# Green Infrastructure for Climate Resilience, Stormwater Management, and Economic Development

**Johnson Controls Headquarters**
Glendale, Wisconsin

**ECT – Chicago/Lombard**

ECT Environmental Consulting & Technology, Inc.

# Green Infrastructure for Climate Resilient Stormwater Management and Economic Development

- DISTRIBUTED VS END-OF-PIPE STORMWATER SYSTEMS
- GREEN INFRASTRUCTURE PRACTICES
- GREEN INFRASTRUCTURE CASE STUDIES

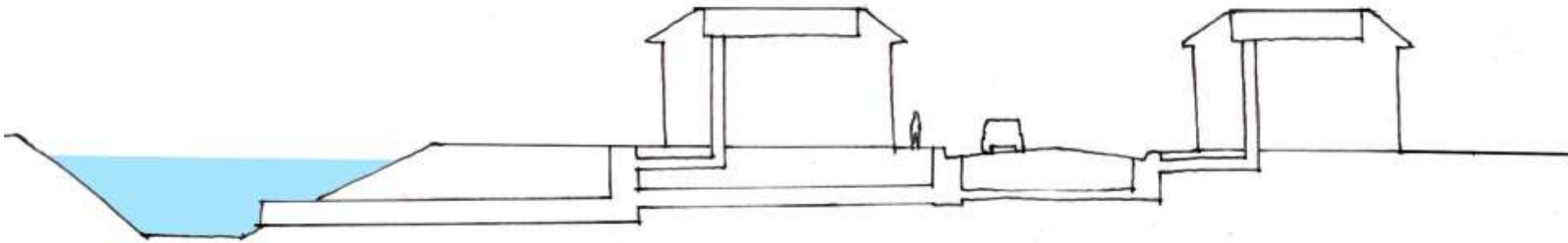
ECT Environmental Consulting & Technology, Inc.

# End of Pipe vs Distributed Green Infrastructure

End of pipe detention basin

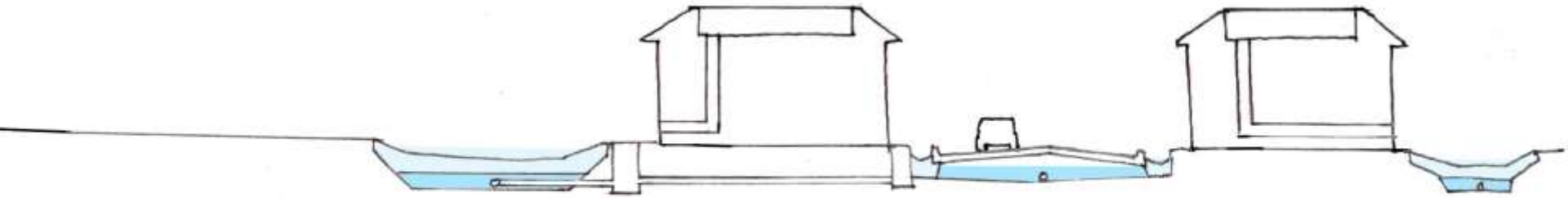
## Change Our View – Change the Paradigm

## End of Pipe vs Distributed Green Infrastructure



## Change Our View – Change the Paradigm

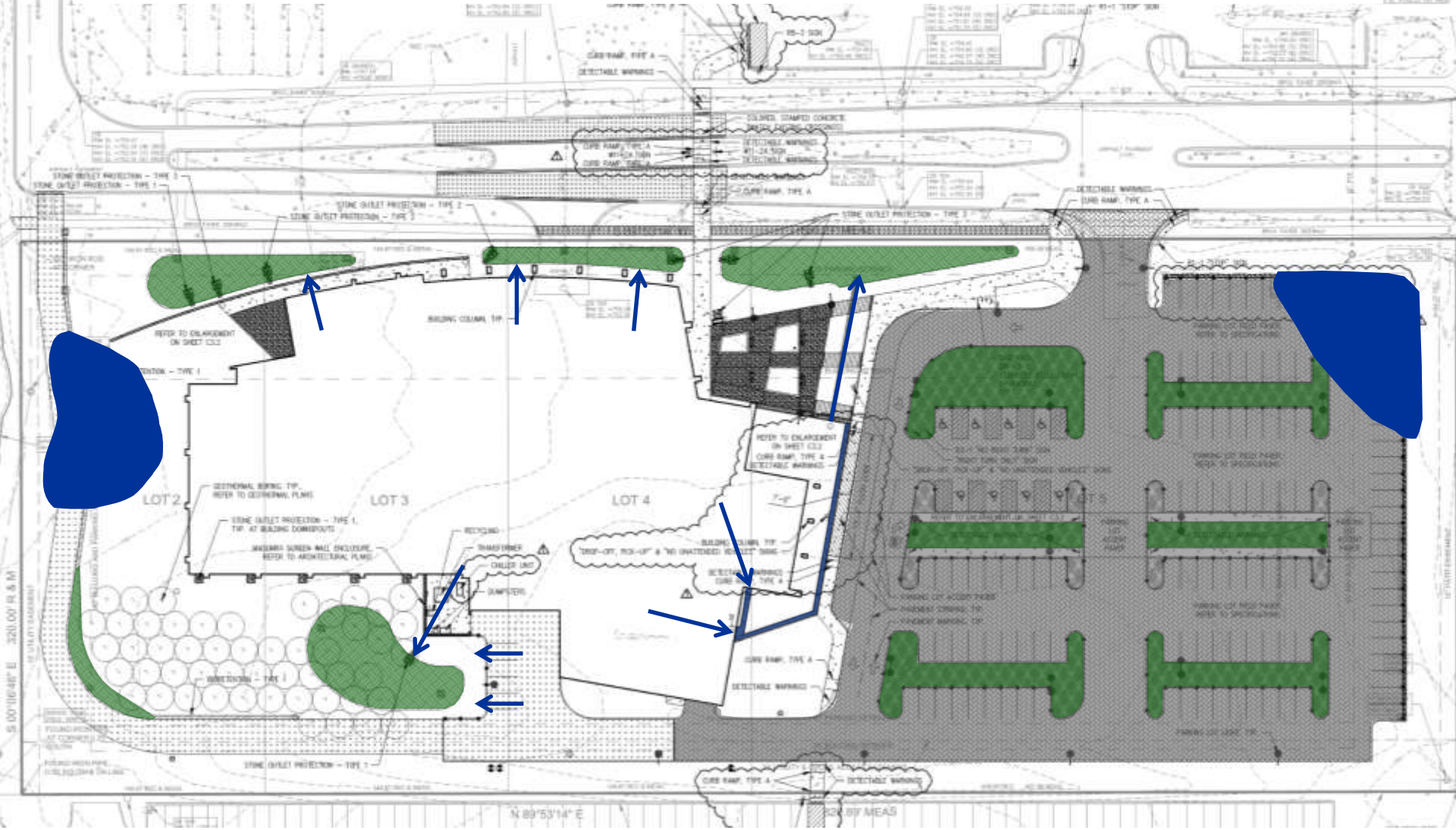
## End of Pipe vs Distributed Green Infrastructure



