THE SURVIVABILITY OF GREEN INFRASTRUCTURE PRACTICES FOR STORM WATER CONTROL IN URBAN ENVIRONMENTS

Cincinnati State Technical & Community College

NEWEA CSO/Wet Weather Integrated Planning Issues Specialty Conference

Lowell, Massachusetts

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Study Focus

- **Will green infrastructure (GI) practices survive in the Cincinnati area long enough to perform the function for which they were designed?**
- **Local conditions are not optimal for GI use:**
  - **Clayey soils**
  - **Hilly terrain**
  - **Urbanized setting**
  - **Variable climate**

Civic Garden Center
Permeable Paving
K. Couch Photo 2015

Study Focus

Study Site Selection:

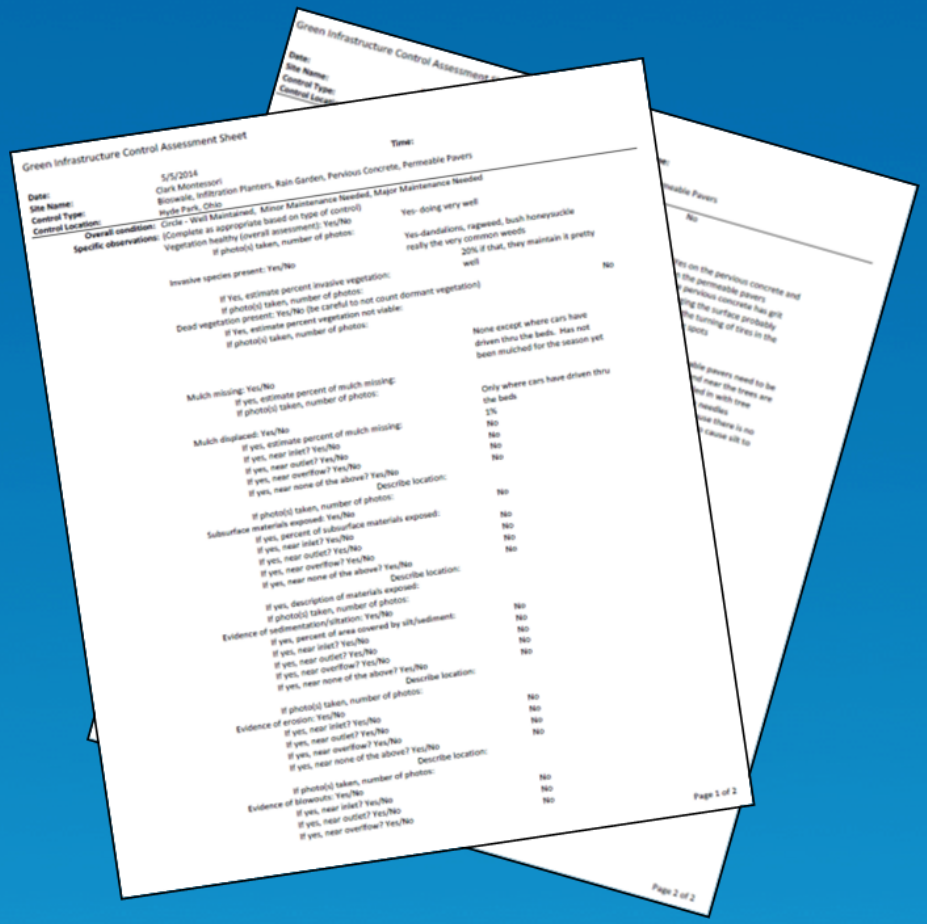
- **GI study sites selected to assess a variety of:**
  - **site conditions,**
  - **land uses,**
  - **GI practices types and sizes,**
  - **property owner types, and**
- **Must be at least 4 years old to allow adequate time for plant maturation**
- **Sites must be publicly accessible to allow third party observations**

Study Sites

Site Name	GI Practice Size	Property Type & Description	Bioretention, Rain Gardens, Urban Planters	Bioswale	Vegetated Roof	Permeable Pavers	Pervious Concrete	Pervious Asphalt
Brazee Street Studios	Small	Private Commercial –Urban (former industrial)	X	X				
Spring Grove Avenue	Small - Medium	Public Transportation – Arterial Roadway		X				
Civic Garden Center (CGC)	Small	Private – Nonprofit, Urban		X	X	X	X	X
Clark Montessori High School	Medium	Public Educational Institution – Urban residential	X	X	X	X	X	
Northern Kentucky University	Large	Public Educational Institution – Semi-Urban			X			
Cincinnati State Technical & Community College (CSTCC)	Large	Public Educational Institution – Urban	X	X		X	X	X

