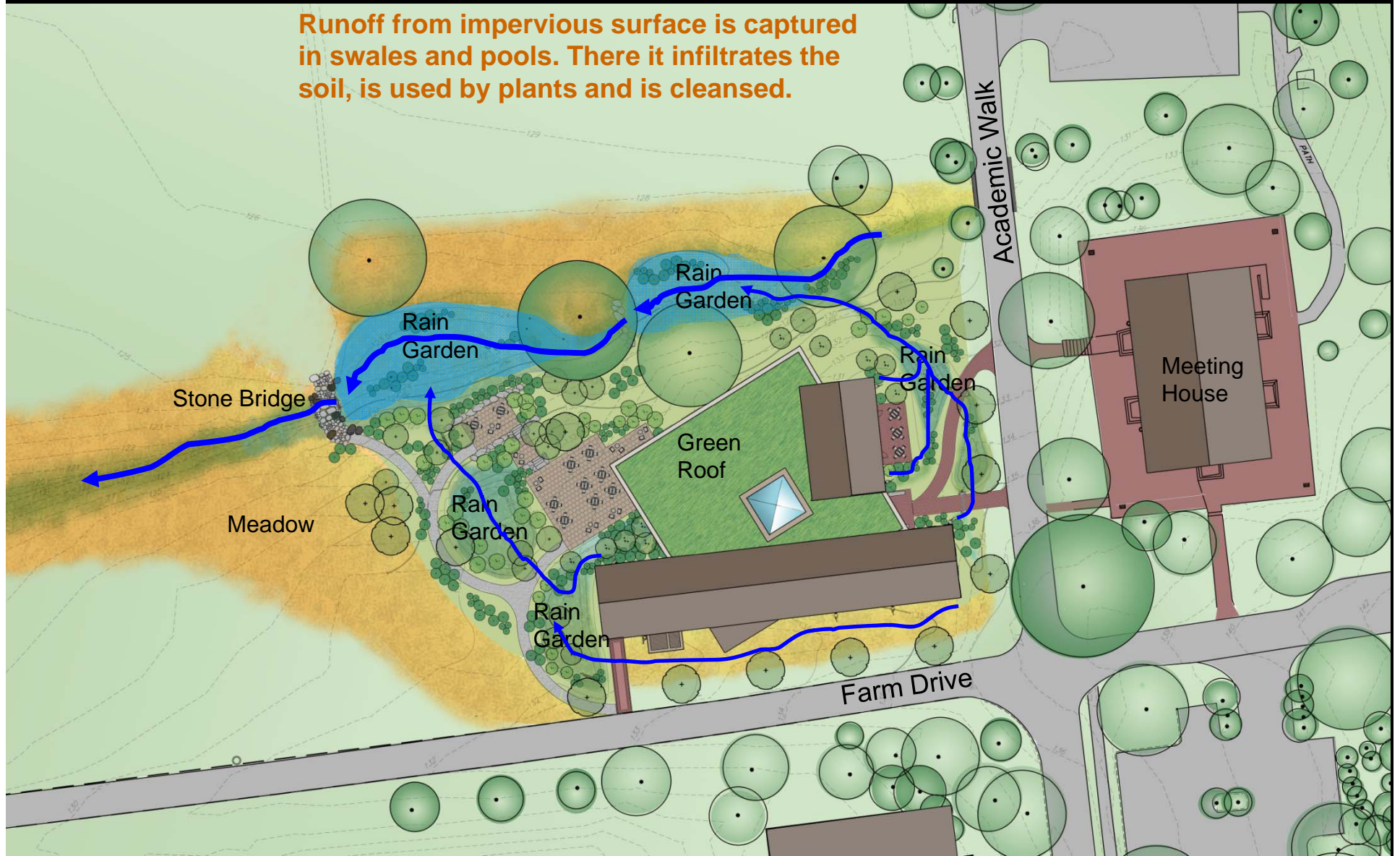




MEADOW



Runoff from impervious surface is captured in swales and pools. There it infiltrates the soil, is used by plants and is cleansed.



Rain Gardens:

Integrate Site Infrastructure & Civil Engineering w/ Landscape Restoration



PERENNIAL PLUGS



SHRUB TUBELINGS

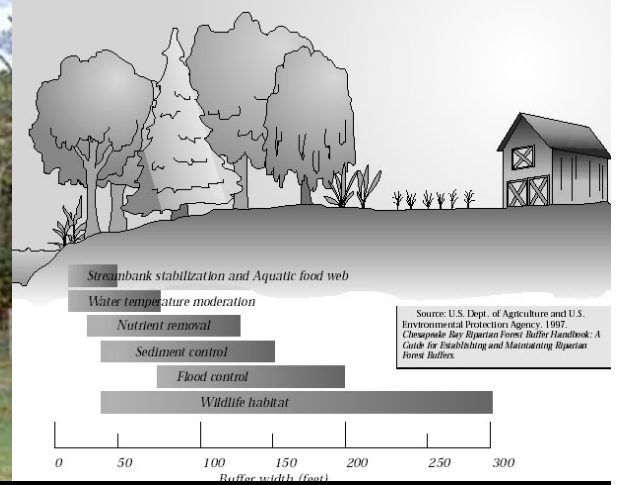


TREE WHIPS

Rain Gardens

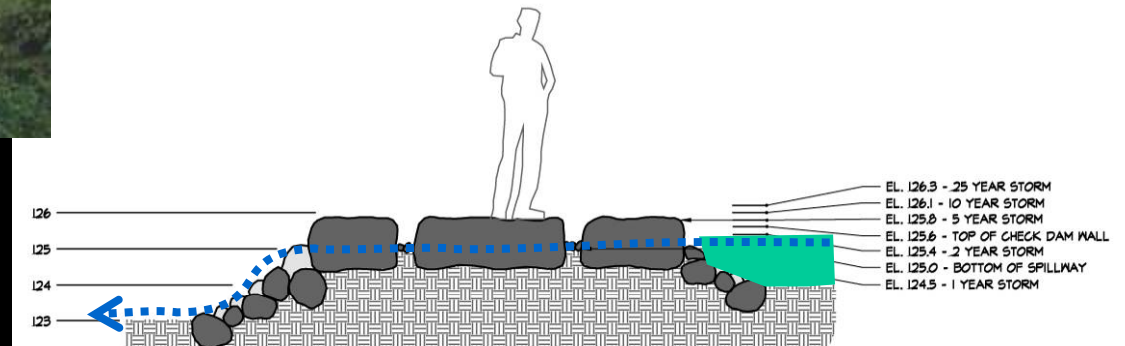
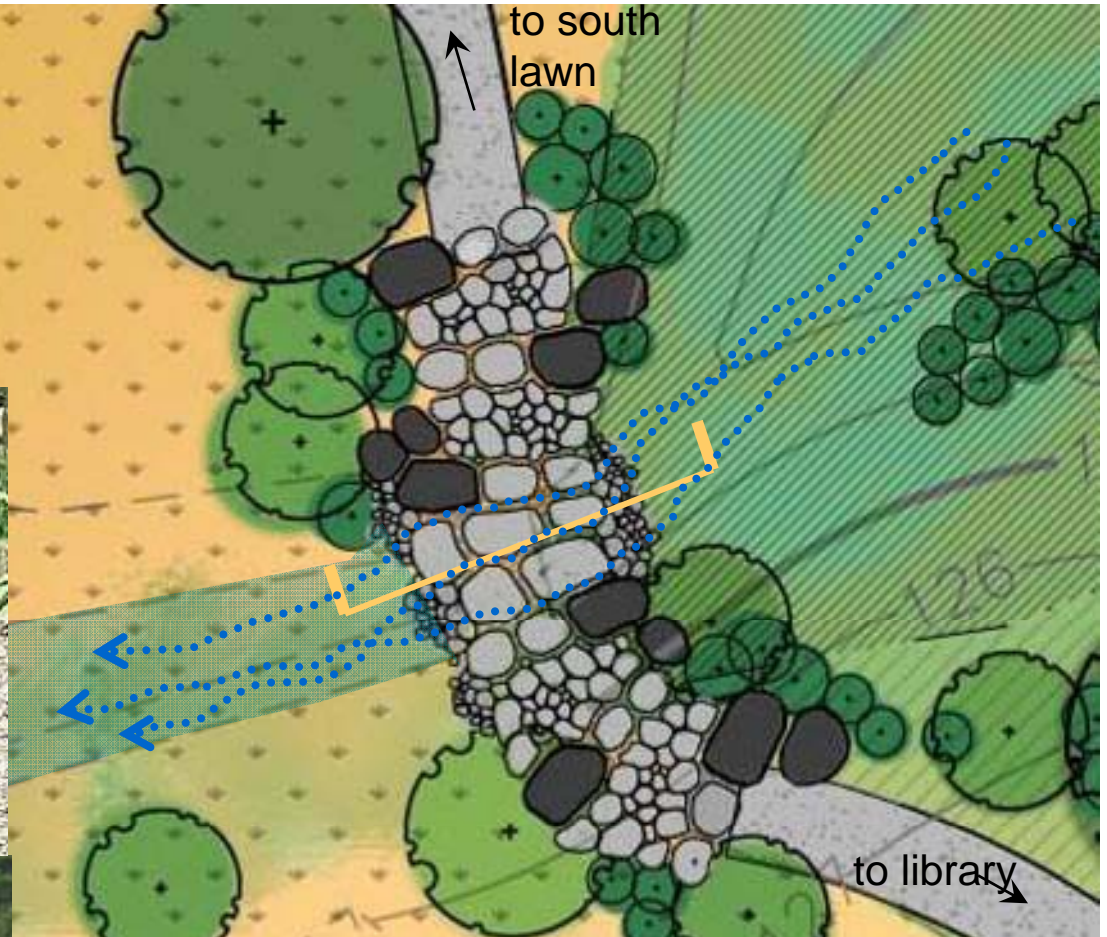


Rain Gardens



Riparian restoration:
Planted buffers of trees, shrubs & grasses improve water quality

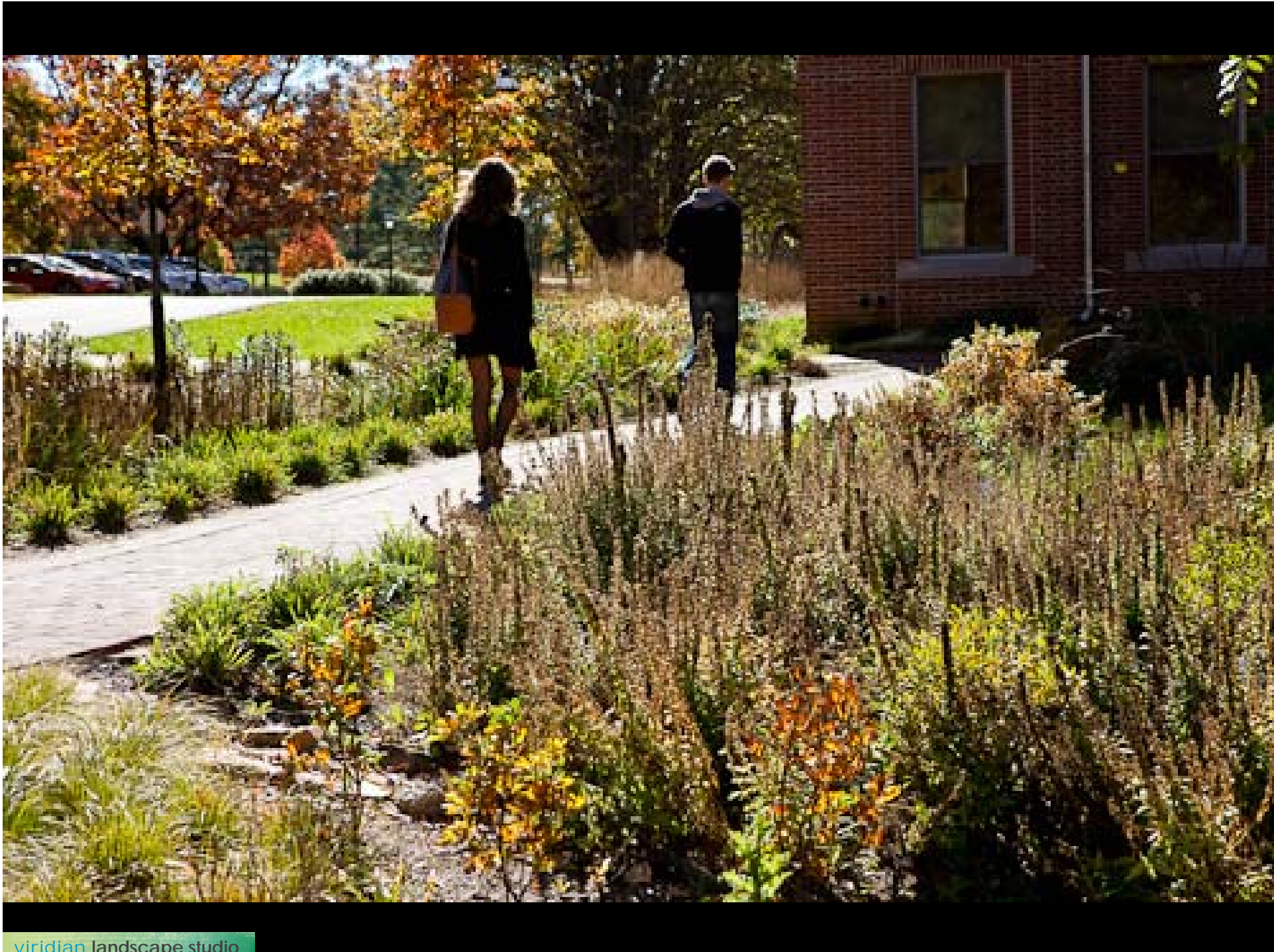
Large stepping stones allow pedestrians to cross drainage way and connect with water.



Outlet Control & Bridge Crossing



Site Plan





East Whiteland Basin Retrofit



East Whiteland Basin Retrofit



PERENNIAL PLUGS



SHRUB TUBELINGS



TREE WHIPS

Installation – April 2006

Modify the outlet to hold small storms (1")

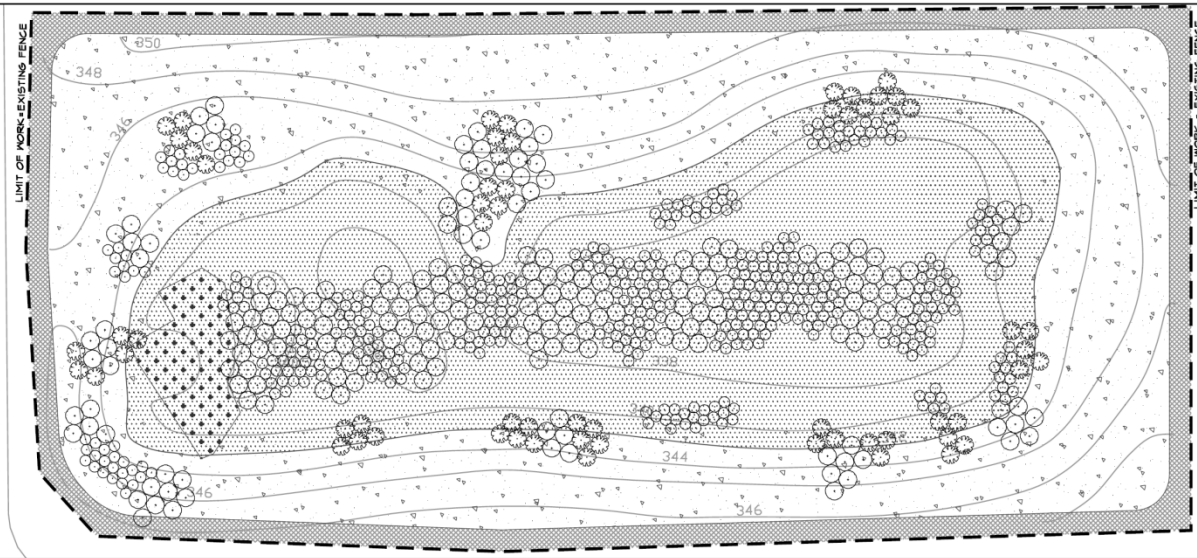


Volunteers planted 300 live stakes and 200 container grown trees and shrubs. After planting the basin was seeded with wet and dry native grass and forb mixes. April 2006








Site Assessment – May 2007



Provide a simple plan



LEGEND

-  LOW-MOW TURF GRASS
-  DRY MEADOW
-  WET MEADOW
-  LIVE STAKES
-  CANOPY TREE
-  UNDERSTORY/FLOWERING TREE
-  SHRUB

FIRST YEAR MAINTENANCE

LOW-MOW TURF GRASS:

1. MOW TURF AREAS AS SOON AS TOP GROWTH IS TALL ENOUGH TO CUT. MOW GRASS TO 4-5 INCHES HIGH. REPEAT MOWING TO MAINTAIN SPECIFIED HEIGHT WITHOUT CUTTING MORE THAN 40 PERCENT OF GRASS HEIGHT. DO NOT DELAY MOWING UNTIL GRASS BLADES BEND OVER AND BECOME MATTED. DO NOT MOW WHEN GRASS IS WET.

2. WATER OR SUPPLEMENT NATURAL RAINFALL TO PROVIDE A MINIMUM RATE OF 1 INCH PER WEEK UNTIL A HEALTHY, DENSE, CLOSE STAND OF GRASS HAS BEEN ESTABLISHED.

WET & DRY MEADOW AREAS:

1. MOW MEADOW AREAS TO A HEIGHT OF 6 INCHES WHEN WEEDS REACH 10 INCHES IN HEIGHT.

2. MOW ON A MONTHLY BASIS THROUGH GROWING SEASON. REMOVE OR FINELY CHOP AND REDISTRIBUTE MOWINGS TO PREVENT CUT WEEDS FROM SMOTHERING NATIVE GRASS SEEDLINGS. THE USE OF A FLAIL-TYPE MOWER IS RECOMMENDED BECAUSE IT CHOPS MATERIAL INTO FINE PIECES, ENCOURAGING MORE RAPID BREAKDOWN OF LEAF LITTER AND PREVENTING SMOTHERING OF SEEDLINGS.