# End of Pipe vs Distributed Green Infrastructure

Distributed system with permeable paving and bioretention

# End of Pipe vs Distributed Green Infrastructure



# WHY MANAGE STORMWATER?

## PUBLIC HEALTH (CSO'S)

## SOIL CONSERVATION

## FLOODING / BASEMENT BACKUPS

## AQUATIC ECOSYSTEMS

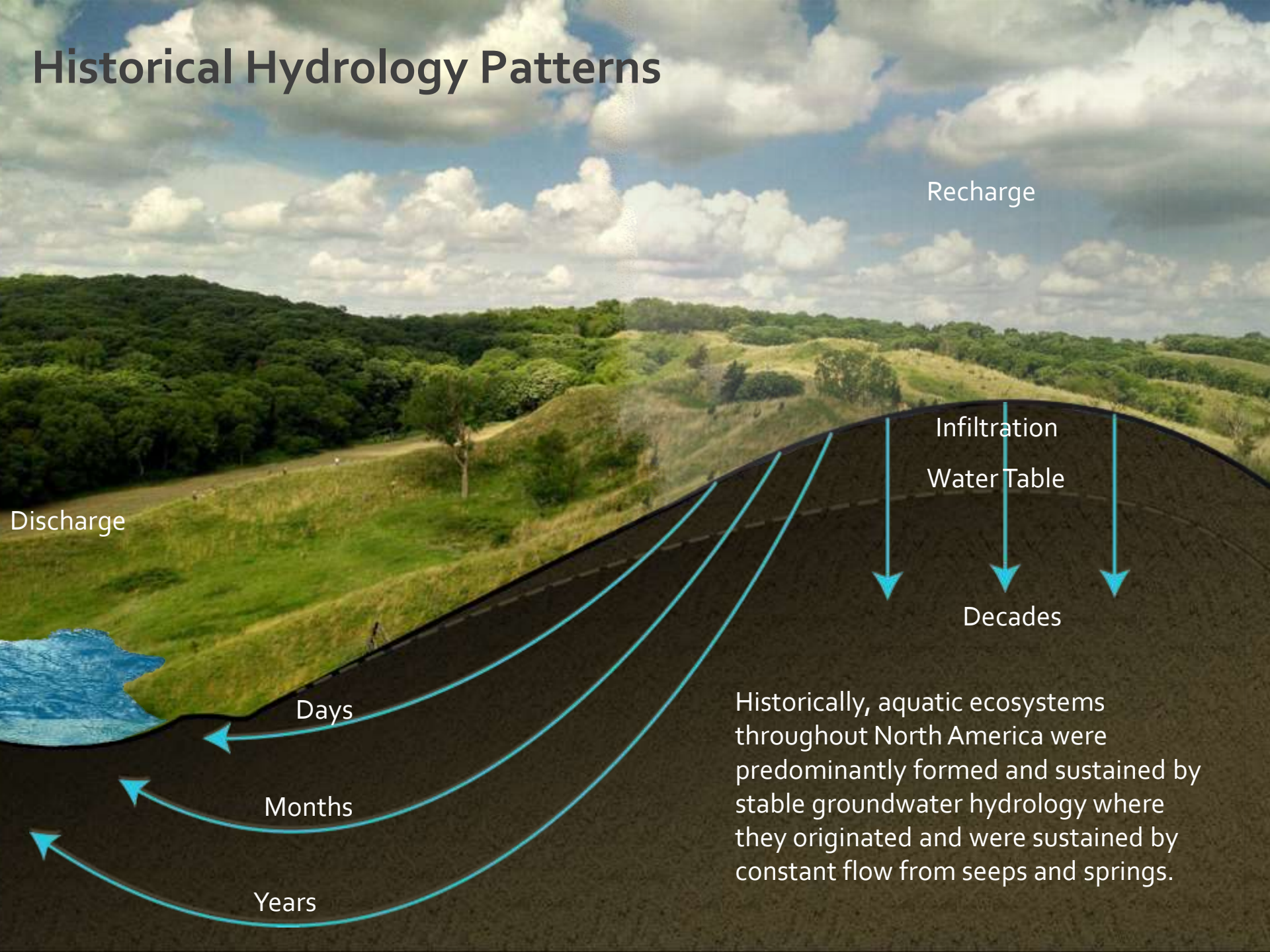
# A Living Systems Approach

*Nature holds the key to our aesthetic, intellectual, cognitive and even spiritual satisfaction.*

*- E. O. Wilson*

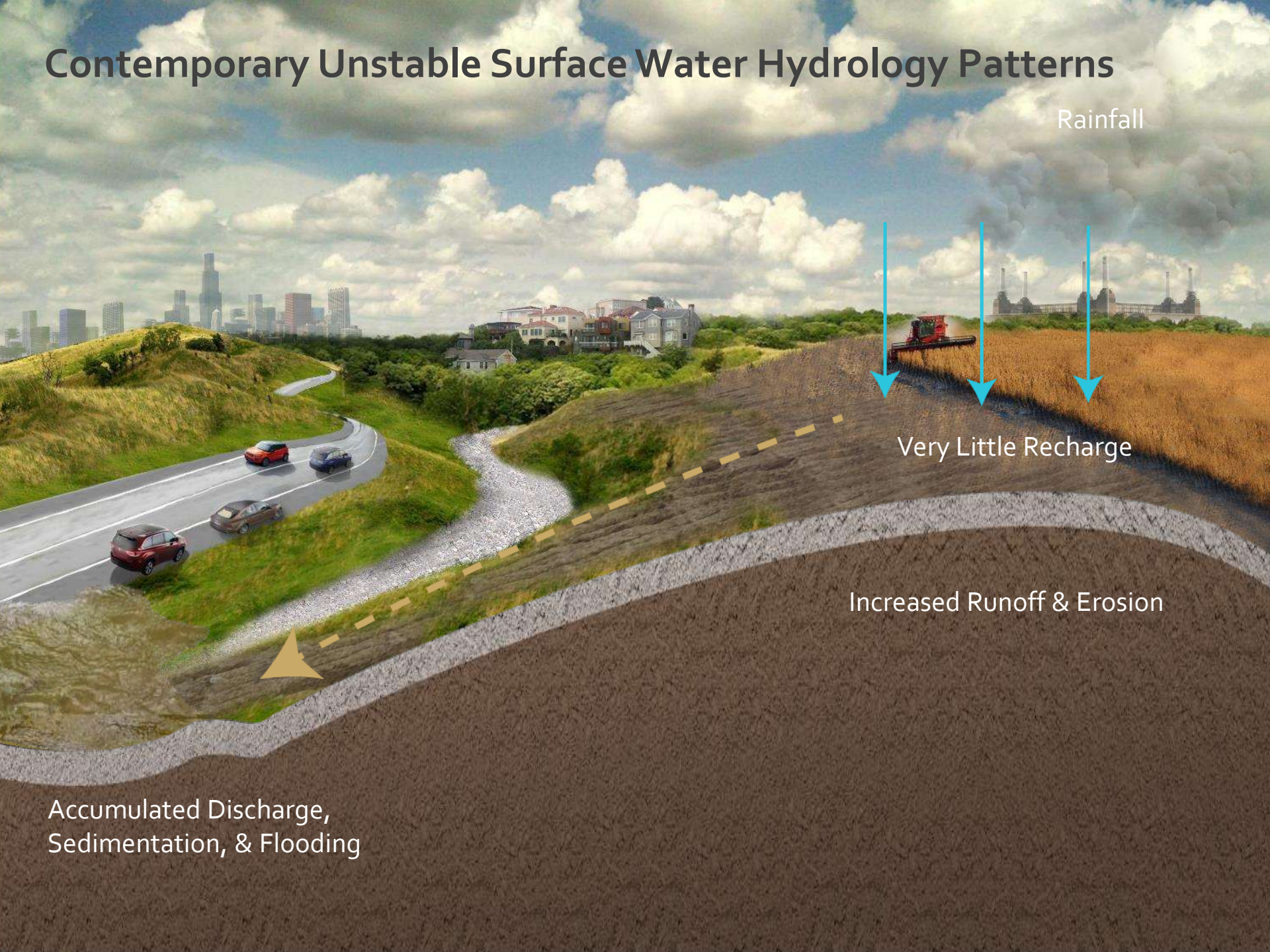
**ASLA Headquarters**
Washington D.C.

# Historical Hydrology Patterns




Historically, aquatic ecosystems throughout North America were predominantly formed and sustained by stable groundwater hydrology where they originated and were sustained by constant flow from seeps and springs.