Study Focus

- **Consistency of observations achieved through the use of standardized forms and photography**
- **Study team composed of GI professionals with varied backgrounds:**
  - **planners**
  - **designers/installers**
  - **GI facility owners**
- **Study began in 2013**



Study Focus

- **Identify signs of potential GI failure:**
  - Plant die off/unplanned open areas – indicate extent, affected plant species/types
  - Significant presence of invasive species – indicate location and extent
  - Structural failure/blowouts/slumping – describe severity
  - Evidence of overflows – indicate extent and locations
  - Significant erosion – indicate severity and location(s)
  - Clogging/sedimentation – indicate extent and location
  - Degradation, movement, buckling of hard surfaces – describe severity

Small Scale Sites
Private, Retail/Commercial Owner

Brazee Street Studios Bioswale
Post installation in 2009 (left) and in Spring 2014 (above) - Good condition
P. Simmons photo

Small Scale Sites
Private, Non-profit Owner

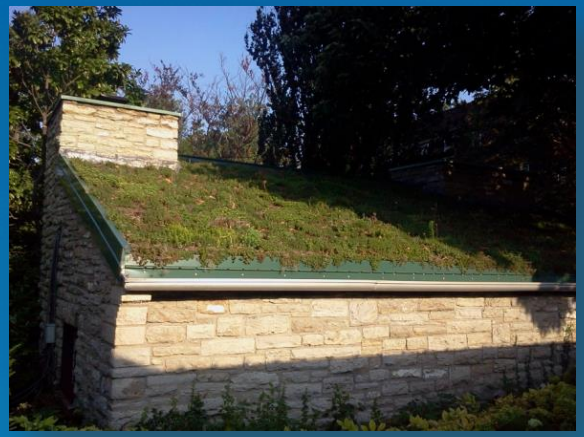
Civic Garden Center, Cincinnati, OH - Permeable Paving Areas
August 2011 – Opening Ceremony T. Ellwood Photo

Small Scale Sites
Private, Non-profit Owner

Civic Garden Center – 4 years later
Permeable Paving Areas
October 2015 K. Couch Photo

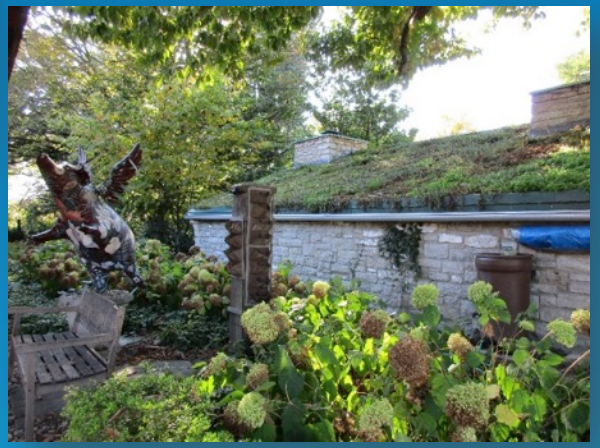
Civic Garden Center
Permeable Pavers/Close-up – Good condition
October 2015 K. Couch Photo

Small Scale Sites
Private, Non-profit Owner



Civic Garden Center, Cincinnati, OH
Sloped Green Roof – Mat Type
August 2010 T. Ellwood photo

Civic Garden Center
Sloped Green Roof
Good condition June 2013
Civic Garden Center Photo



Civic Garden Center
Sloped Green Roof
Good condition after dry spell and freeze
October 19, 2015 K. Couch photo

Medium Size Sites
Publicly Owned, Transportation

Spring Grove Avenue, Cincinnati, Ohio
Bioswale after Construction
March 21, 2010 CDM Smith photo

Spring Grove Avenue Bioswale
Good condition - Healthy plants, well maintained
2015
Google Earth Street View Photo

Medium Size Sites
Public, Educational Institution

Clark Montessori High School, Cincinnati, Ohio 2006
CAGIS Online 2015

Clark Montessori Under Construction 2011
CAGIS Online 2015

Medium Size Sites
Public, Educational Institution

Clark Montessori High School
Urban Planters – Constructed 2011
May 2014
P. Simmons photo