3. WATER OR SUPPLEMENT NATURAL RAINFALL TO PROVIDE A MINIMUM RATE OF 1 INCH PER WEEK.

SECOND YEAR MAINTENANCE

LOW-MOW TURF GRASS:

1. MOW TURF AREAS AS SOON AS TOP GROWTH IS TALL ENOUGH TO CUT. MOW TO 4-5 INCHES HIGH. REPEAT MOWING TO MAINTAIN SPECIFIED HEIGHT WITHOUT CUTTING MORE THAN 40 PERCENT OF GRASS HEIGHT. DO NOT DELAY MOWING UNTIL GRASS BLADES BEND OVER AND BECOME MATTED. DO NOT MOW WHEN GRASS IS WET.

WET & DRY MEADOW AREAS:

1. MOW MEADOW AREAS TO A HEIGHT OF 8 INCHES IN MID SPRING BEFORE WARM SEASON GRASSES EMERGE, BUT WHEN COOL SEASON WEEDS ARE ACTIVELY GROWING. IF WET MEADOW AREAS ARE TOO WET TO MOW IN SPRING, MOW IN LATE FALL. REMOVE OR FINELY CHOP AND REDISTRIBUTE MOWINGS.

2. INSPECT 1-2 TIMES ANNUALLY FOR INVASIVE SPECIES. IF BIENNIAL WEEDS SUCH AS SWEET CLOVER, WILD PARNIP, QUEEN ANNS LACE, OR BURDOCK APPEAR, THEY SHOULD BE MOWED OR WEED WHACKED TO A HEIGHT OF 12 INCHES OR LESS WHEN IN BLOOM. DO NOT ALLOW BIENNIAL WEEDS TO GO TO SEED.

3. TO MAINTAIN MEADOW AND PREVENT SUCCESSION TO WOODY HABITAT, MOW TO A HEIGHT OF 6-8" ONCE EVERY TWO YEARS IN MID SPRING. REMOVE OR FINELY CHOP AND REDISTRIBUTE MOWINGS.

GENERAL REQUIREMENTS

1. DO NOT MOW OR USE WEED WHACKERS NEAR TREES & SHRUBS.

2. DO NOT MOW TO LESS THAN RECOMMENDED MOWING HEIGHT.

3. INSPECT ALL SEEDED AREAS FOR BARE SPOTS (GREATER THAN 1 SQUARE FOOT) IN LATE SUMMER. RESEED BARE SPOTS WITH APPROPRIATE SEED MIXES DURING THE FALL SEEDING WINDOW (AUGUST 15 - SEPTEMBER 30) OR SPRING SEEDING WINDOW (APRIL 15 - JUNE 15).

4. REPLENISH MULCH AROUND TREES AND SHRUBS EACH SPRING TO SUPPRESS WEEDS. REMOVE WEEDS BY HAND AS NEEDED. VIGOROUS WEED CONTROL IS NEEDED FOR THE FIRST THREE YEARS OR UNTIL TREES ARE TALL ENOUGH TO SHADE OUT COMPETING WEEDS.

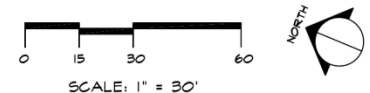
5. INSPECT TREE SHELTERS AND STAKES TO ENSURE THEY ARE SOUND AND UPRIGHT. REMOVE DECOMPOSING SHELTERS AND PIECES. REMOVE TREE SHELTERS THAT HAVE BEEN SPLIT ALONG THE LASER LINE BY FAST-GROWING TREES.

6. MONITOR FOR DEER DAMAGE DURING ESTABLISHMENT YEARS. USE REPELLANT AS NEEDED.

7. ESTABLISH AN EMERGENCY DROUGHT WATERING PLAN FOR THE FIRST AND SECOND YEARS. IF NO WATERING IS PROVIDED, BE PREPARED TO RESEED BARE AREAS AND REPLANT DEAD OR DAMAGED TREES & SHRUBS IF LOSS IS 20% OR GREATER.

8. MONITOR AND REMOVE INVASIVE SPECIES IN ALL AREAS. IT IS RECOMMENDED THAT AN INVASIVE SPECIES EXPERT BE CONTRACTED FOR ANNUAL OR BIENNIAL VISITS TO ASSIST IN IDENTIFICATION AND ELIMINATION OF ANY LOCAL INFESTATIONS OF BIENNIAL OR PERENNIAL WEEDS OR INVASIVE WOODY SPECIES.

9. KEEP PHOTO RECORDS AND WRITTEN LOGS AS A RECORD OF SUCCESSSES AND FAILURES OF PLANTING AND MANAGEMENT TECHNIQUES. TAKE PHOTOS WITHIN THE FIRST MONTH AFTER INSTALLATION ('BEFORE') AND ONCE EACH SEASON (FOUR TIMES ANNUALLY). TAKE PHOTOS FROM THE SAME LOCATION SO THAT CHANGES CAN BE COMPARED.



CAHILL ASSOCIATES, INC.
104 SOUTH HIGH STREET
WEST CHESTER, PA 19382

SCALE: AS NOTED
APRIL 1, 2006

ROLF SAUER & PARTNERS, LTD.
3888 TERRACE STREET
PHILADELPHIA, PA 19182
215-482-7973

EAST WHITELAND TOWNSHIP
DETENTION BASIN RETROFIT
AT SIDLEY RD. & THAYER RD.

L2.0
MAINTENANCE PLAN

East Whiteland Township Stormwater Basin Retrofit, East Whiteland Township, PA

Site Assessment – June 2010









Quantifying Sustainable Infrastructure for a
Green Future
along the Allegheny River

ecology

urban form

connections

market

Cahill Associates/CH2M Hill
Viridian Landscape Studio
Continental Conservation

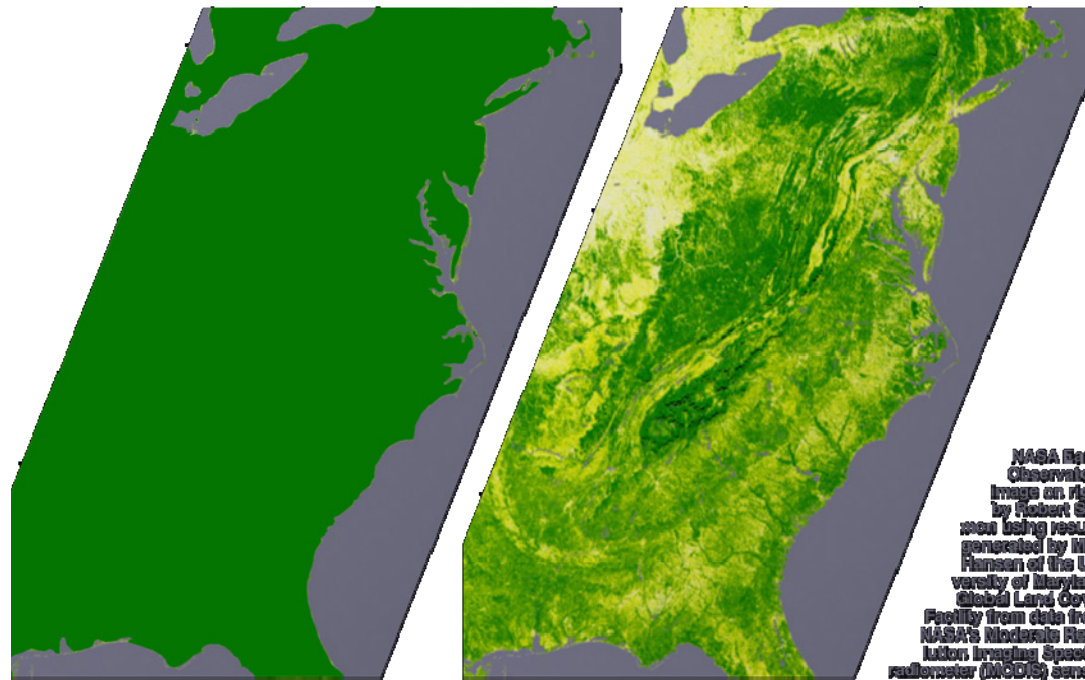
Perkins Eastman

Trans Associates
Clear View Strategies

GSP Consulting

Historic Ecology

North America was 99% covered by forest from the Atlantic shoreline to the prairies of the Great Plains. Today only fragments remain....



Pre-European settlement

Present



<http://earthobservatory.nasa.gov> 14 October 2003

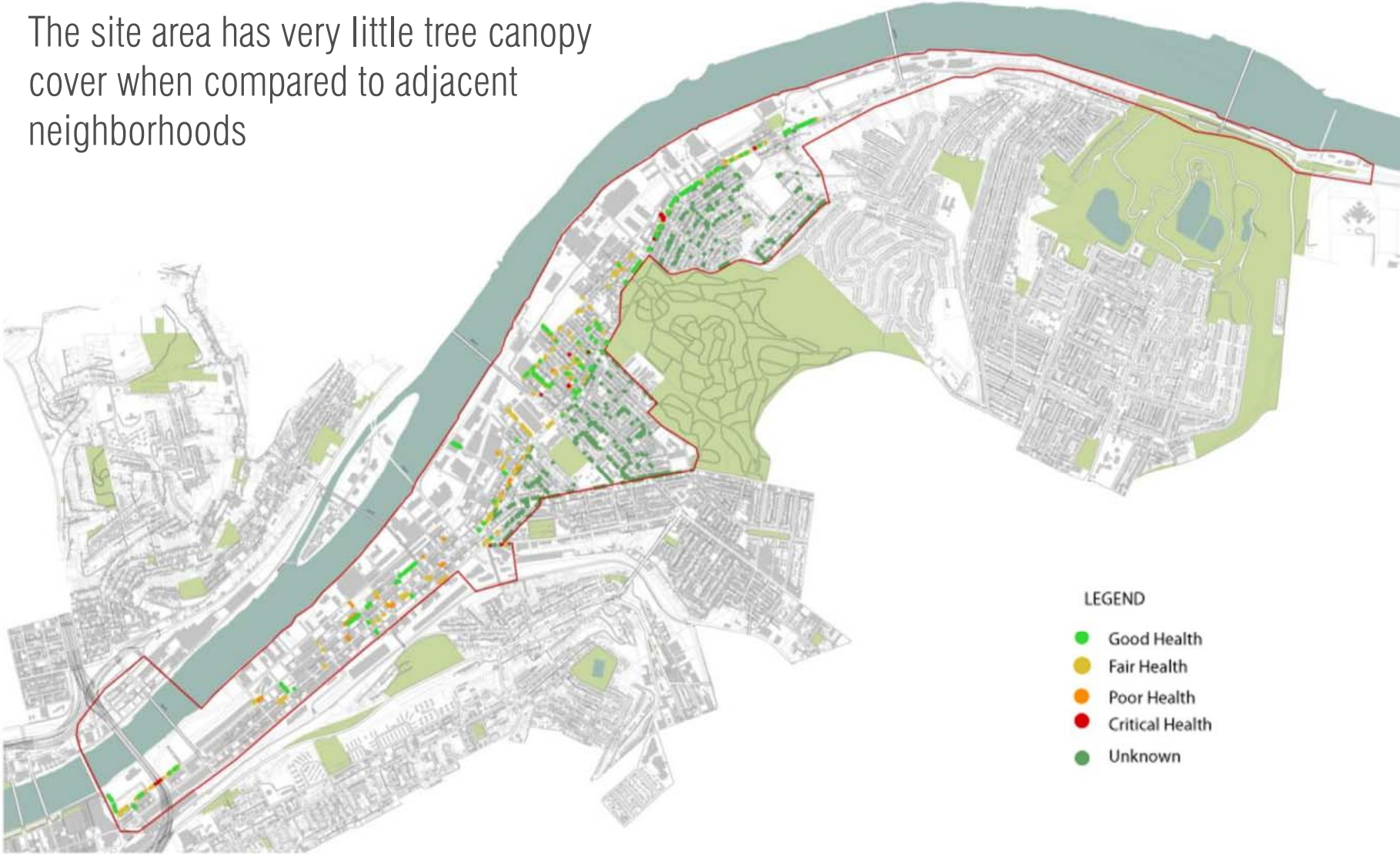
NASA Earth
Observatory
Image on right
by Robert Sim-
mon using results
generated by Matt
Hansen of the Uni-
versity of Maryland
Global Land Cover
Facility from data from
NASA's Moderate Reso-
lution Imaging Spectro-
radiometer (MODIS) sensor.



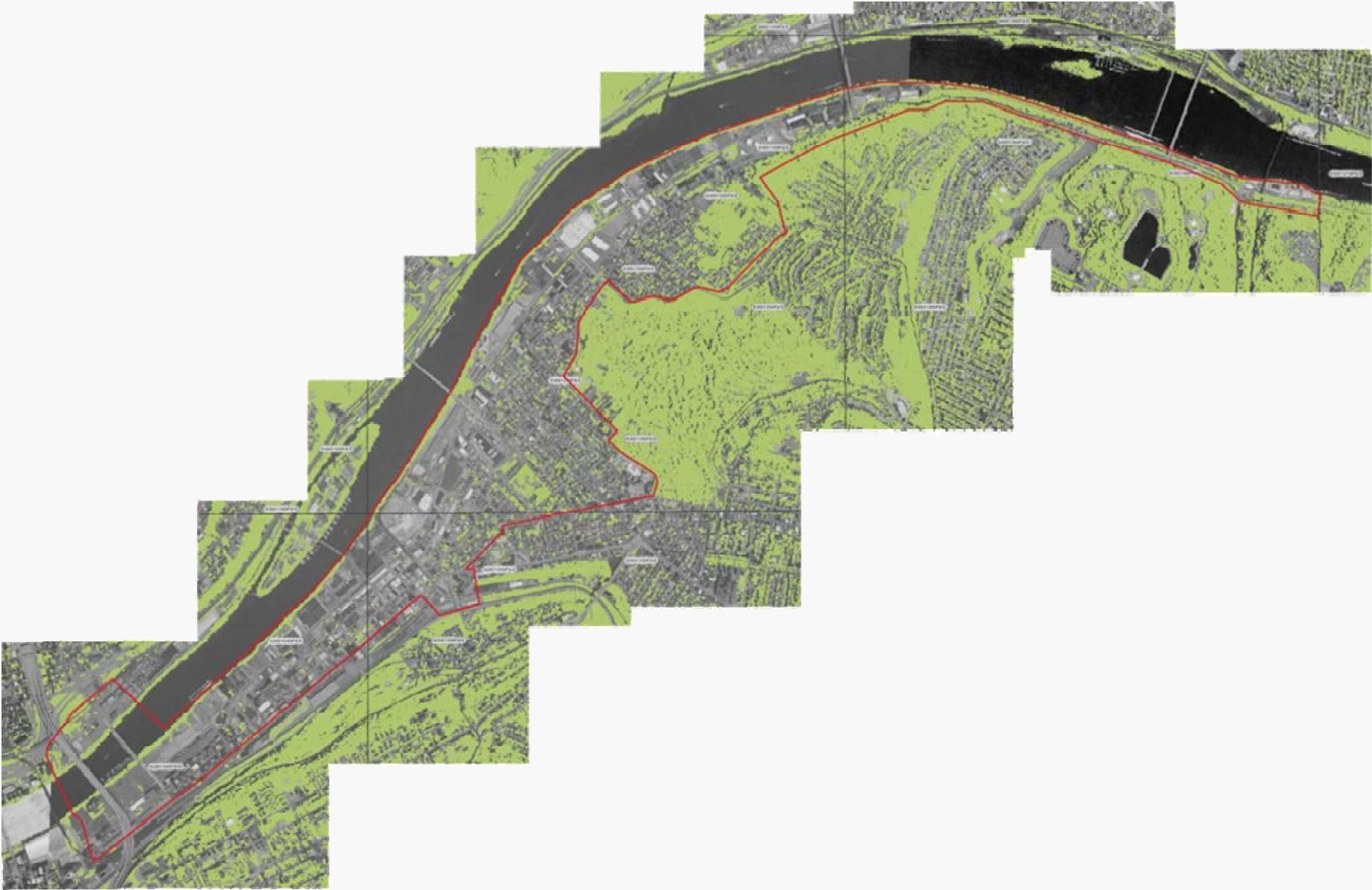
The floodplains along the Allegheny River all the way to its confluence with the Monongahela were formerly a diverse mosaic of different native community types.

Existing Tree Canopy Cover

The site area has very little tree canopy cover when compared to adjacent neighborhoods

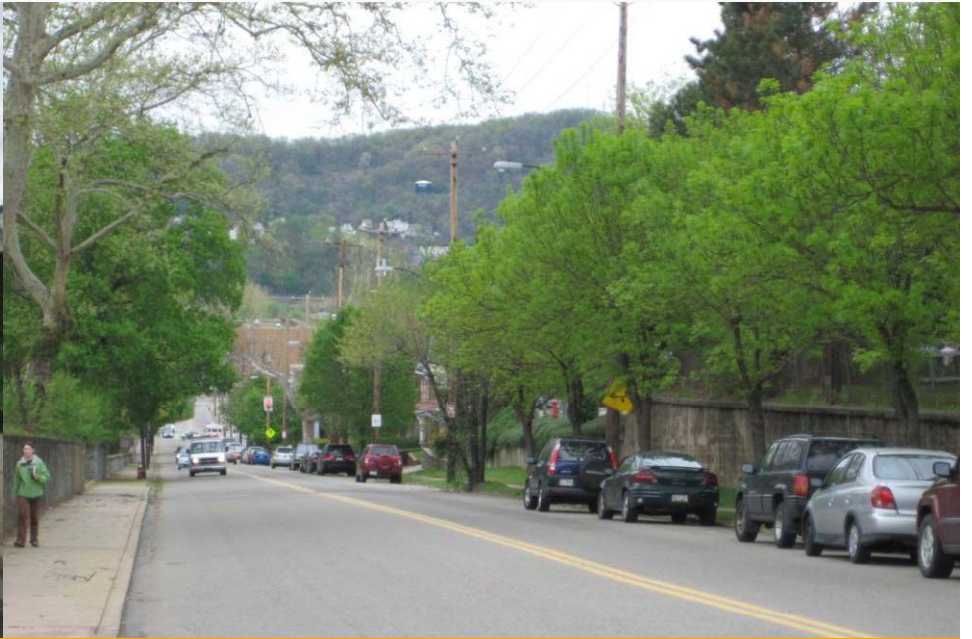


Existing Tree Canopy Cover



Existing Tree Canopy Cover

Which is most desirable?