# Contemporary Unstable Surface Water Hydrology Patterns



# GREEN STORMWATER INFRASTRUCTURE

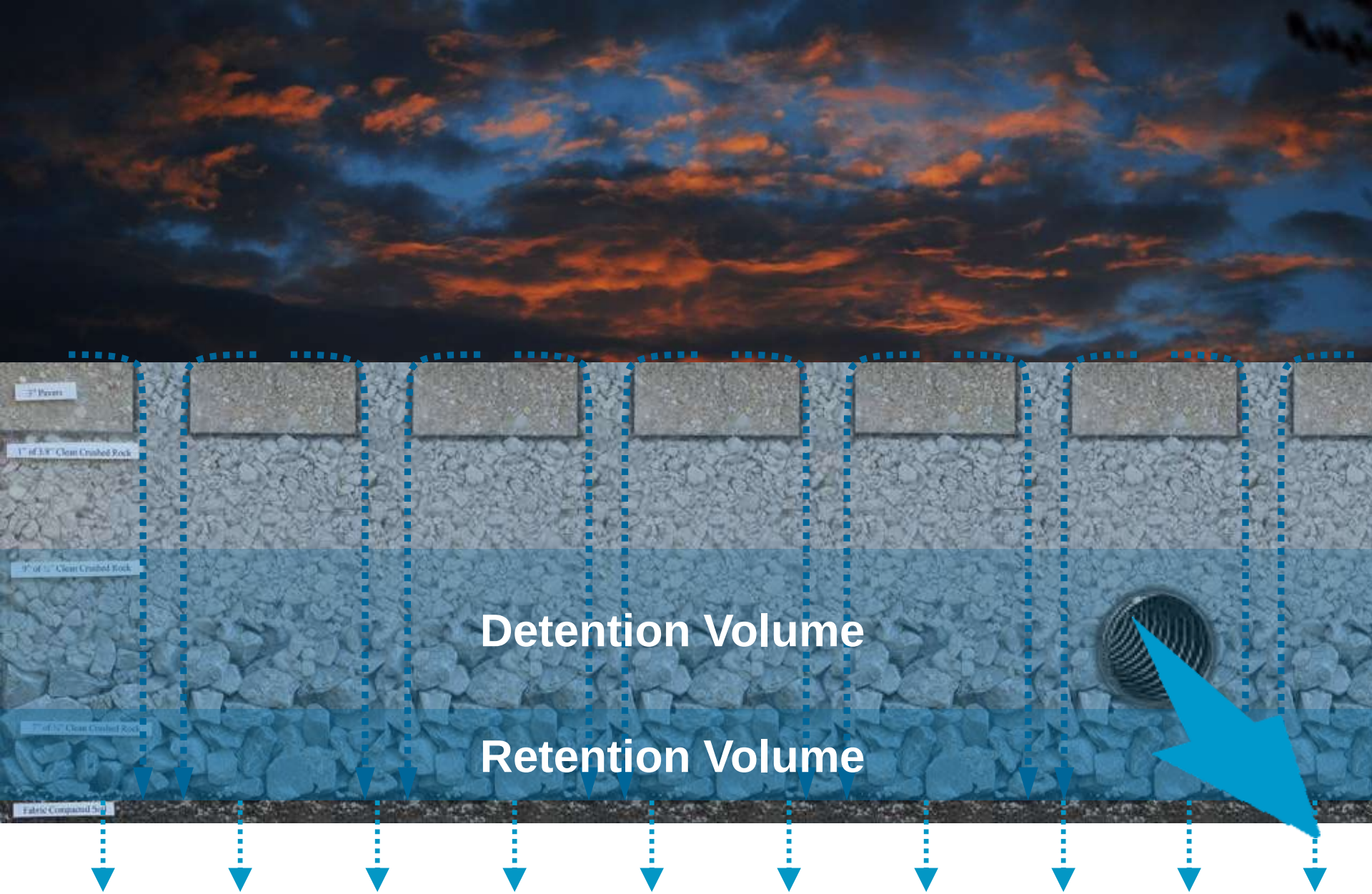
## PERMEABLE PAVING

## GREEN ROOFS

## NATURALIZED PLANTINGS

## BIORETENTION / RAIN GARDENS

# Permeable Paving

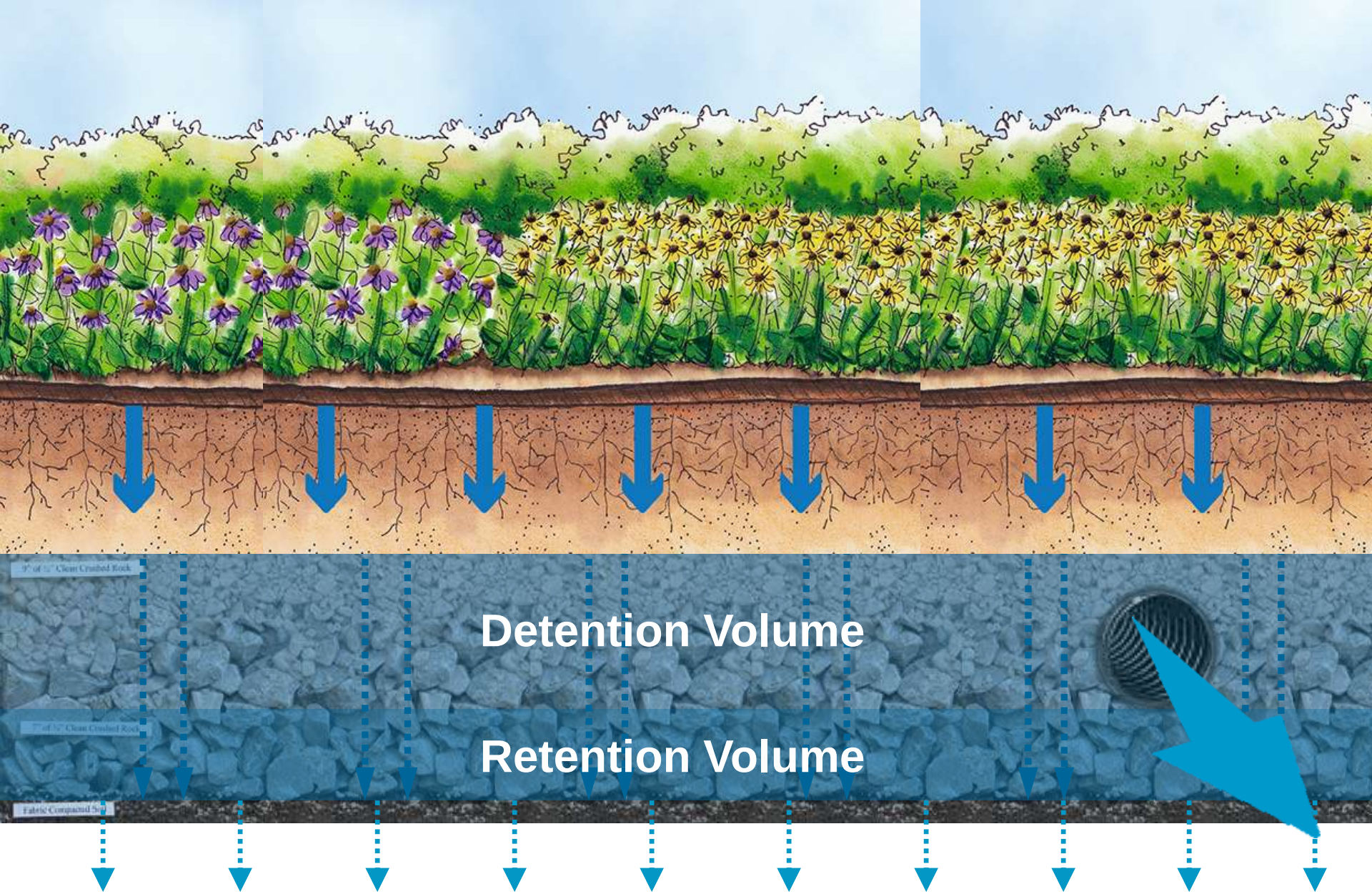



# Porous Pavement: Infiltration (Retention) and Detention Capacity

# BENEFITS OF VEGETATED GREEN INFRASTRUCTURE

- PROVIDES HABITAT
- MIMICS FULL SWEET OF HYDRLOLOGIC PROCESSES
- EVAPOTRANSPIRATION
- INFILTRATION AND AQUIFER RECHARGE
- IMPROVES SOIL HEALTH TO SUSTAIN INFILTRATION CAPACITY
- CAN BE INTEGRATED WITH CODE MANDATED LANDSCAPE REQUIREMENTS
- AESTHETIC ENHANCEMENT