Clark Montessori High School
Urban Planters – Good Condition
October 2015
K. Couch photo

Medium Size Sites
Public, Educational Institution

Clark Montessori High School Pervious Paver Driveway
Leaf litter present, coarse sand missing
May 2013
P. Simmons photo

Clark Montessori High School Pervious Concrete Parking Lot
May 2013
P. Simmons photo

Large Scale Sites
Public, Higher Education

Northern Kentucky University Green Roof
Installed in 2009

NKU Green Roof after 5 years
Colder winter than normal
March 2014
R. Mirrizi photo

NKU Green Roof July 2014
R. Mirrizi photo

Large Scale Sites
Public, Higher Education

CSTCC Parking Lot Aerial
Permeable Paving – 5 years later
Summer 2015 Google Earth 2015

Cincinnati State Technical & Community College (CSTCC) Parking Lot – Permeable Paving Under Construction
Fall 2010 R. Mirizzi photo

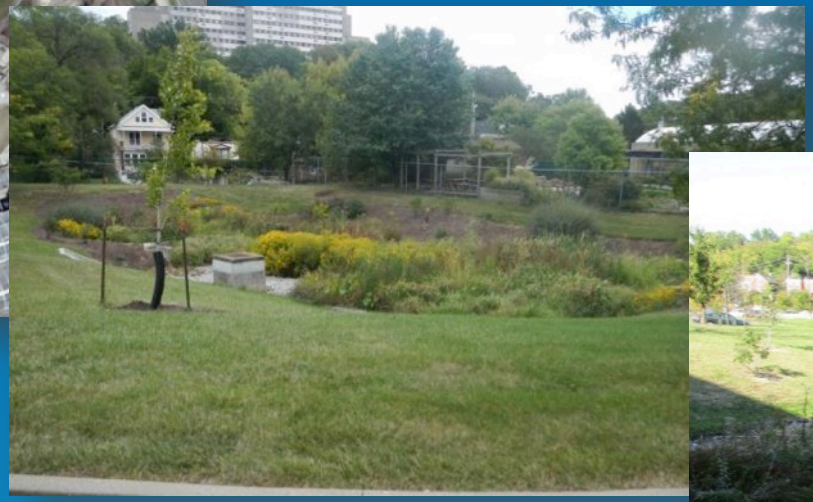
Large Scale Sites
Public, Higher Education

CSTCC
Permeable paver parking spaces – Close up - Coarse sand between pavers in good condition
October 2015
K Couch photo

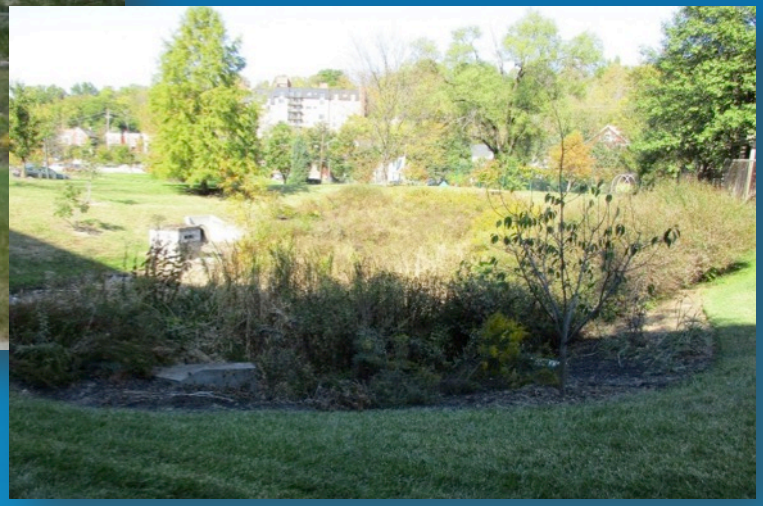
CSTCC
Permeable paver parking spaces
Good condition – better than adjacent asphalt
October 2015
K Couch photo

Large Scale Sites
Public, Higher Education

CSTCC Detention Basin – next to Parking Lots – 2007 aerial
CAGIS Online



CSTCC
Bioretention Basin Retrofits at after 2 years – Good condition September 2013
CDM Smith photo



CSTCC Basin Retrofit at 4 years After first freeze – good condition October 2015
K. Couch photo