Existing Tree Canopy Cover

Which is most desirable?

Existing Tree Cover in Pittsburgh



Strip District



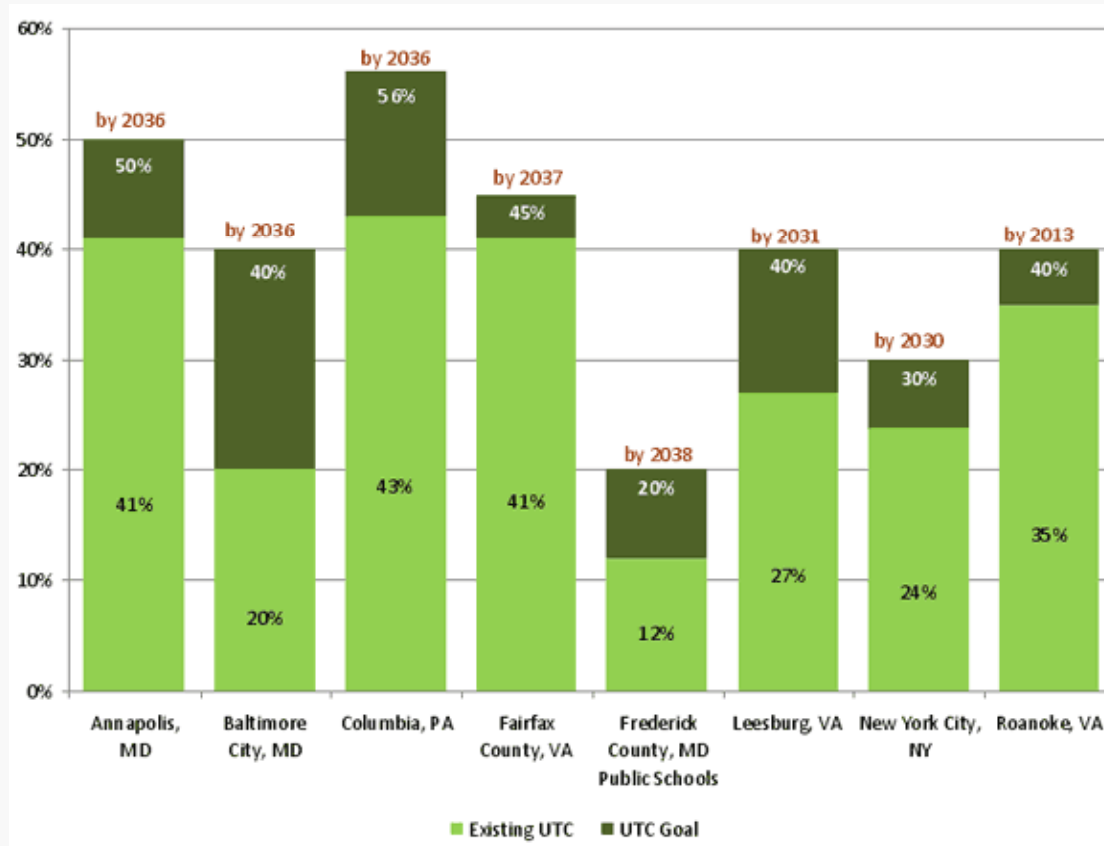
Lawrenceville



Squirrel Hill

Urban Tree Cover (UTC)

Urban Tree Canopy Cover Goals for Other Cities



Source: Watershed Forestry Resource Guide - A Partnership of the Center for Watershed Protection and US Forest Service

Target Goal: 40% Tree Canopy Cover

Achieve 40% Tree Canopy Cover over 20 years.
Canopy Coverage Benefits Include:

- Heat Island Reduction
- Stormwater Runoff Reduction
- Air quality improvement
- Carbon offset
- Reduced Crime & Quality of Life Enhancement



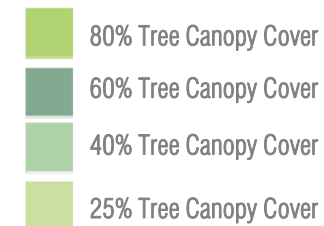
Target goal set by comparing several sources including Friends of Pittsburgh's Urban Forest, American Forests, Watershed Forestry Resource Guide

Tree Canopy Vision Goal

Achieve 40% Urban Tree Canopy Cover using a Zonal Approach:

- Regenerative Zone: River's Edge to 200 feet (80%)
- Regenerative Zone: Buffer to AVRR Green Boulevard (60%)
- Transitional Zone: AVRR Green Boulevard to Liberty Ave/Butler Street (40%)
- Preservation Zone: Butler Street to Site Boundary (25%)

40% canopy cover can only be achieved by incorporating significant open / park / green space (not built) in addition to a 200' river buffer

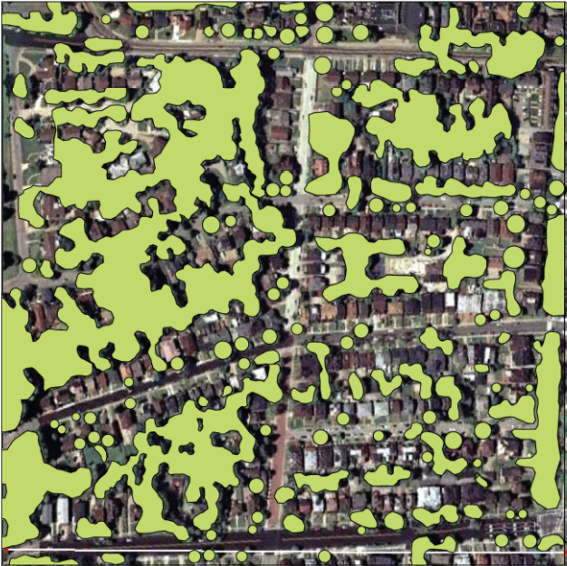


40% Tree Canopy Cover Goal

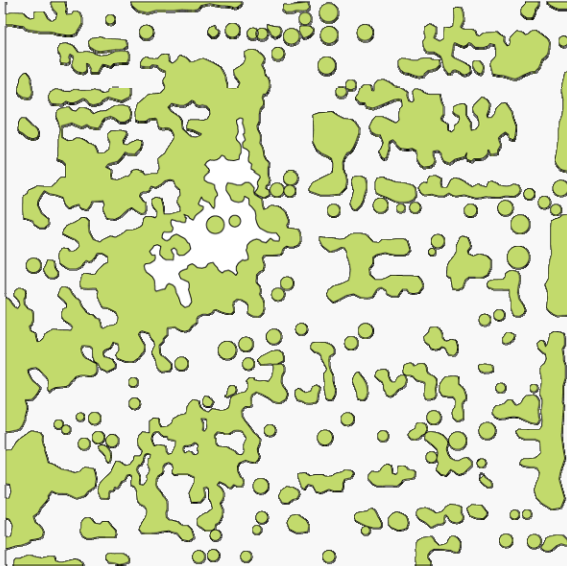
Existing Squirrel Hill Neighborhood in Pittsburgh



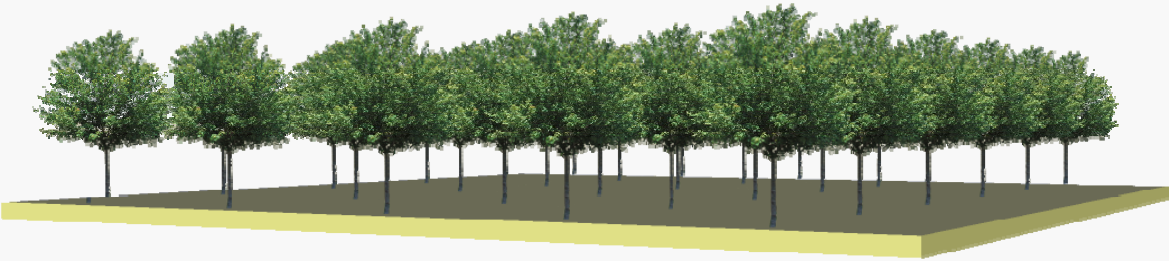
Total Area 66 acres (same as Strip District scheme)



Existing Tree Cover

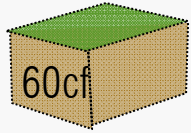


~28 Acre Canopy Coverage=
>40% Cover



***Canopy cover represents green leaf cover as measured from a high-resolution aerial. A 40% canopy coverage does not mean 40% of the marketable area is utilized for tree plantings but rather that 40% of the development area will be covered by an elevated canopy after 20 years.

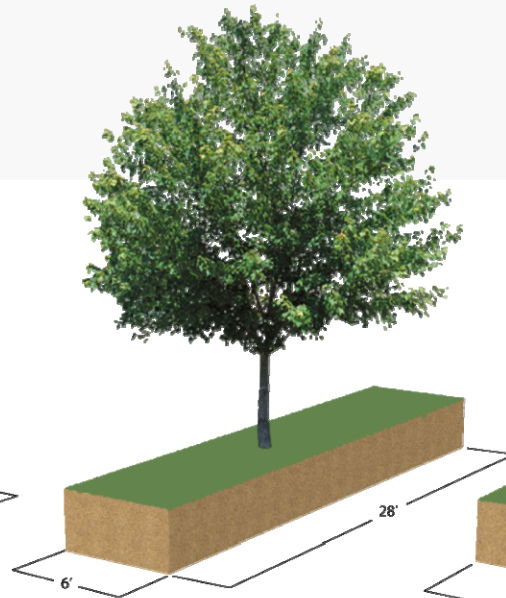
The Importance of Soil Volume



A 4' x 5' x 3' tree pit (typical in urban settings) only provides 60 cubic feet of soil!



120 cf



500 cf



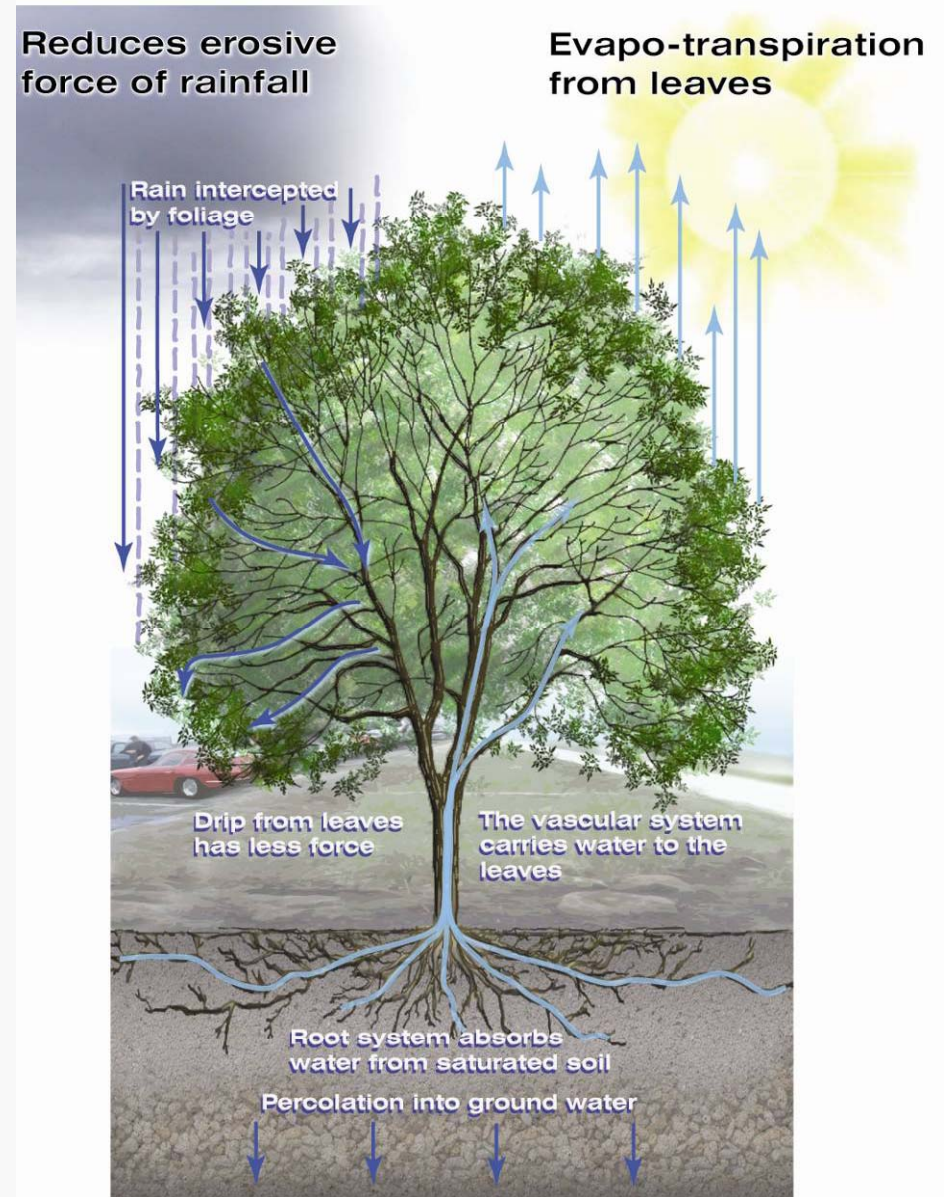
1000 cf

A 10' x 34' x 3' tree trench provides the 1000+ cf necessary for successful tree canopy cover

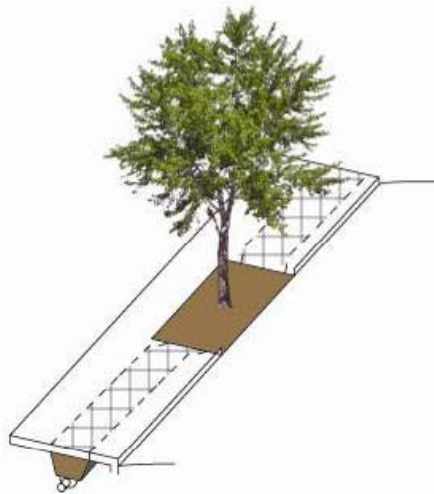
The success to street tree longevity is credited to the amount of soil volume available for tree growth. A large tree, with a desired lifespan beyond 15 years (average life of a downtown street tree is just 13 years) needs a **minimum 500 – 1000 cubic feet of soil** to reach a size that significantly contributes to a healthy community and ecosystem.

A Tree is the Best BMP

- Soil volume targets are set at **800cf/single tree** and **600cf/multiple trees (groves)**.
- **Targets provide tree lifespan past 15 years to >40 years.**
- **Targets create a direct correlation between soil volume for trees and soil volume for stormwater management.**
- **Air and water** must move into and out of the soil mass

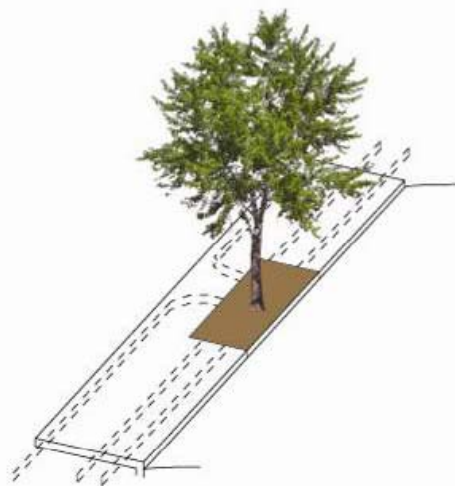


The Importance of Soil Volume



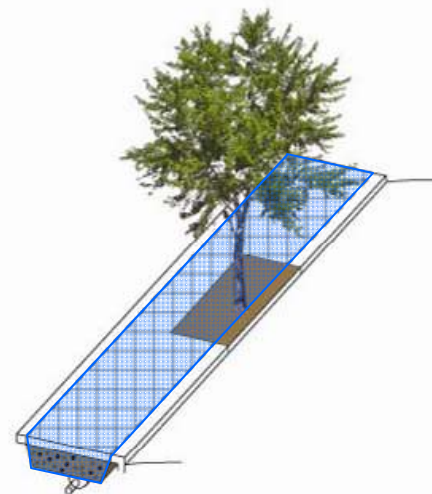
Soil Trenches

continuous trench of soil between street trees, creating a greater area for root growth and the sharing of resources between individual street trees.



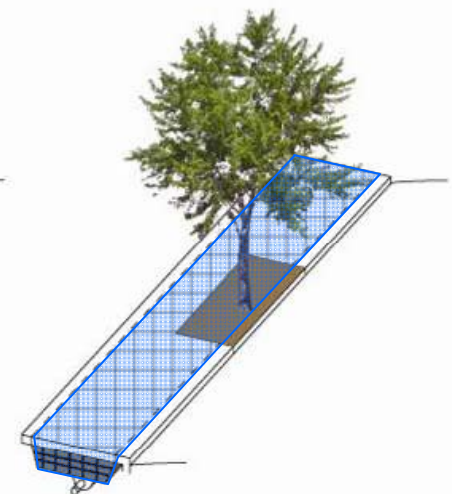
Root Paths

network of paths that direct roots under paving and into more favorable areas for air, water and nutrients.



Structural Soil

mixture of gravel and planting soil which meets standard compaction requirements while remaining permeable enough to allow for vigorous root growth.



Soil Cells

plastic interlocking modules that stabilize the soil beneath the plants, prevent soil compaction, and enable the root structure to develop.



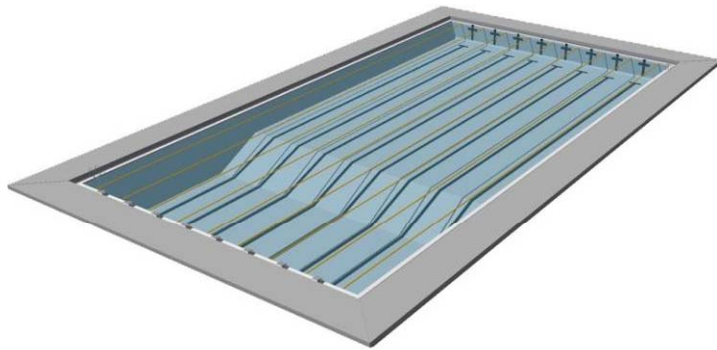
potential
pervious
surface area.