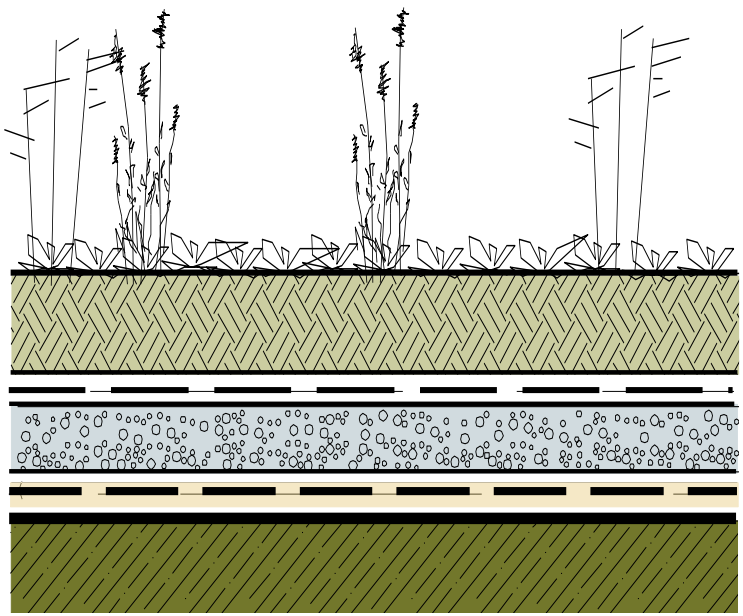
# Bioretention and Rain Gardens


Detention Volume
Retention Volume

# Green Roofs

# Green Roof Model – A natural soil analogy

## Imitate nature and its geological principles

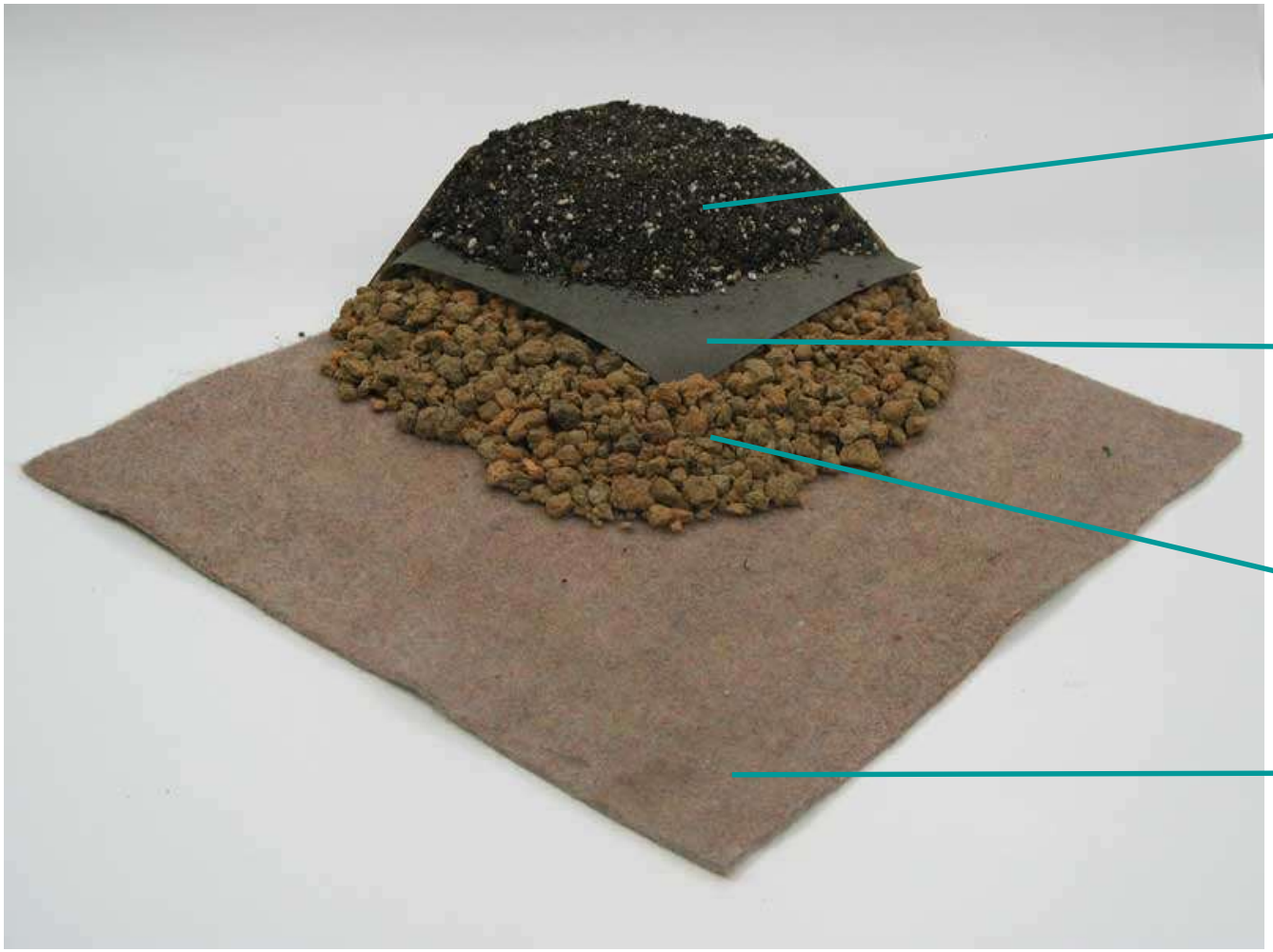



A-Horizon

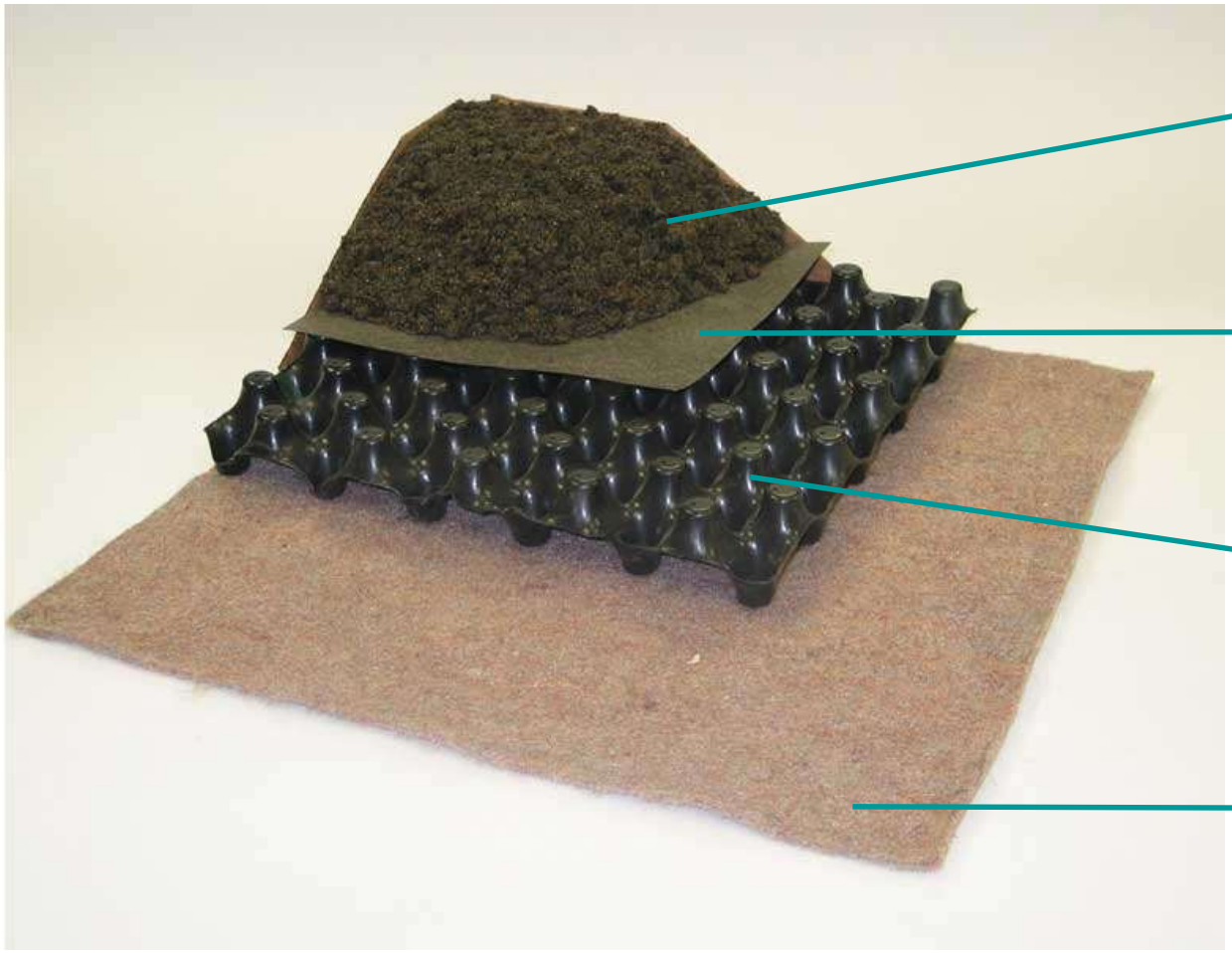
B-Horizon

C-Horizon
(Bedrock)