As long as air and water can move into and out of the soil mass, these options can serve dual duty for **tree growth** and **stormwater management**.

Stormwater Calculations

Every 1-acre planted with 40% tree canopy with appropriate soil volume will have the following stormwater benefits...

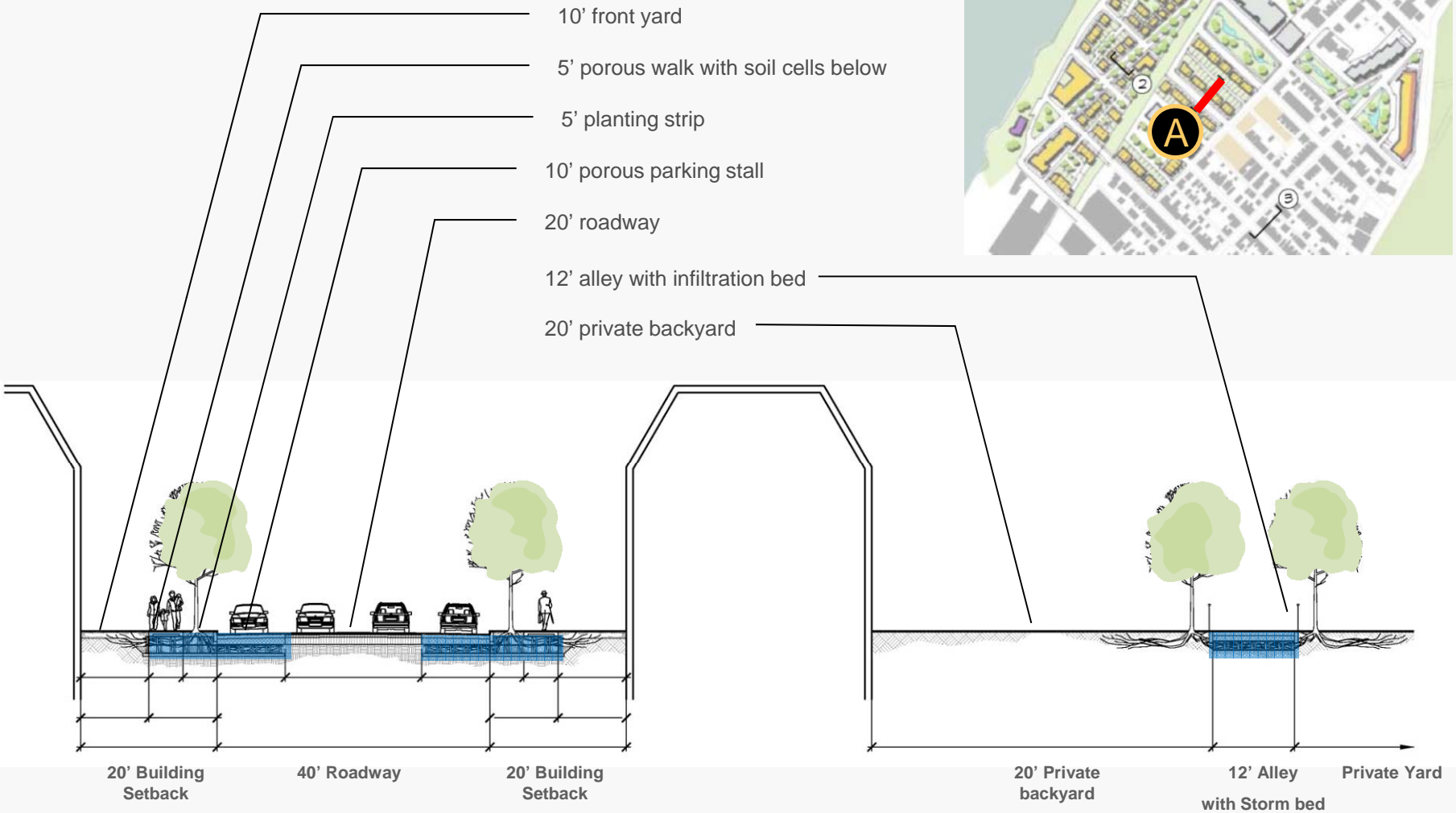
- Essentially remove 886,000 gallons (per acre/per year) of stormwater from the combined sewer system
- Capture 1.2 million gallons of runoff (per acre/per year) from impervious surfaces
- Capture 1.6 acres of *adjacent* impervious runoff



Enough stormwater runoff is captured per year (when planted at 40% tree canopy with appropriate soil volume) to fill 2,419 Olympic-sized swimming pools!

X 2,419

Prototypical Sections: Proposed Low Density with Backyard and Alley



Proposed Low Density with Backyard and Alley

Envisioning the New Riverfront

Strip District Today From 11th – 21st Street



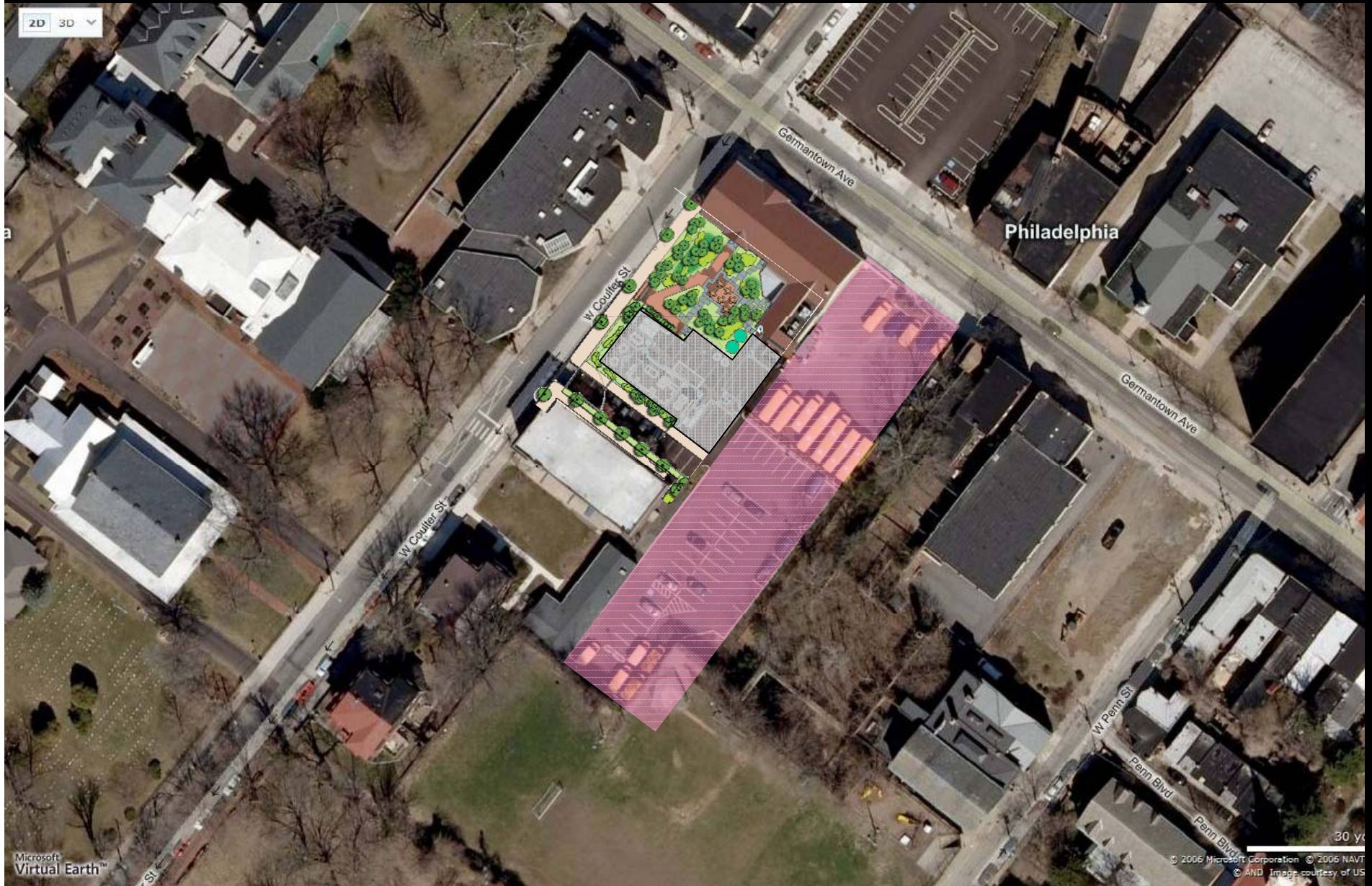
View looking east from 11th Street

Envisioning the New Riverfront

Proposed Strip District from 11th – 21st Street



A New Courtyard for Germantown Friends School Philadelphia PA



Current Conditions

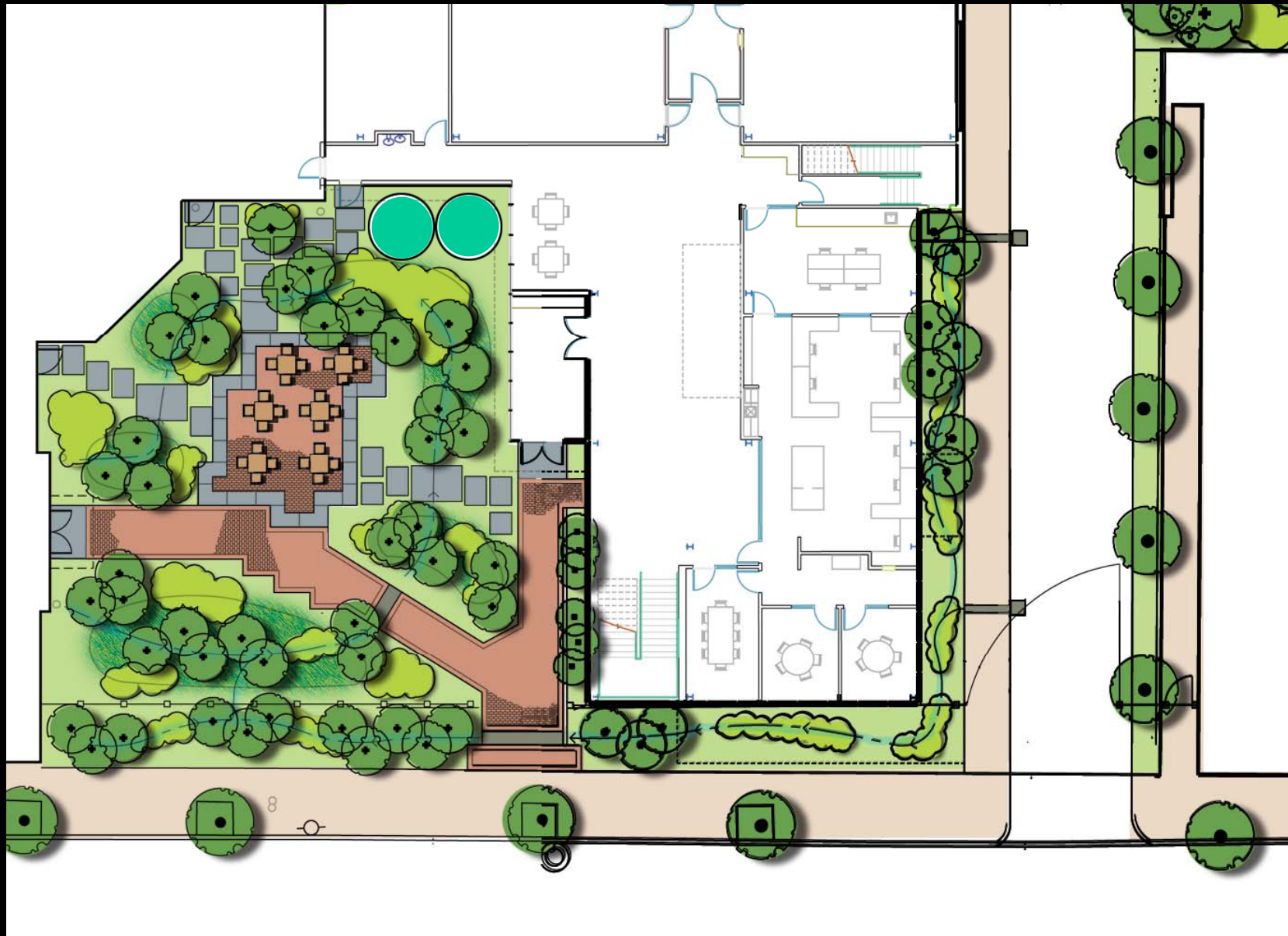




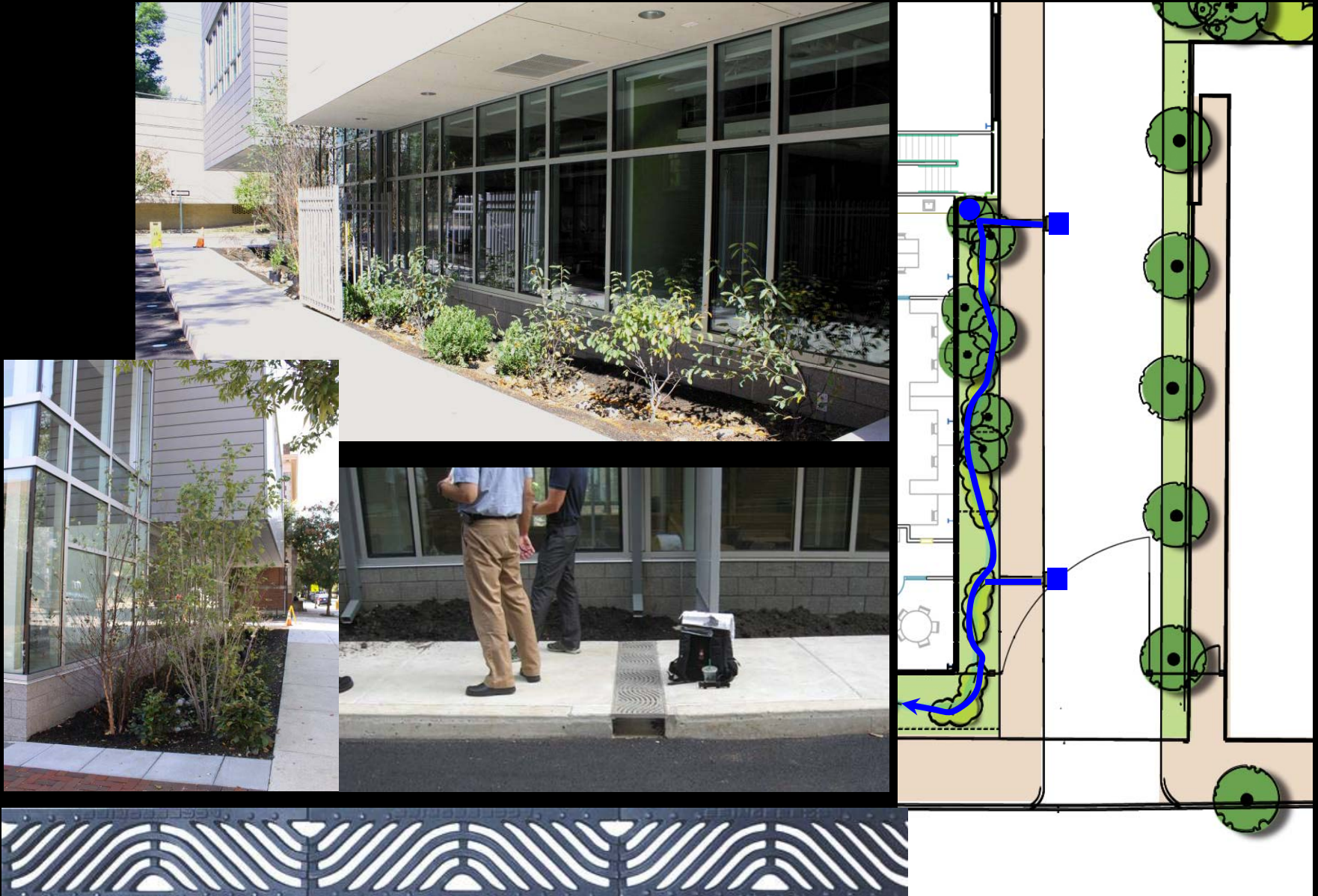
Current Conditions



Courtyard Plan

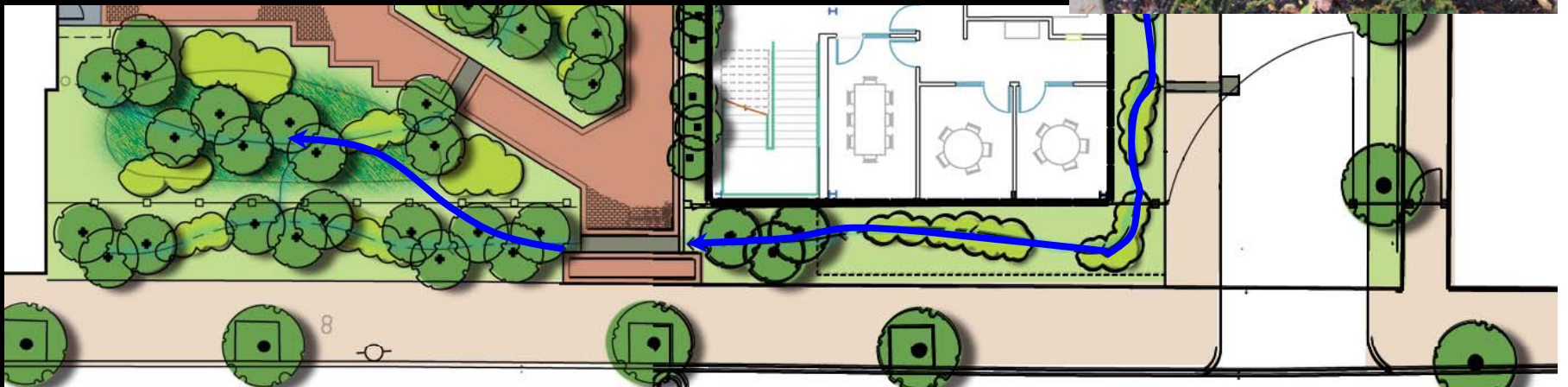


Harvest stormwater from the roof and street . . .