# Granular Drainage Systems



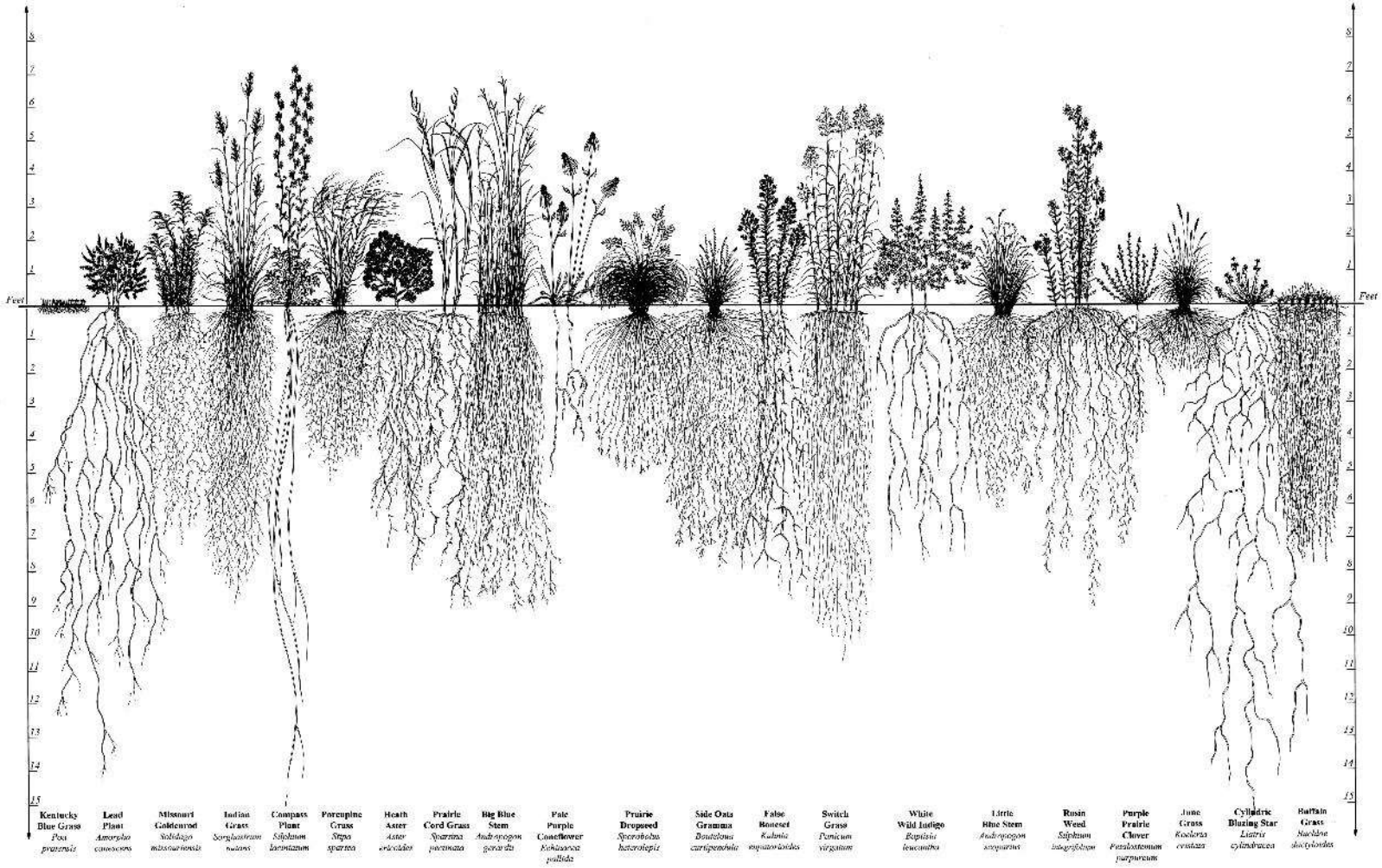
# Drainage Board Systems



# Naturalized Landscapes

# ROLE OF HERBACEOUS PLANTS

- SOIL HEALTH
- DISPERSED ROOT SYSTEMS
- EROSION CONTROL



# BMP Impacts on Cost

| BMP | Construction Cost | Site Utilization | Marketing/ Aesthetics | Maintenance/ Longevity |
|---|---|---|---|---|
| Green Roof | - | + | + | + |
| Permeable Paving | 0/- | + | + | + |
| Bioretention | +/0 | + | + | 0 |
| Native Landscapes | + | 0 | + | + |
| Natural Drainage | + | - | 0 | 0 |

+ Beneficial Impact/Reduced Cost

0 Neutral impact

- Negative Impact/Increased Cost

# Johnson Controls HQ

Glendale, Wisconsin

Office

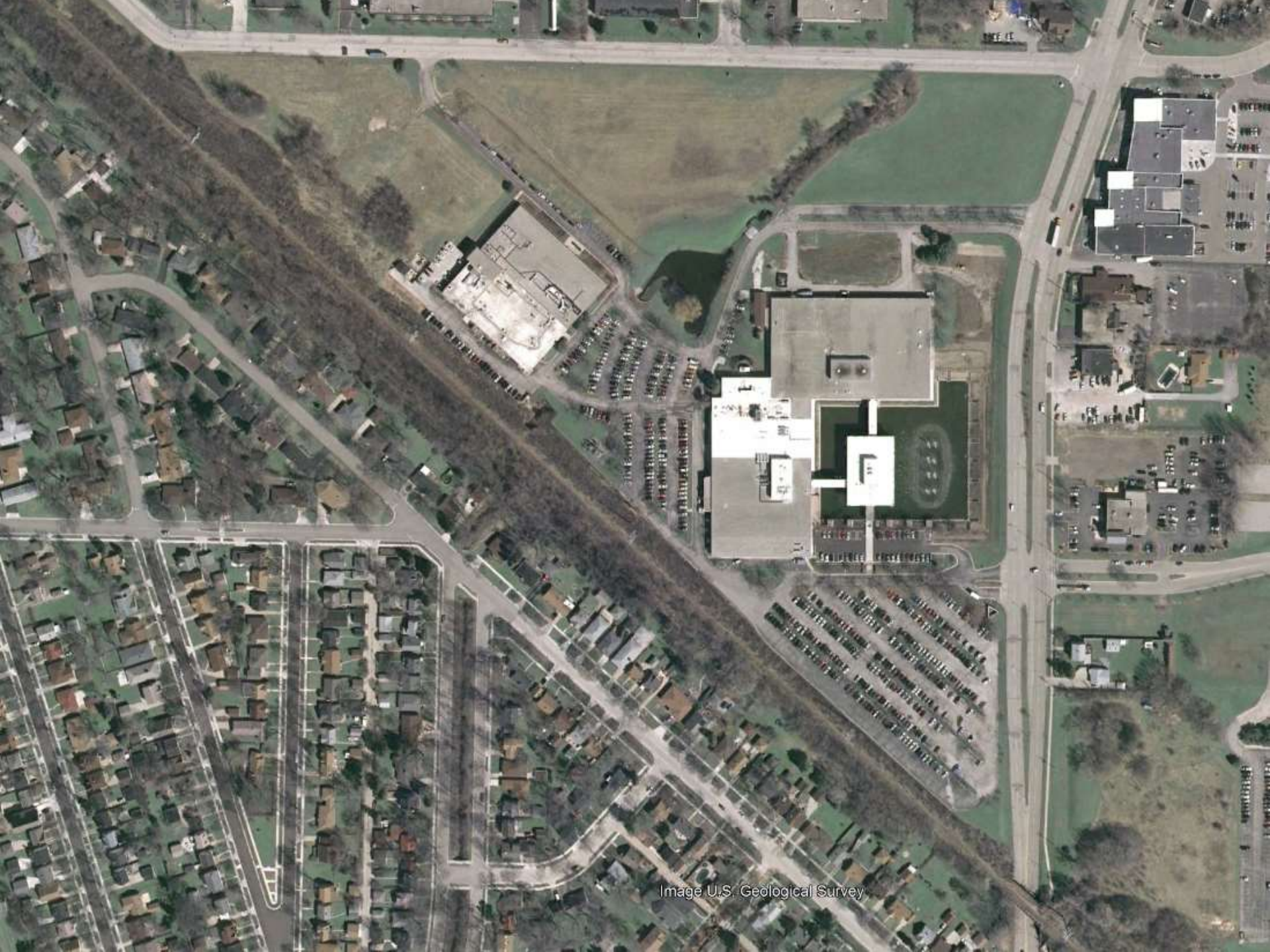
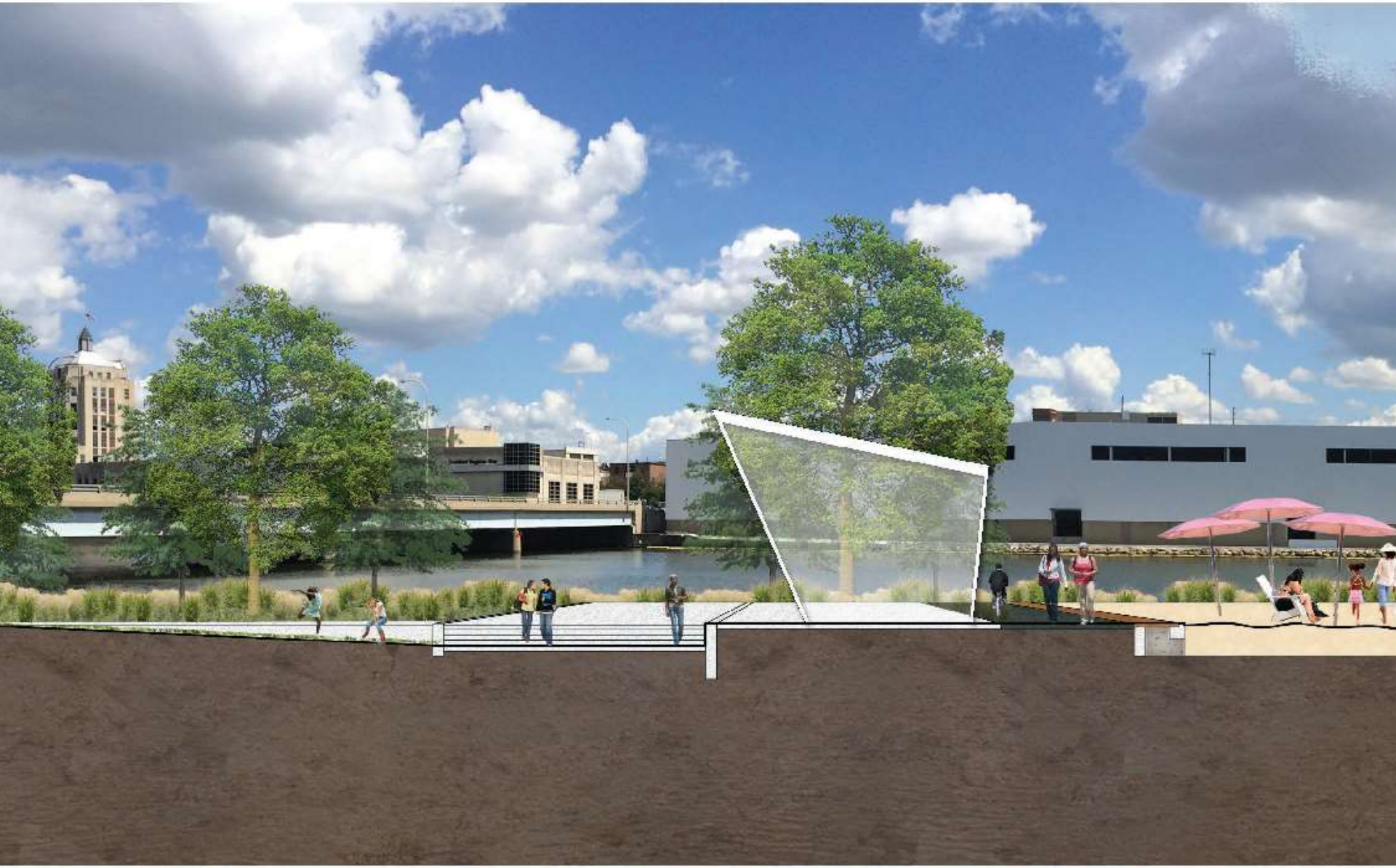