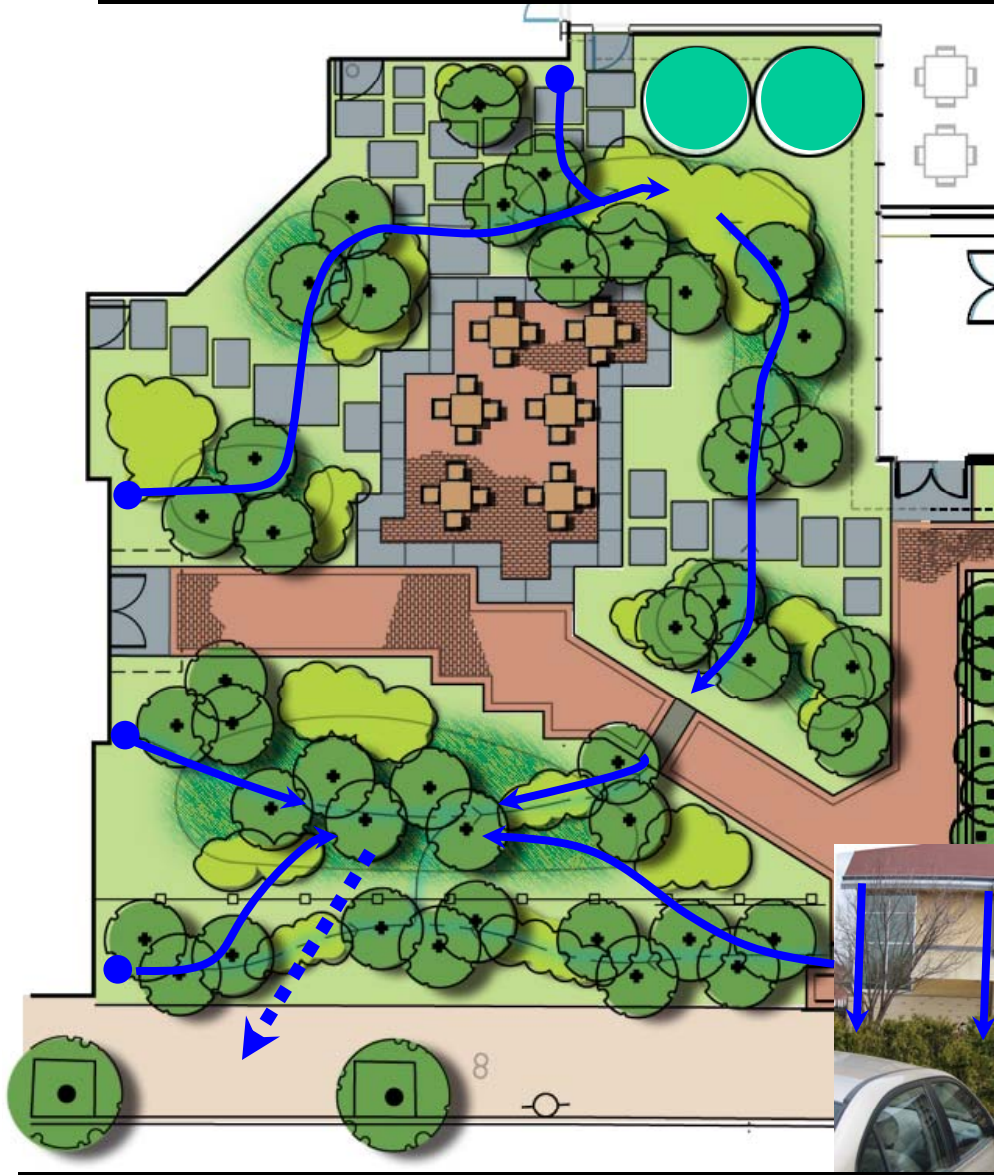
Inlets, curb breaks and downspouts with decorative splash blocks announce the cleansing chain.

Trace path of the water . . .



We used various techniques to express and highlight the path of the water.

Lush plantings cleanse the water . . .



With proper soil amendments and plantings, the courtyard became a lush woodland setting.

JULY 2009



Planted in the style of the Wissahickon Forest



Photo: Wissahickon Creek near Philadelphia c. 1865
from the National Gallery of Art by John Moran



Painting: *View on the Wissahickon*
by James Peale 1830

Planting Palette

Trees



Acer rubrum - red maple



Quercus palustris - pin oak



Betula nigra - river birch



Amelanchier canadensis - Shadblow serviceberry

Shrubs



Aronia arbutifolia - red chokeberry



Aronia melanocarpa - black choke-



Clethra anifolia - summer sweet



Cornus amomum - swamp dogwood



Eupatorium perfoliatum - boneset

Herbaceous



Ilex verticillata - winterberry holly



Onoclea sensibilis - sensitive fern



Salix discolor - pussywillow



Sambucus canadensis - elderberry



Spirea tomentososa - steeplebush



Verbena hastata - swamp verbena



Vernonia novaboracensis - New York ironweed



Aster novae-angiae - New England aster



Lobelia cardinalis - red cardinal flower
Lobelia siphilitica - blue cardinal flower



Eupatorium perfoliatum - bonset



Asclepias incarnata - swamp milkweed



Juncus effusus - common rush
Carex lurida - shallow sedge



Elymus virginicus - Virginia wildrye
Panicum virgatum - switchgrass



Scirpus cyperinus - woolgrass

Plants for the
Rain Gardens at
GFS Science
Building

Prepared by Viridian Landscape Studio
March 2007

JUNE 2009



Construction sequence
is critical and hard to
control



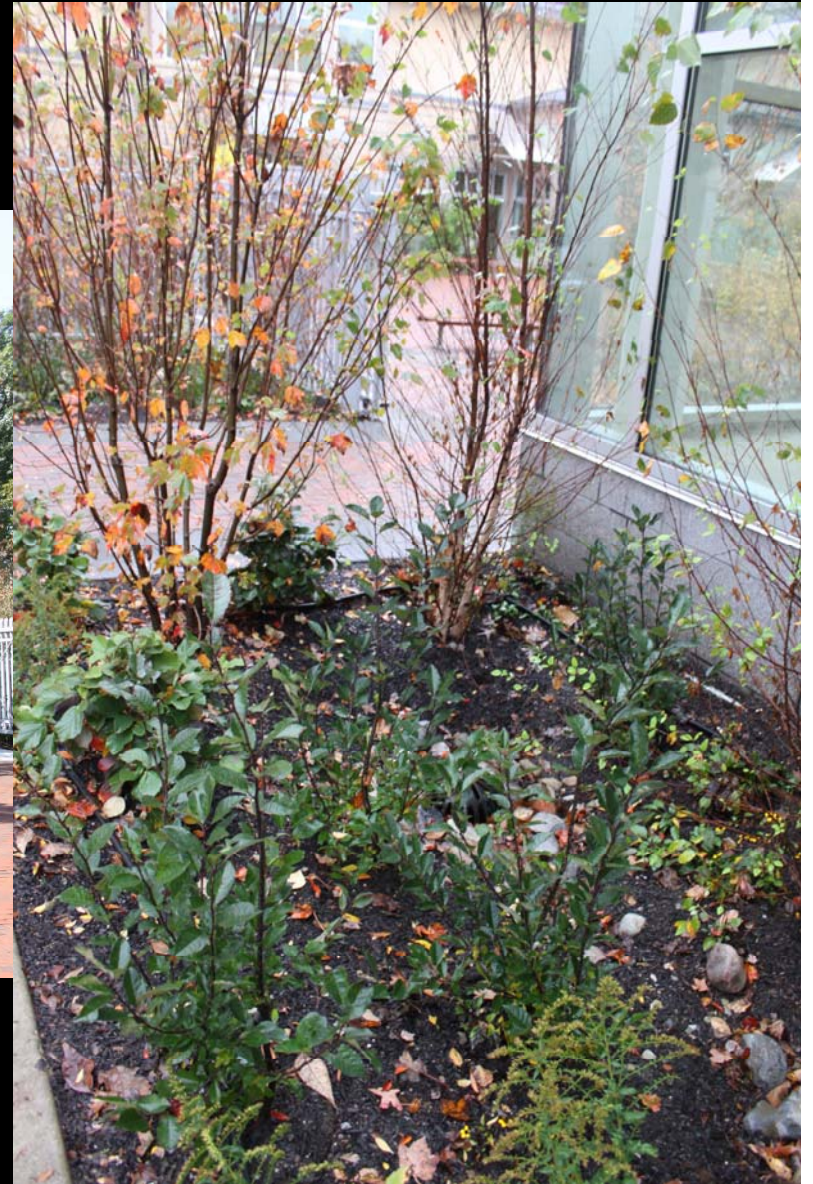
AUGUST 2009



Emulating the Wissahickon Forest

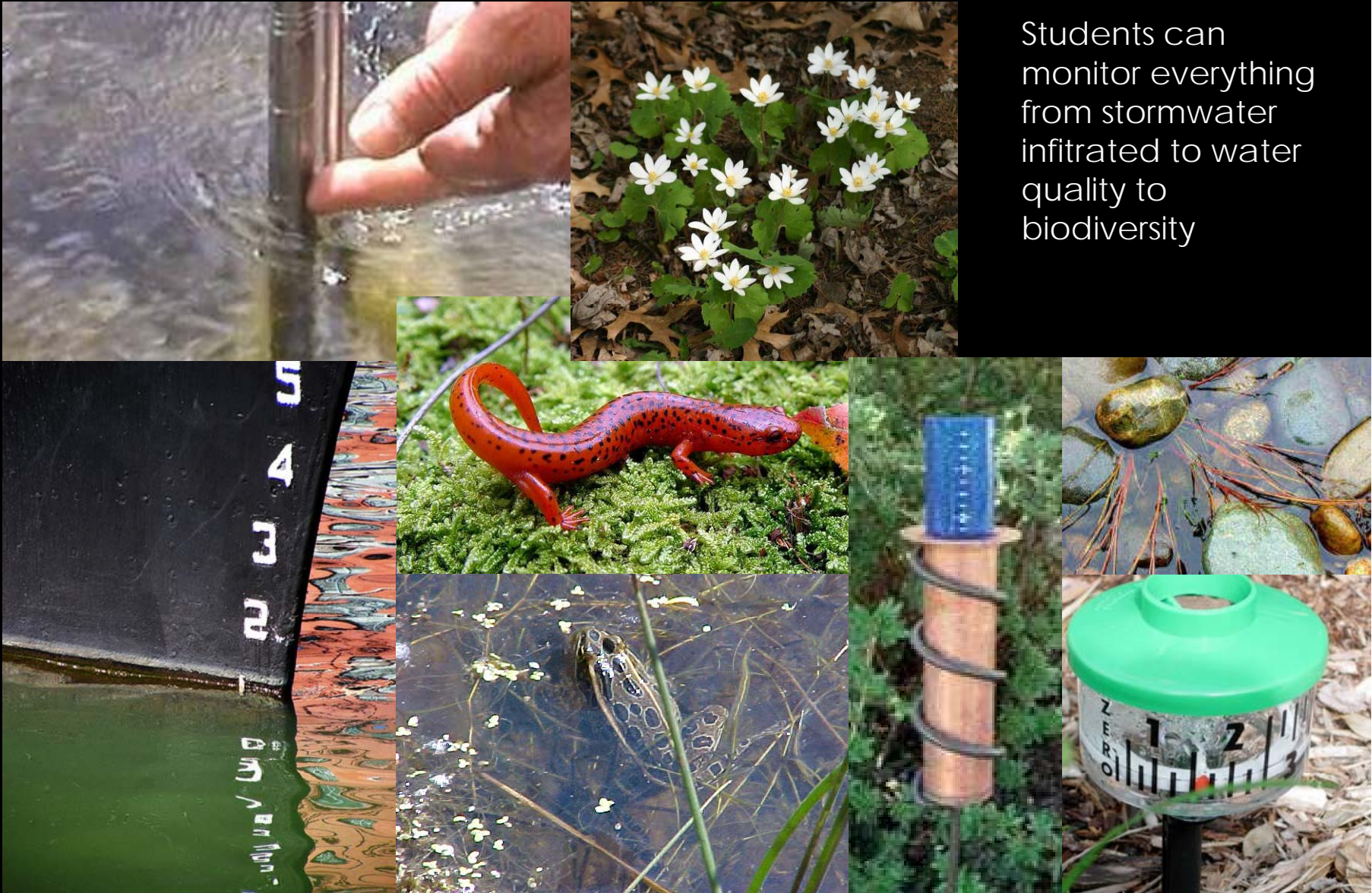


Emulating the Wissahickon Forest



Measures of success

Students can monitor everything from stormwater infiltrated to water quality to biodiversity



Cathedral of Hope

East Liberty Presbyterian Church



Viridian Landscape Studio

CH2MHill

Site Plan



N/T
 THE EAST LIBERTY PRESBYTERIAN
 CHURCH OF PITTSBURGH
 81,106.11 SQ. FT.
 1.862 ACRES

- LEGEND**
- LAWN
 - FLOWERING PERENNIALS AND GROUNDCOVER
 - LAWN SHRUBS AND PERENNIALS
 - CANOPY TREE
 - SMALL CANOPY TREE
 - FLOWERING / UNDERSTORY TREE

CH2MHILL

1717 MARSH STREET SUITE 400
 PITTSBURGH, PA 15203
 412-261-4220

Viridian
 landscape studio

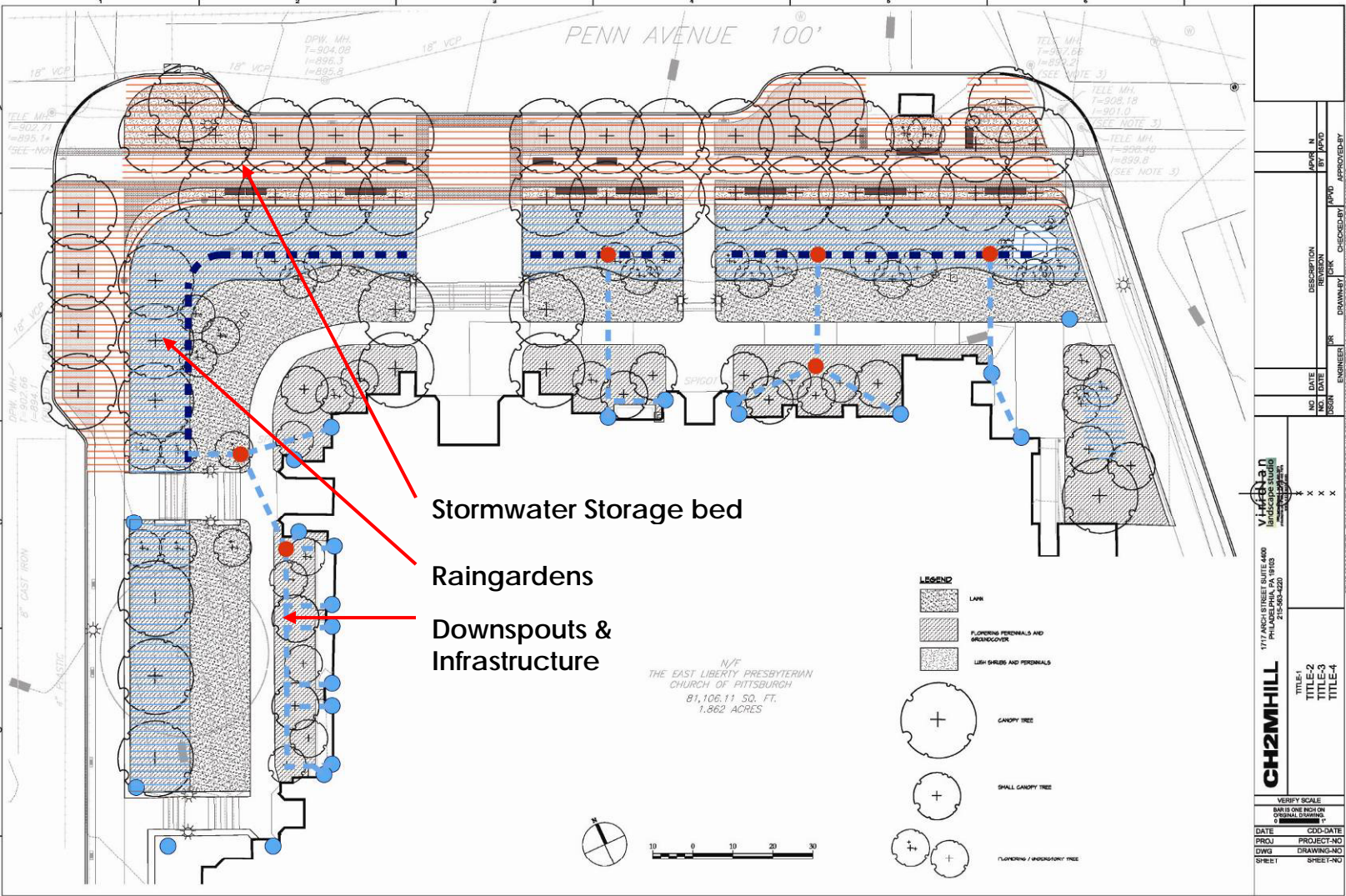
NO.	DATE	DESCRIPTION	APPROVED BY
DESIGN			
ENGINEER			
DRAMA/ART			
CHECKED BY			
APPROVED BY			

VERIFY SCALE
 MAKE ONE COPY ON
 ORIGINAL DRAWING

DATE: COD-DATE
 PROJ: PROJECT-NO
 DWG: DRAWING-NO
 SHEET: SHEET-NO

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Stormwater Management Plan: Infrastructure



Substrate Plan: Soil Volume (min. 600cf per tree)