Image U.S. Geological Survey

# Davis Park Riverfront Park

Rockford, Illinois

Planning & Urban Design



# Iowa State University

Ames, Iowa

Higher Ed

**Biorenewables Complex**

Ames, Iowa

Image credit ZGF Architects

**Biorenewables Complex**
Ames, Iowa

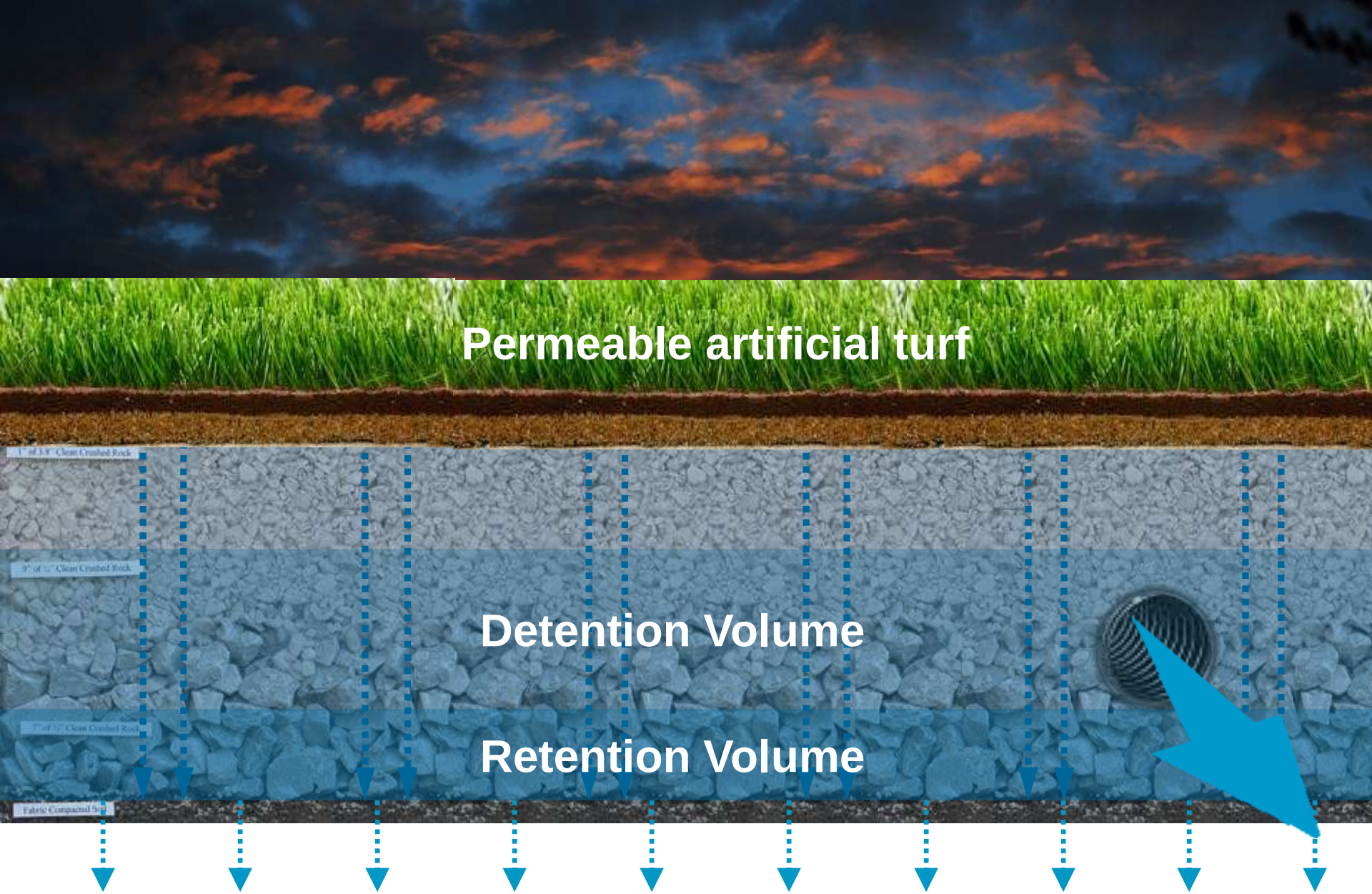
**College of Design**
Ames, Iowa

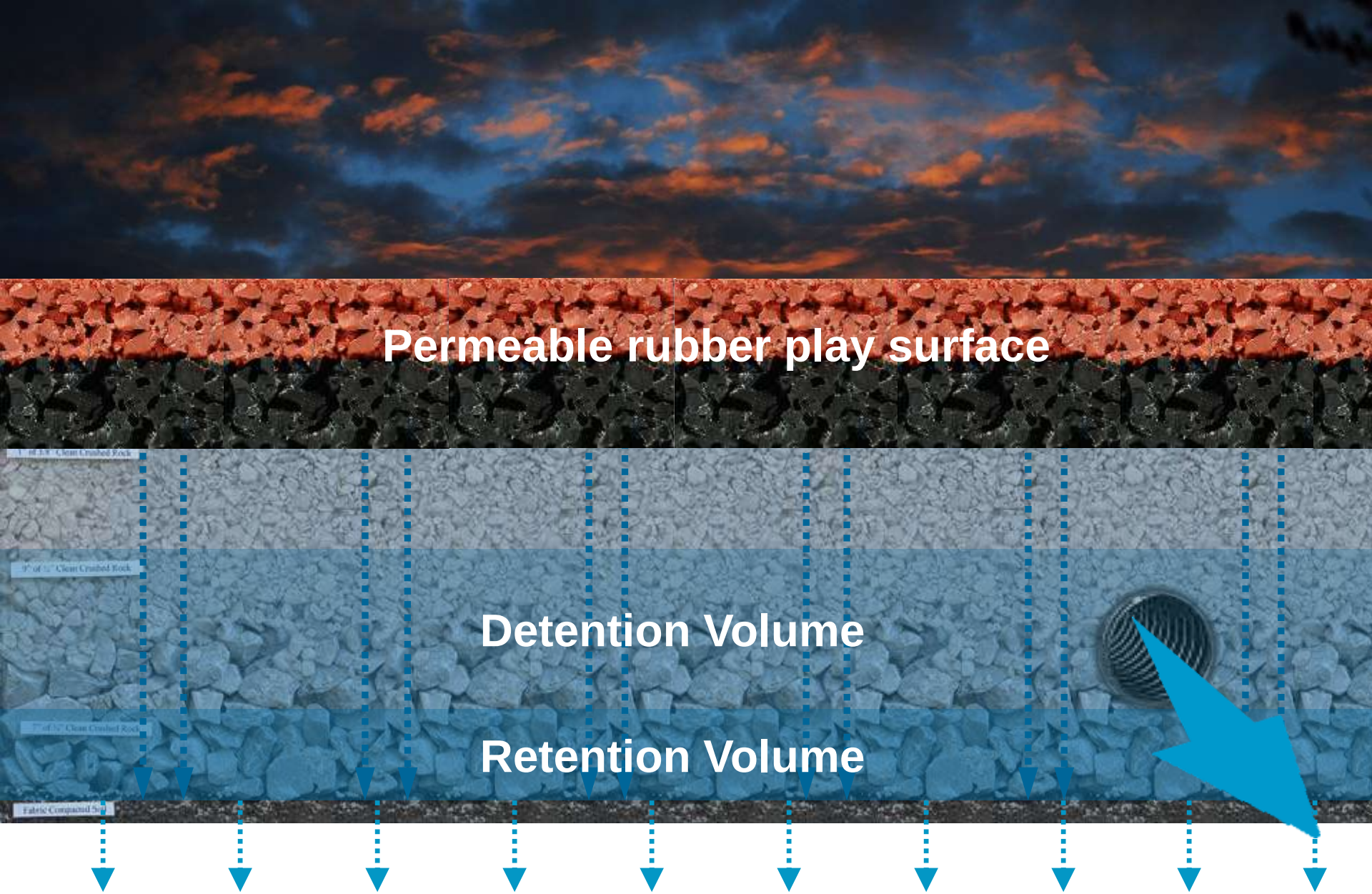
# Chicago Public Schools – Space to Grow

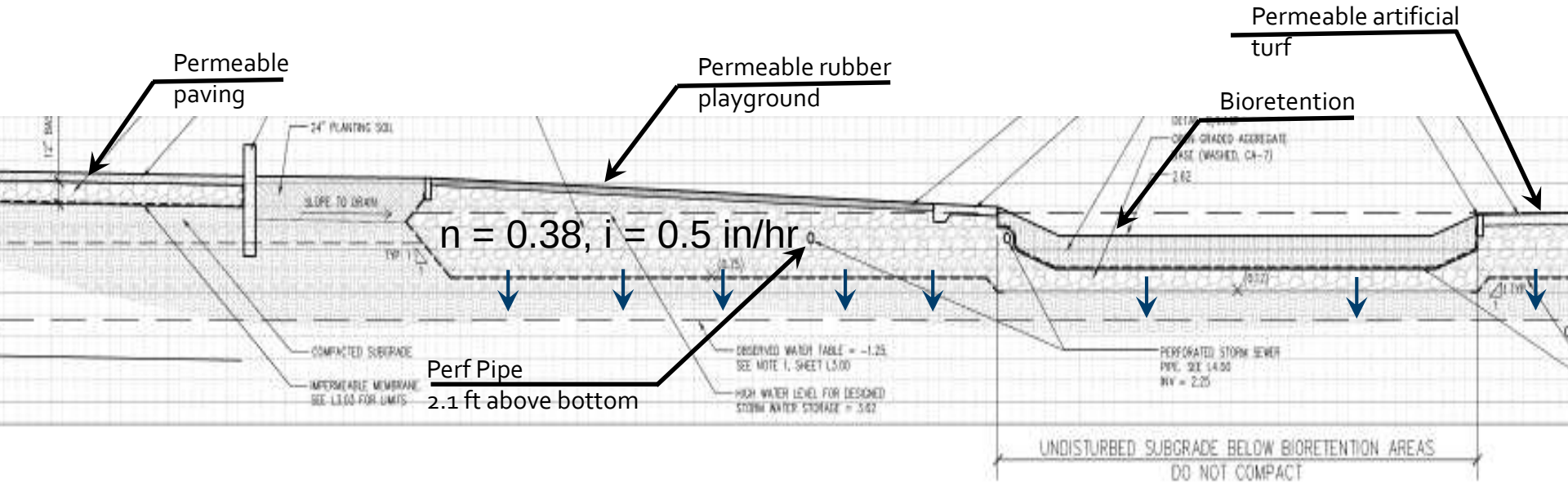
Grissom Elementary K-12

# Grissom Elementary School

Pervious rubber play surface, typ.
Pervious asphalt basketball court
Bioretention rain garden
Asphalt Track & field area drains to gravel storage
Gravel storage zone
Pervious artificial turf
Permeable pavers