N/Y
 THE EAST LIBERTY PRESBYTERIAN
 CHURCH OF PITTSBURGH
 81,106.11 SQ. FT.
 1.862 ACRES

- LEGEND**
- 600 CF SOIL VOLUME FOR TREES IF GROUPED
 - LAWN
 - FLOWERING PERENNIALS AND BRANCOVER
 - LUSH SHRUBS AND PERENNIALS
 - CANOPY TREE
 - SMALL CANOPY TREE
 - FLOWERING / UMBRELLA TREE

Viridian
 LANDSCAPE STUDIO
 1717 ARCH STREET SUITE 4400
 PHILADELPHIA PA 19103
 215-482-4200
 www.viridianstudio.com

NO.	DATE	DESCRIPTION	BY	APPROVED BY
1		CONCEPT		
2		SCHEMATIC DESIGN		
3		PRELIMINARY DESIGN		
4		FINAL DESIGN		

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TITLE 1
 TITLE 2
 TITLE 3
 TITLE 4

VERIFY SCALE

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DATE	CCO DATE

PROJ	PROJECT NO

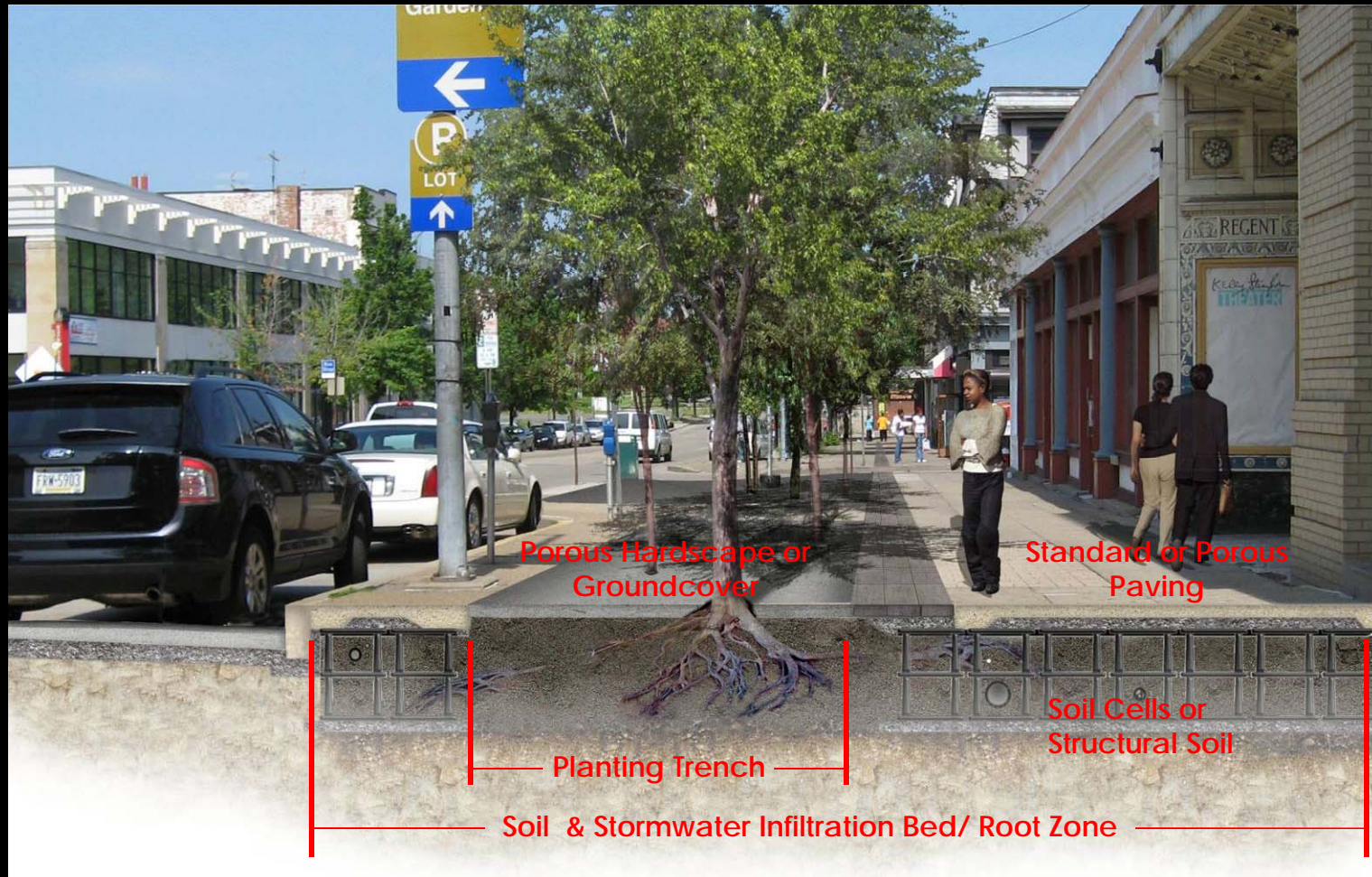
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SHEET	SHEET NO

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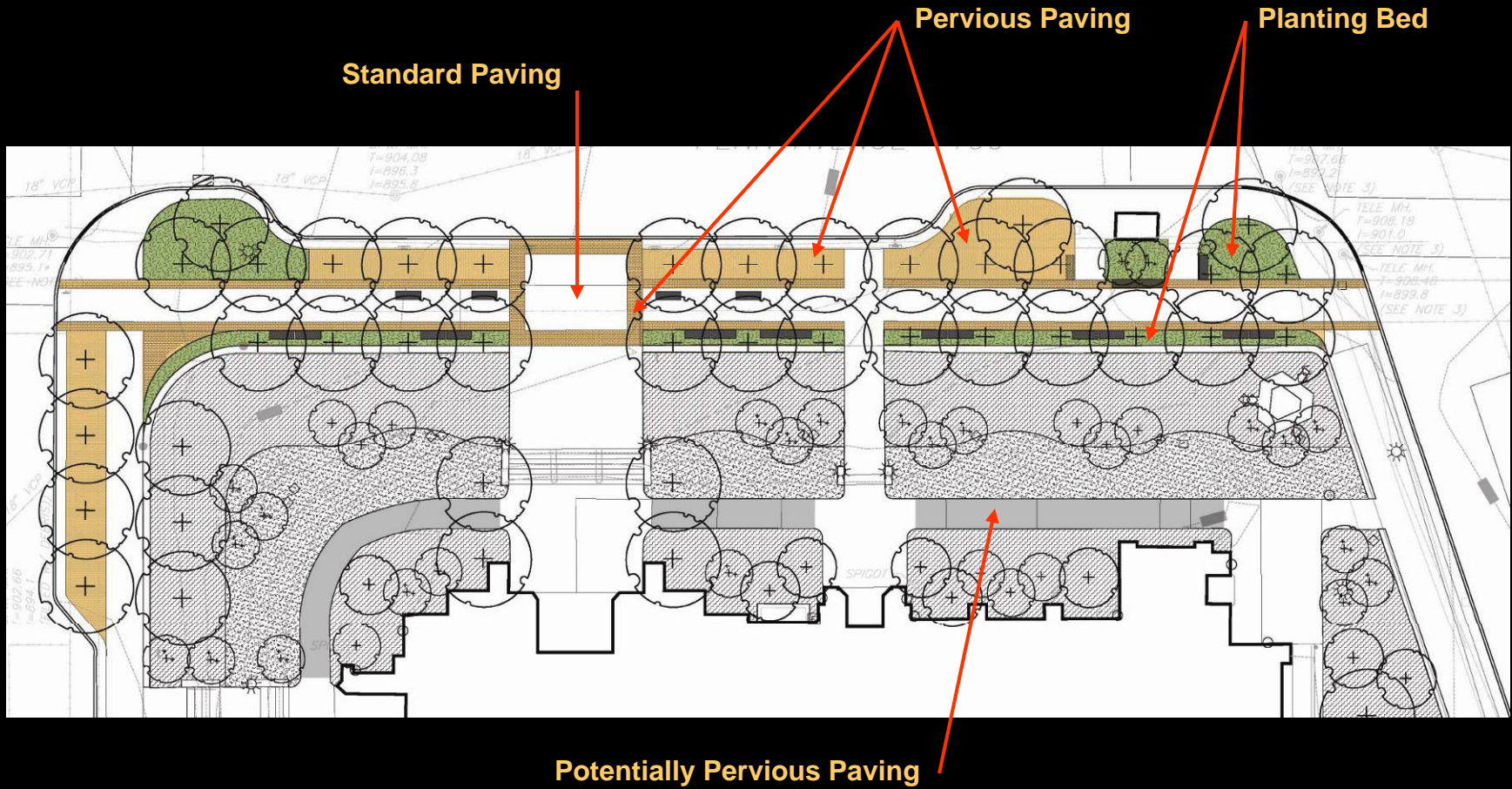
Trench Configurations and Sizes: Soil Volume

What happens underground / who maintains it?



Hardscape Materials

Paving Option Diagram



Hardscape Materials

Porous paving options



Porous Pavers



Porous Concrete

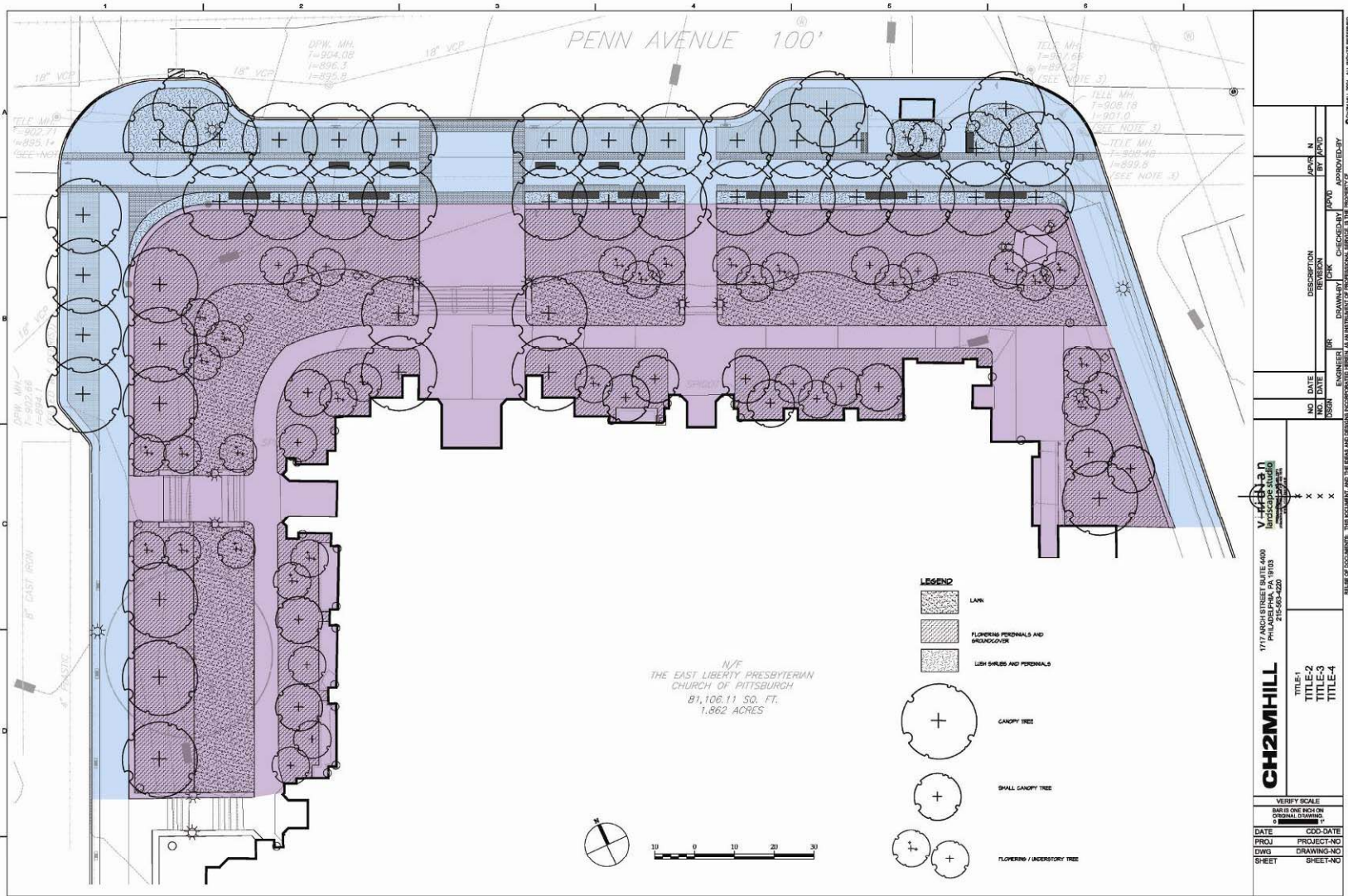


Porous Asphalt



Porous Resin Bonded Aggregate

Management Plan: Public vs. Private



Maintenance Plan: Tree Ownership?



Green Utilities: Soils, Trees and Stormwater

If we solve the stormwater and give proper soil volume, we can achieve streetscapes that solve our CSO problems, deliver robust Urban Forests and provide livable communities



Restoring the City: The Greening of Greenfield School



Viridian Landscape Studio



SMP Architects

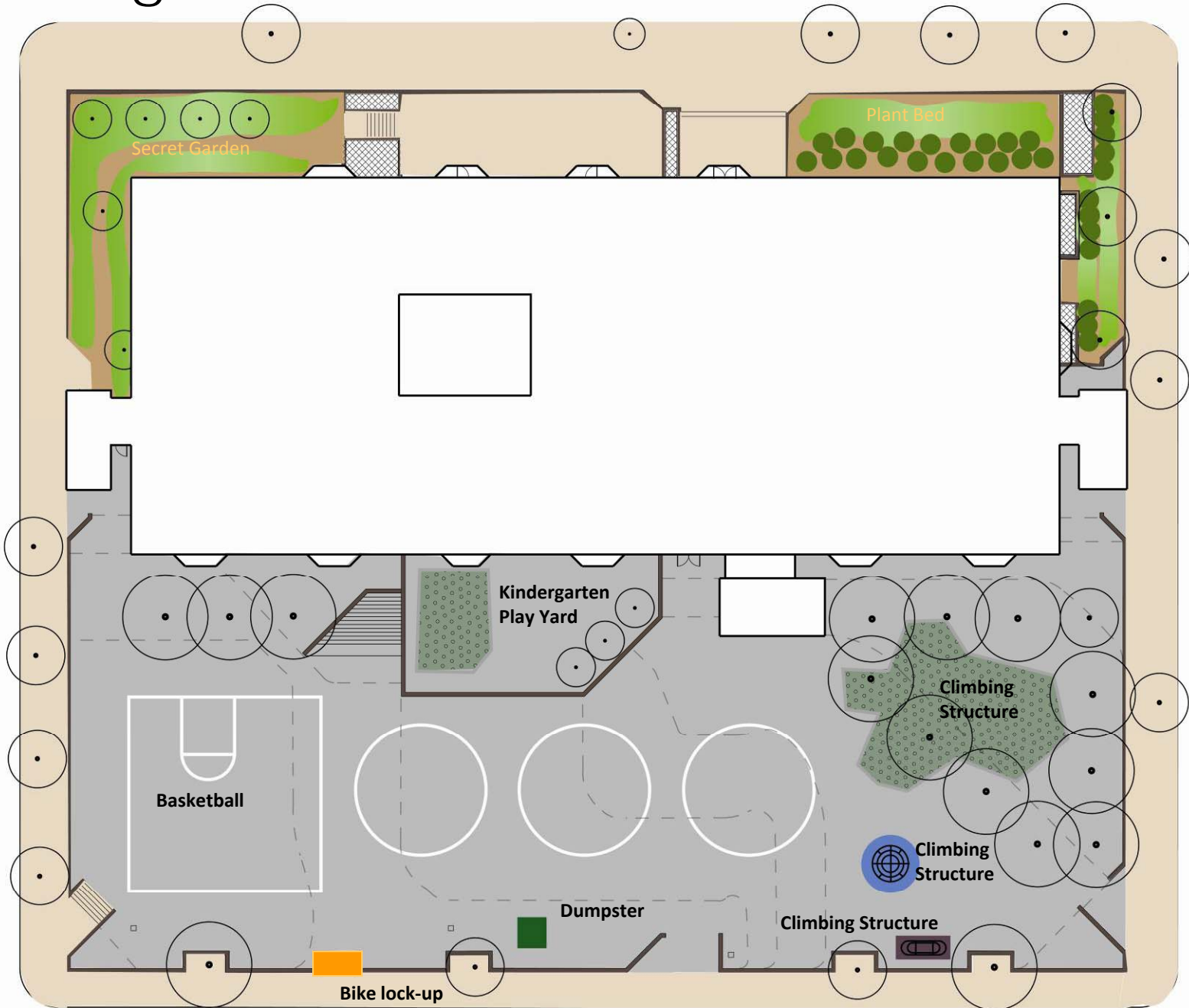


Meliora Environmental Design

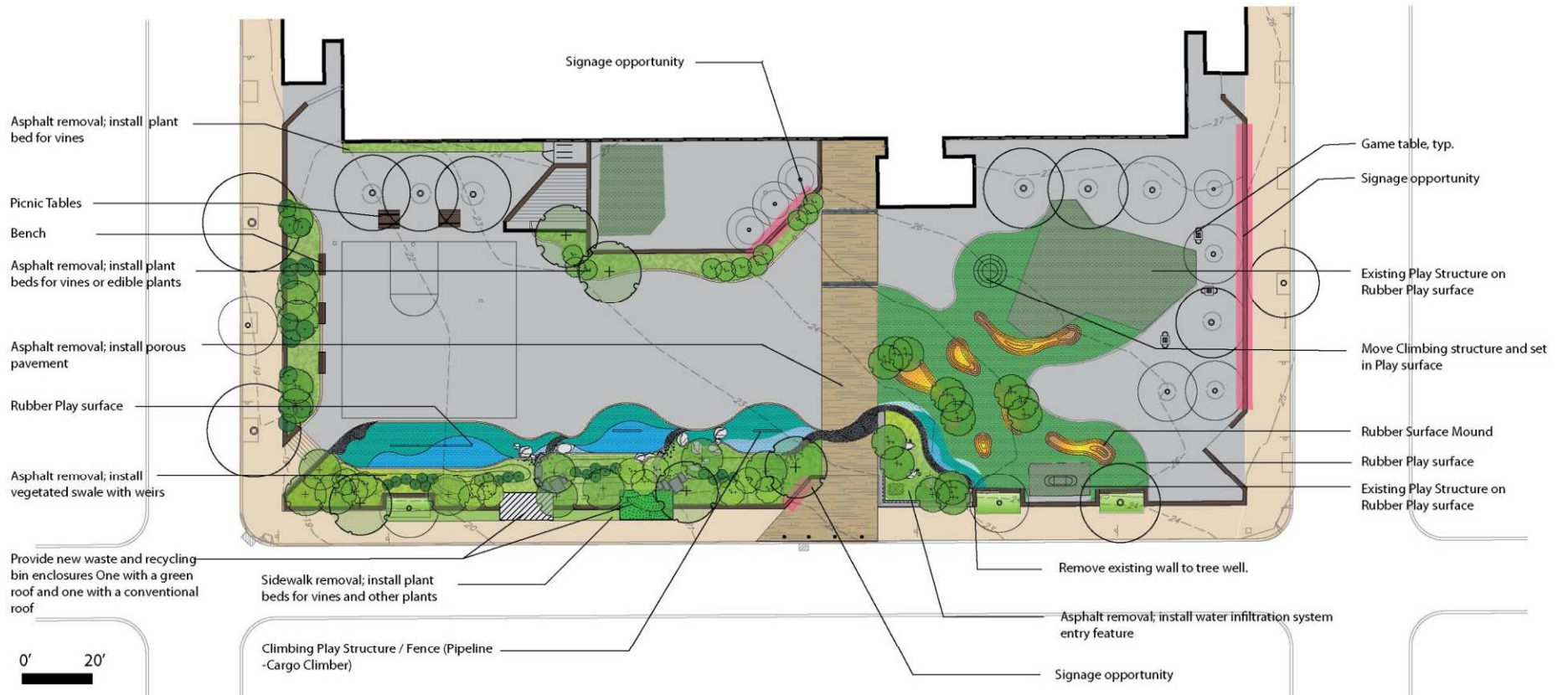
Vegetation Assessment Practices: Site Inventory Adjacent Parkland