Permeable artificial turf
Detention Volume
Retention Volume


Permeable rubber play surface
Detention Volume
Retention Volume

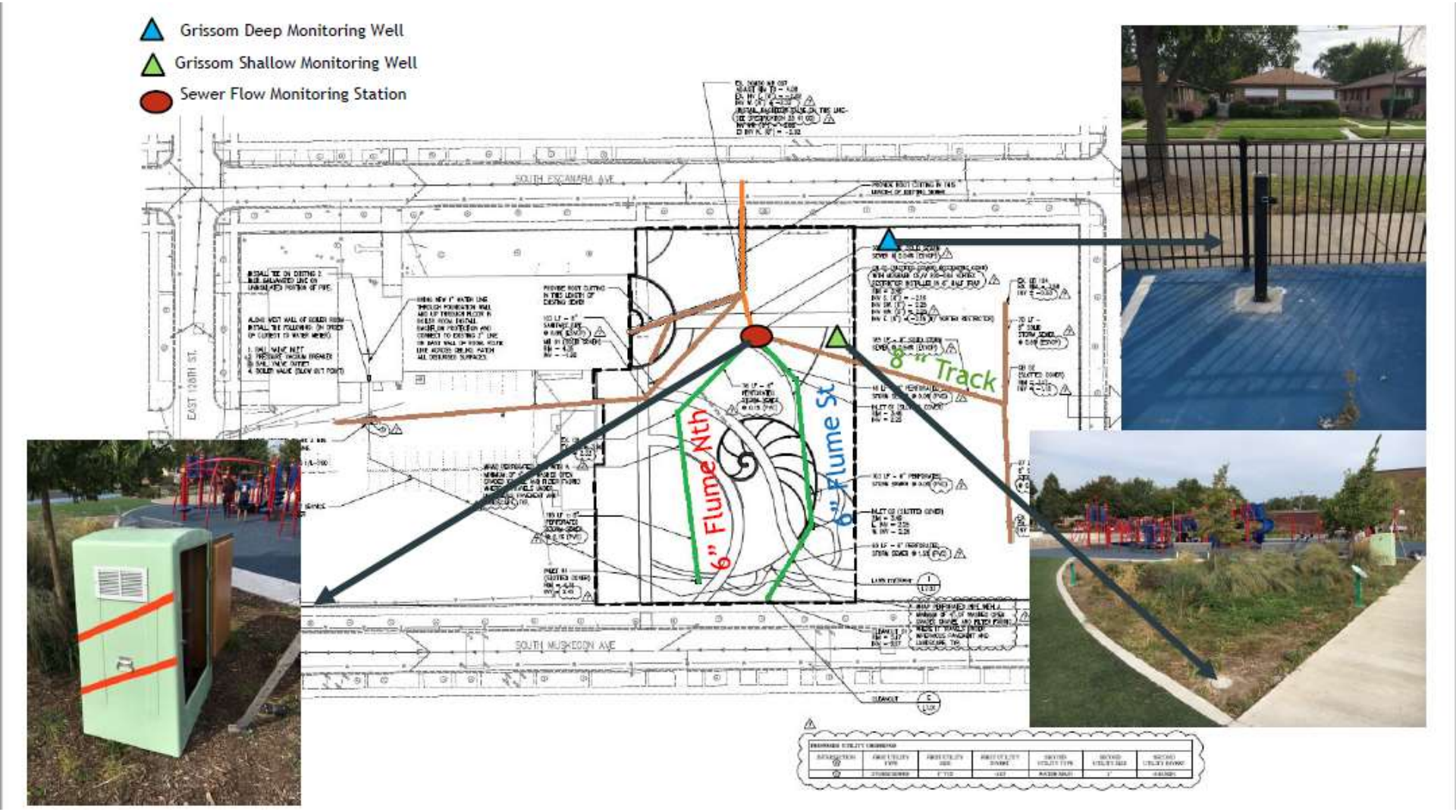

Permeable paving
Permeable rubber playground
Permeable artificial turf
Bioretention
n = 0.38, i = 0.5 in/hr
Perf Pipe
2.1 ft above bottom
24" PLANTING SOIL
SLOPE TO DRAIN
COMPACTED SUBGRADE
IMPERMEABLE MEMBRANE
SEE L3.03 FOR LIMITS
OBSERVED WATER TABLE = -1.25
SEE NOTE 1, SHEET L5.00
HIGH WATER LEVEL FOR DESIGNED
STORM WATER STORAGE = 3.62
PERFORATED STORM SEWER
INV = 2.25
UNDISTURBED SUBGRADE BELOW BIORETENTION AREAS
DO NOT COMPACT

# Grissom Elementary

| | Existing Conditions | Proposed Conditions | % reduction |
|---|---|---|---|
| Threshold Event* | 0.1 inches | 4.6 inches | - |
| 2-year Event (3.04" Rainfall) | | | |
| Runoff Volume (inches) | 2.49 | 0.00 | 100% |
| Peak Flow (cfs) | 9.9 | 0.00 | 100% |
| 10-year Event (4.47" Rainfall) | | | |
| Runoff Volume (inches) | 3.89 | 0.00 | 100% |
| Peak Flow (cfs) | 15 | 0.00 | 100% |
| 100-year Event (7.58" Rainfall) | | | |
| Runoff Volume (inches) | 6.98 | 1.18 | 83% |
| Peak Flow (cfs) | 25.9 | 0.21 | 99% |
| Equivalent Curve Number** | 95 | 40 | - |

* The threshold event is the smallest rainfall amountt sufficient to produce runoff

** The equivalent Curve Number is the CN value of a land surface that would produce an approximately equivalent amount of runoff as the given storm system.




# USGS Monitoring

# Grissom: Gallons of Water into Storage

- Total precip. to fall start of study through July 1 is 30.98 inches
- Equates to 124,694.5 ft3 of rainfall falling on GI
- 0 Discharge from GI
- >932,780 gallons of water saved from entering Combined storm sewer

USGS Monitoring

# USGS Monitoring

# Woodlawn Housing Development

Chicago, Illinois

Residential

Image Credit McBride Kelley Baurer Architects

# Iowa Green Streets

**West Union, Iowa**

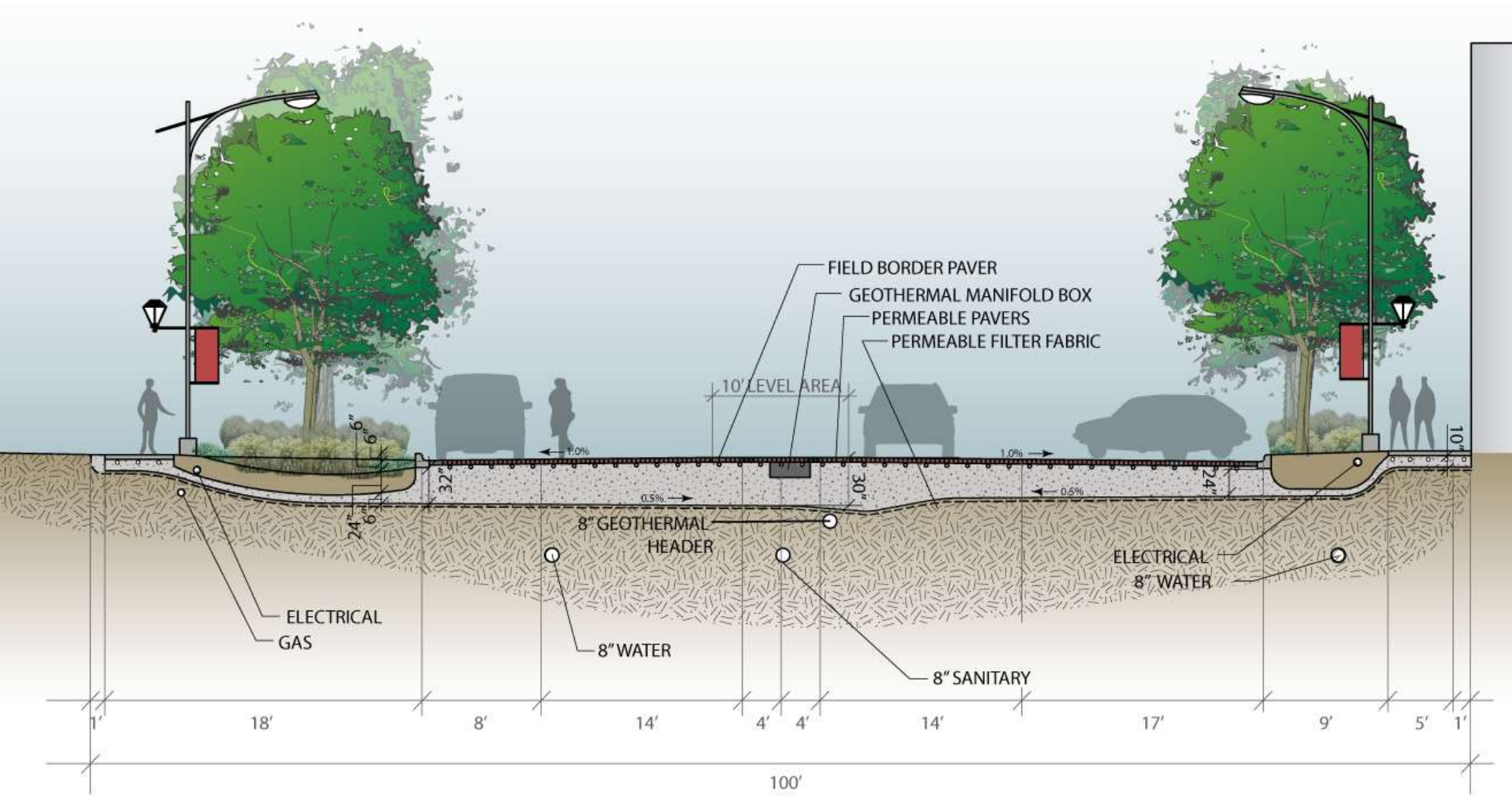
**Streetscapes**

EXIT
TRADITION
never graduate

FIRST NA

HISTORIC BRICK PAVERS beneath the street will be salvaged and re-used in key locations like the intersections
RAIN GARDENS along the street will detain and treat stormwater runoff and will provide colorful plantings with year-round interest
STREET TREES will be added to frame pedestrian spaces and shade buildings and sidewalks
PERMEABLE UNIT PAVING in the street and sidewalk will filter stormwater and reduce runoff rates and volumes
West Union

# Street Section



10:08

ADVANCED
SYSTEMS INC
Canon
800-274-2047

hoe, Braun & White

Tyvek
US OUT

SABOE
JEWELERS
STOP

# Summary of Results

| | Pre-Project | Post-Project | % Reduction |
|---|---|---|---|
| Threshold Event | 0.05" | 1" | - |
| 2-Year Event (2.91" rain) | | | |
| Runoff Volume (inches) | 2.2 | 1.38 | 37% |
| Peak Flow (cfs) | 19.2 | 3.8 | 80% |
| 10-Year Event (4.31" rain) | | | |
| Runoff Volume (inches) | 3.49 | 2.53 | 28% |
| Peak Flow (cfs) | 29.8 | 5.8 | 81% |
| 100-Year Event (6.36" rain) | | | |
| Runoff Volume (inches) | 5.44 | 4.35 | 20% |
| Peak Flow (cfs) | 45.8 | 8.3 | 82% |

# Questions