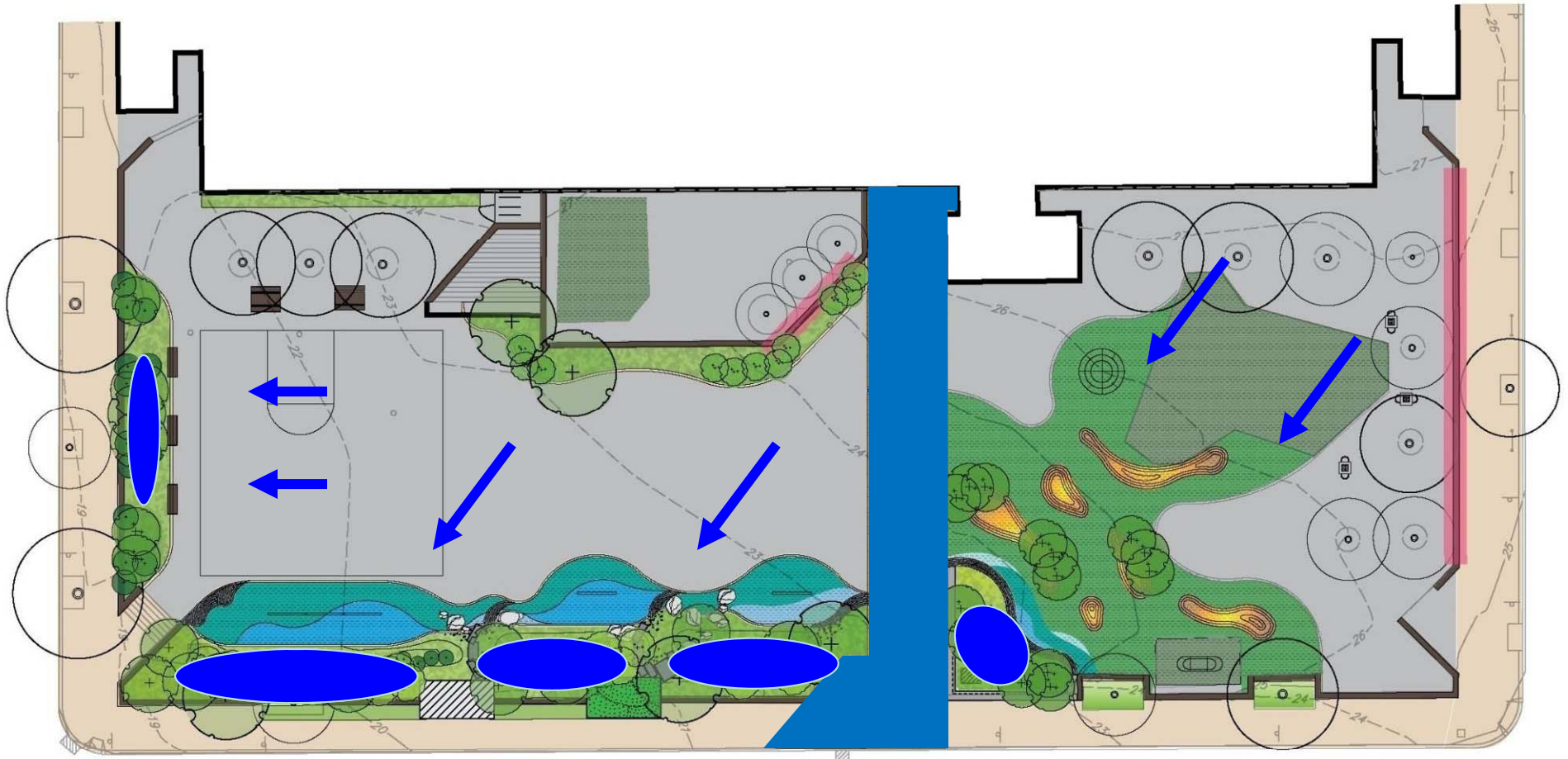
Existing Plan



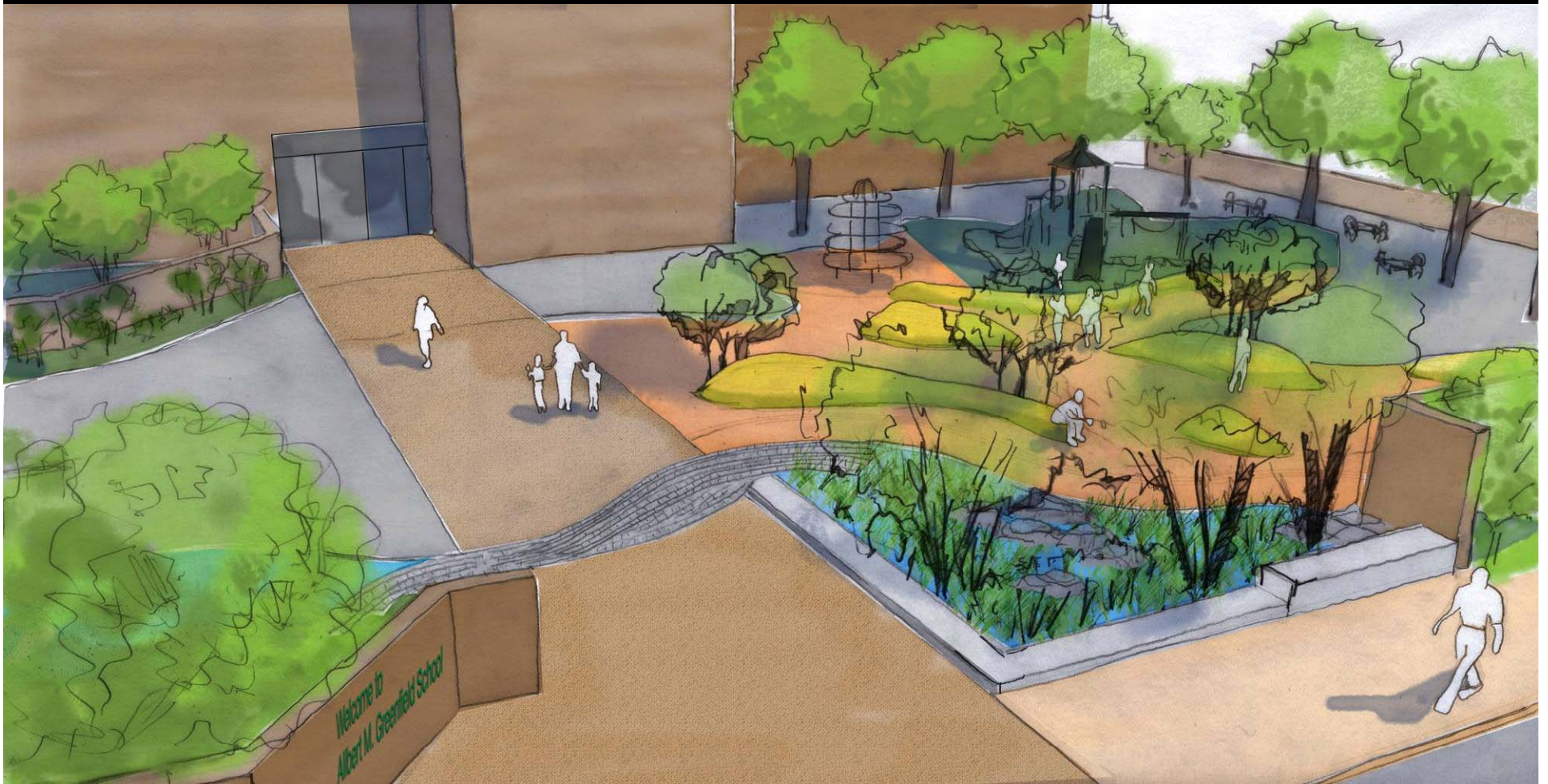
Overall Plan



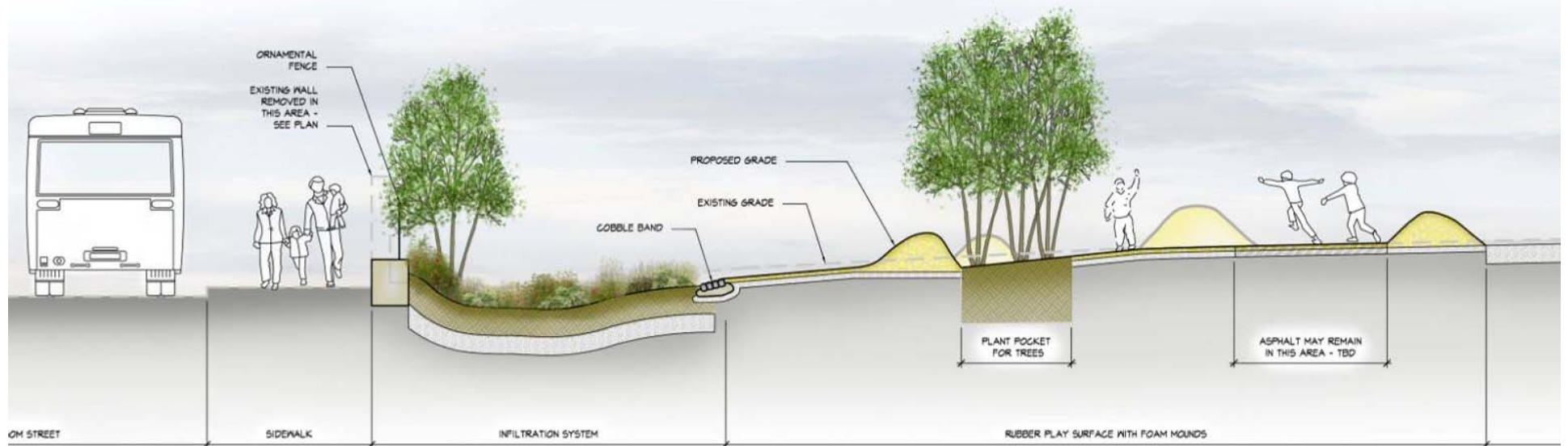
Stormwater Plan



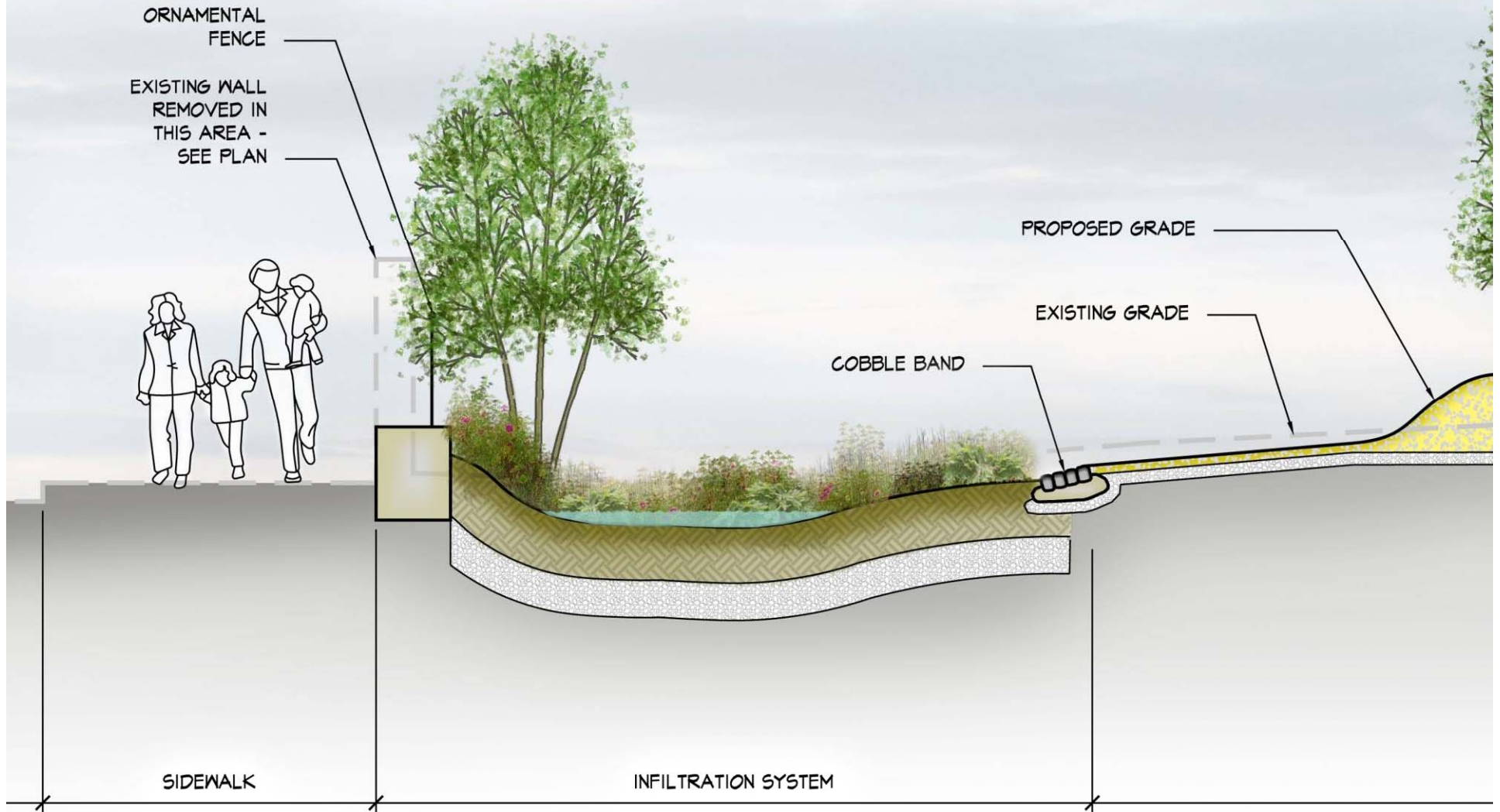
East Play Yard



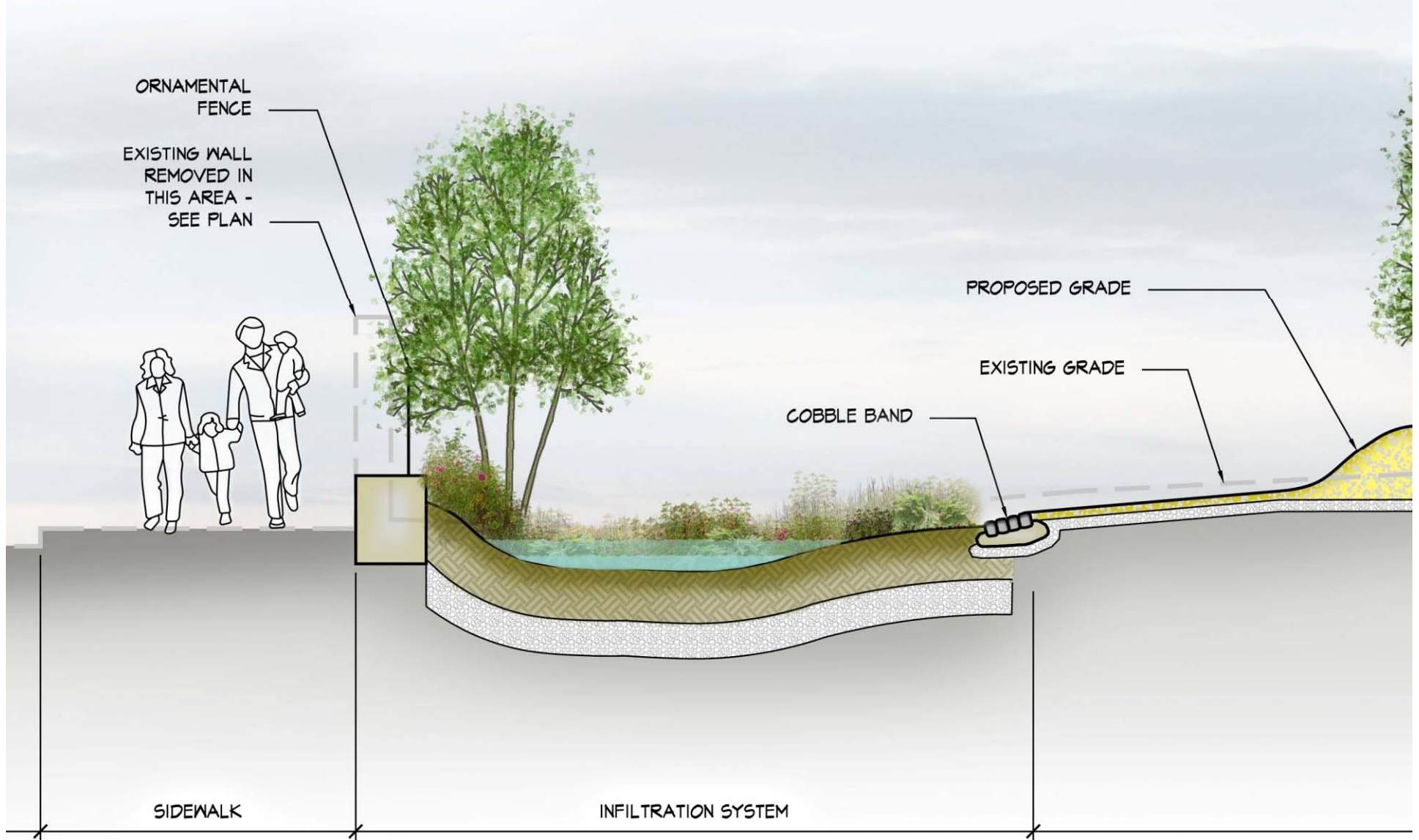
East Play Yard: Cross Section



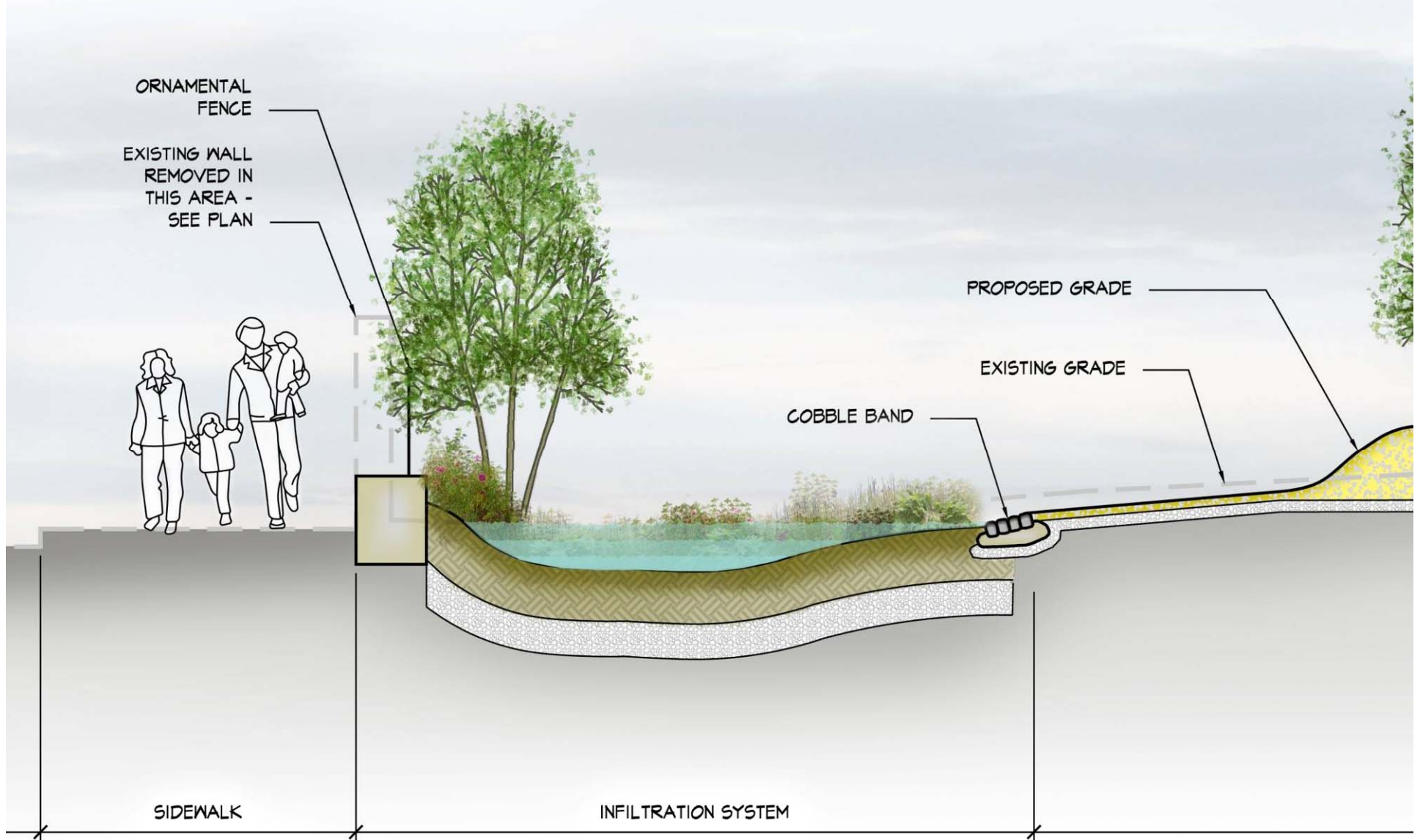
East Play Yard: Entry Feature



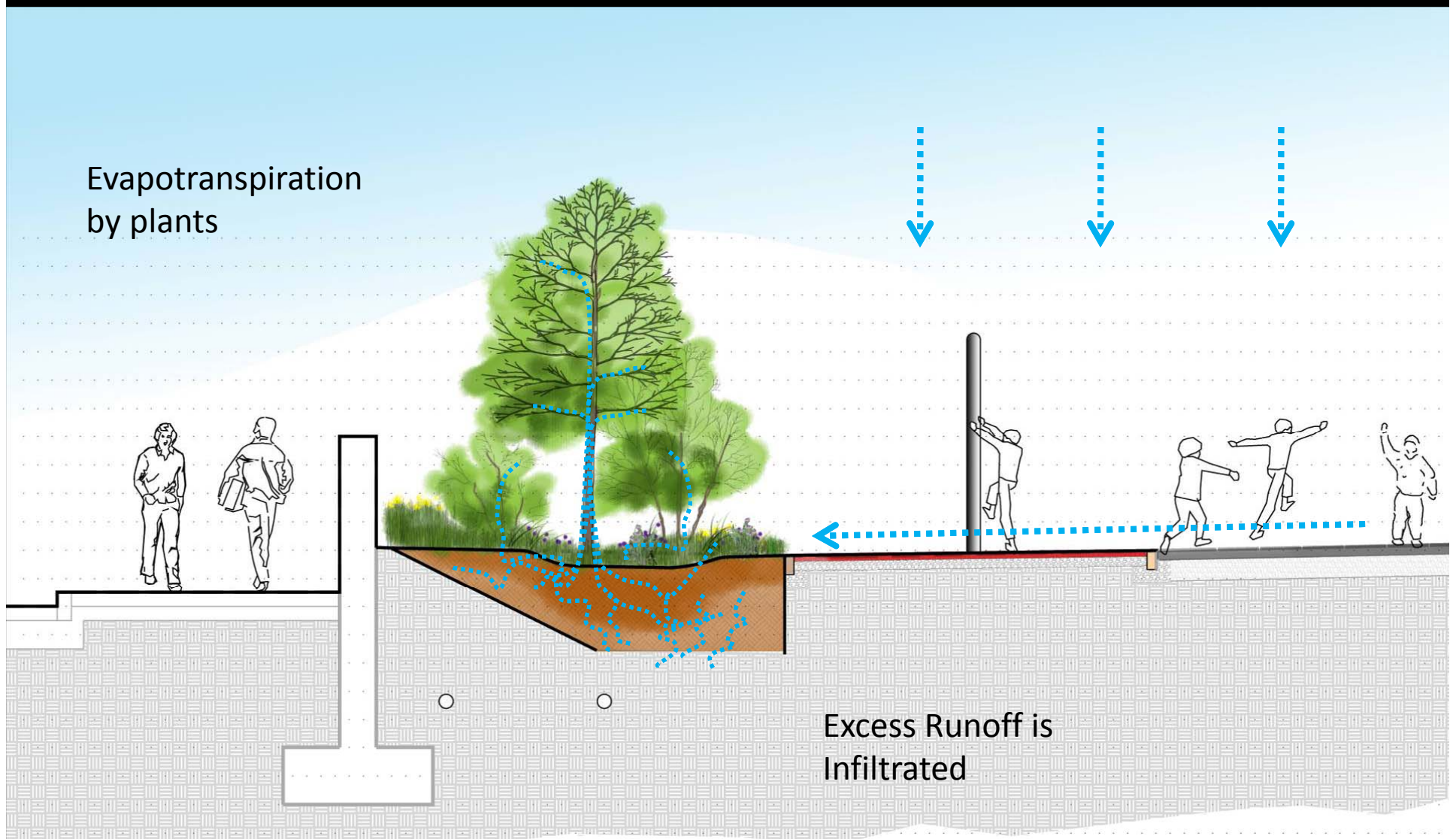
East Play Yard: Entry Feature



East Play Yard: Entry Feature

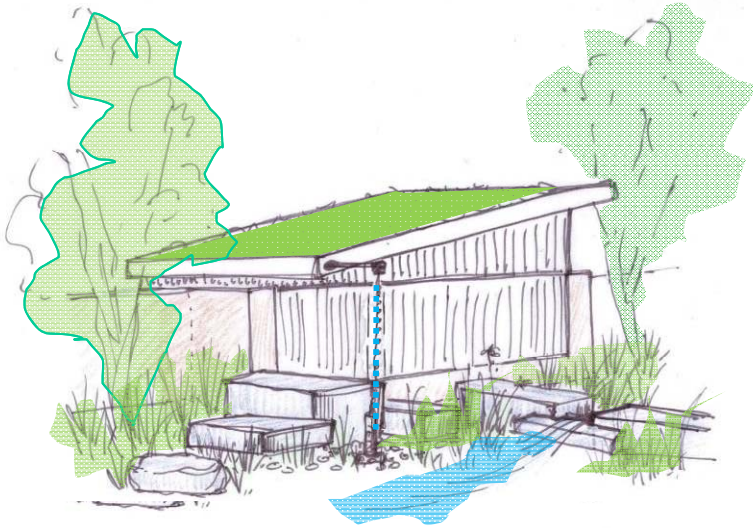


West Play Yard: Cross Section at Infiltration Swale



South Swale

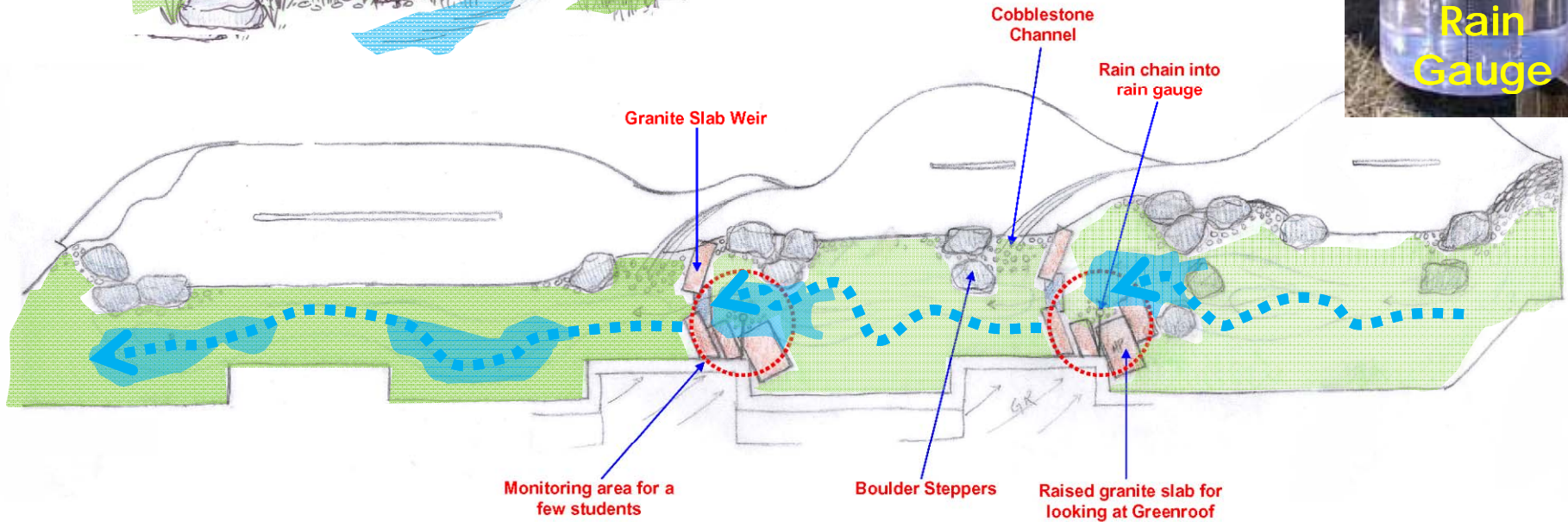
©www.RainChains.com



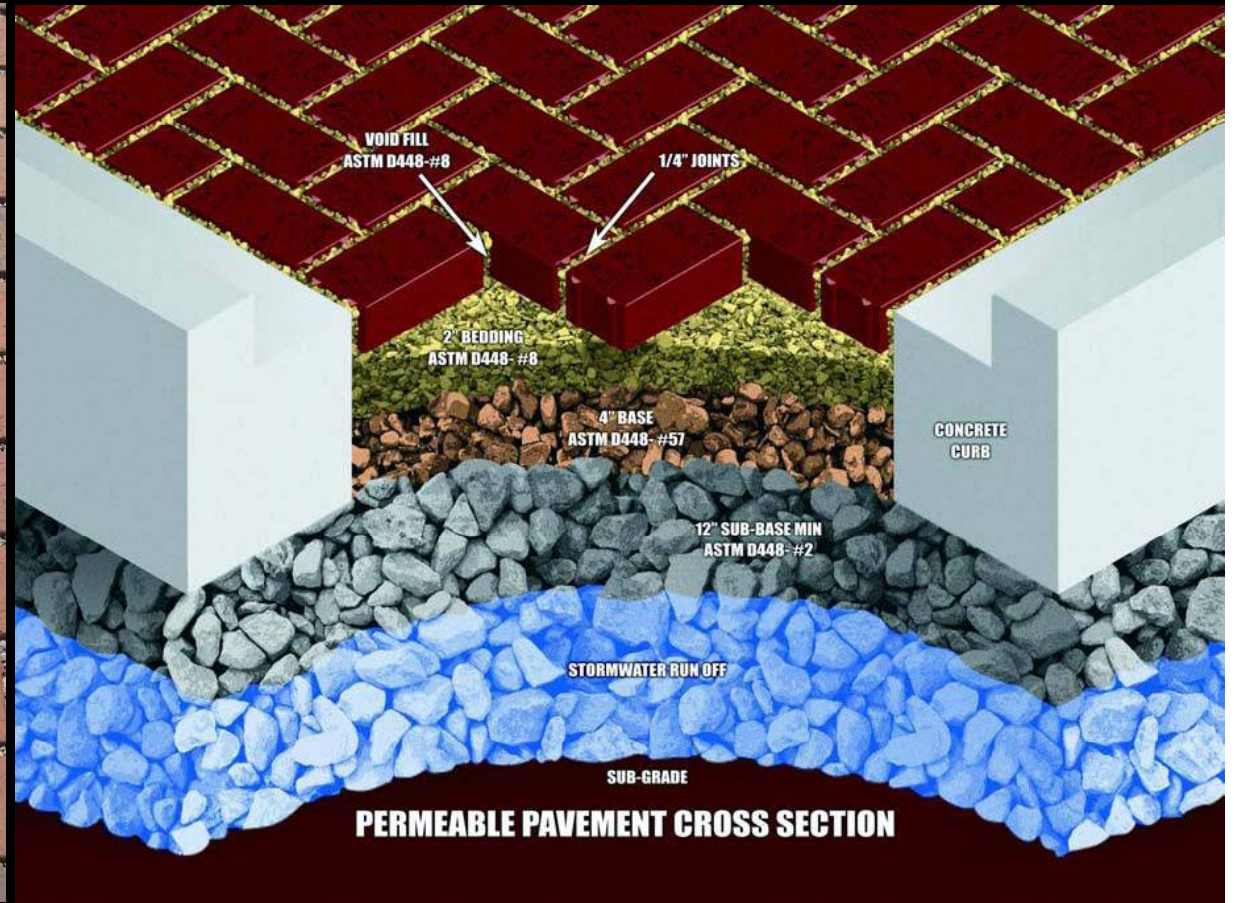
Rain Chain



Rain Gauge



Porous Pavers:



Rubber Play Surface



SofCRETE Colors



Black



Green



Blue



Brown



Grey



Terra Cotta



Beige





Marble and granite from Independence Mall



Granite from the Philadelphia Zoo



Sandstone Bridge Abutments from Schuylkill River Bridges









Greenfield Green Facts

38 trees planted

59 shrubs planted

503 herbaceous perennials

Phase 1 Existing

17225 sf Impervious Cover

98.7 % of Impervious Cover

230 sf Pervious Cover

01.3% of Pervious Cover

Phase 1 As Built

14783 sf Impervious Cover

84.7% of Impervious Cover

2672 sf Pervious Cover

15.3% of Pervious Cover

Phase 2 Existing

8756 sf Impervious Cover

85.1 % of Impervious Cover

1537 sf Pervious Cover

14.9% of Pervious Cover

Phase 2 As Built

4905 sf Impervious Cover

47.7% of Impervious Cover

5388 sf Pervious Cover

52.3% of Pervious Cover



We can restore the environment by
reconnecting
Water, Soils, & Vegetation



And celebrating place!