Large Scale Sites
Public, Higher Education

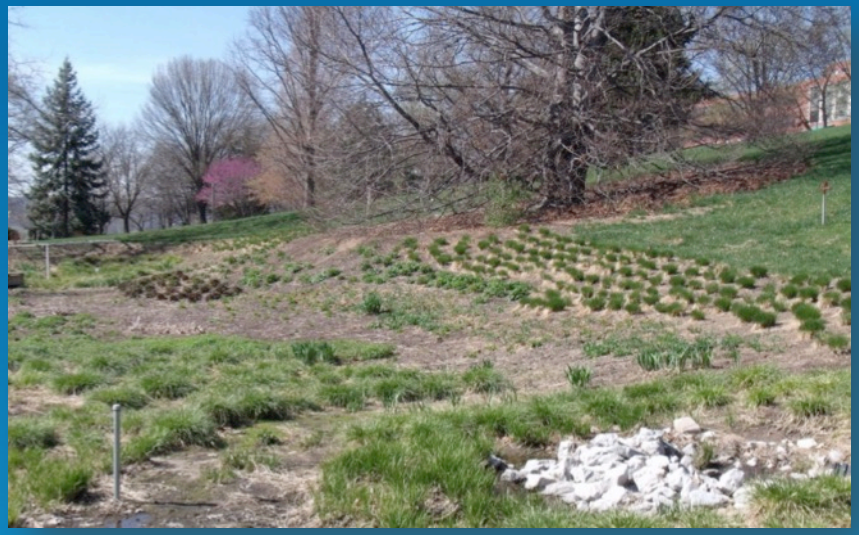
Cincinnati State Technical & Community College (CSTCC)

Front Lawn – Series of Biodetention Basins Under Construction Fall 2010

R. Mirizzi photo

Large Scale Sites
Public, Higher Education

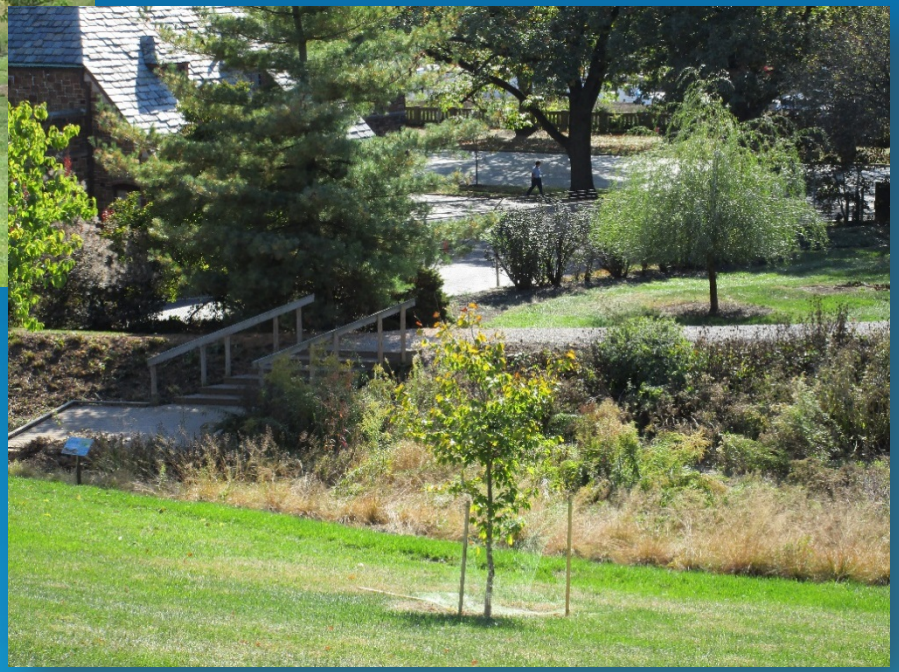
CSTCC
Biodetention Basin (constructed in 2010)
After hard winter
March 2014 R. Mirizzi photo



CSTCC
Same Biodetention Basin
Rebounded well – good vegetation
July 2014 R. Mirizzi photos

Large Scale Sites
Public, Higher Education

CSTCC
Biodetention Basin after 4 years
Good condition & well maintained
July 2014 R. Mirizzi photo



CSTCC
Biodetention Basin after 5 years
and recent hard freeze
Good condition & well maintained
October 2015 K. Couch photo

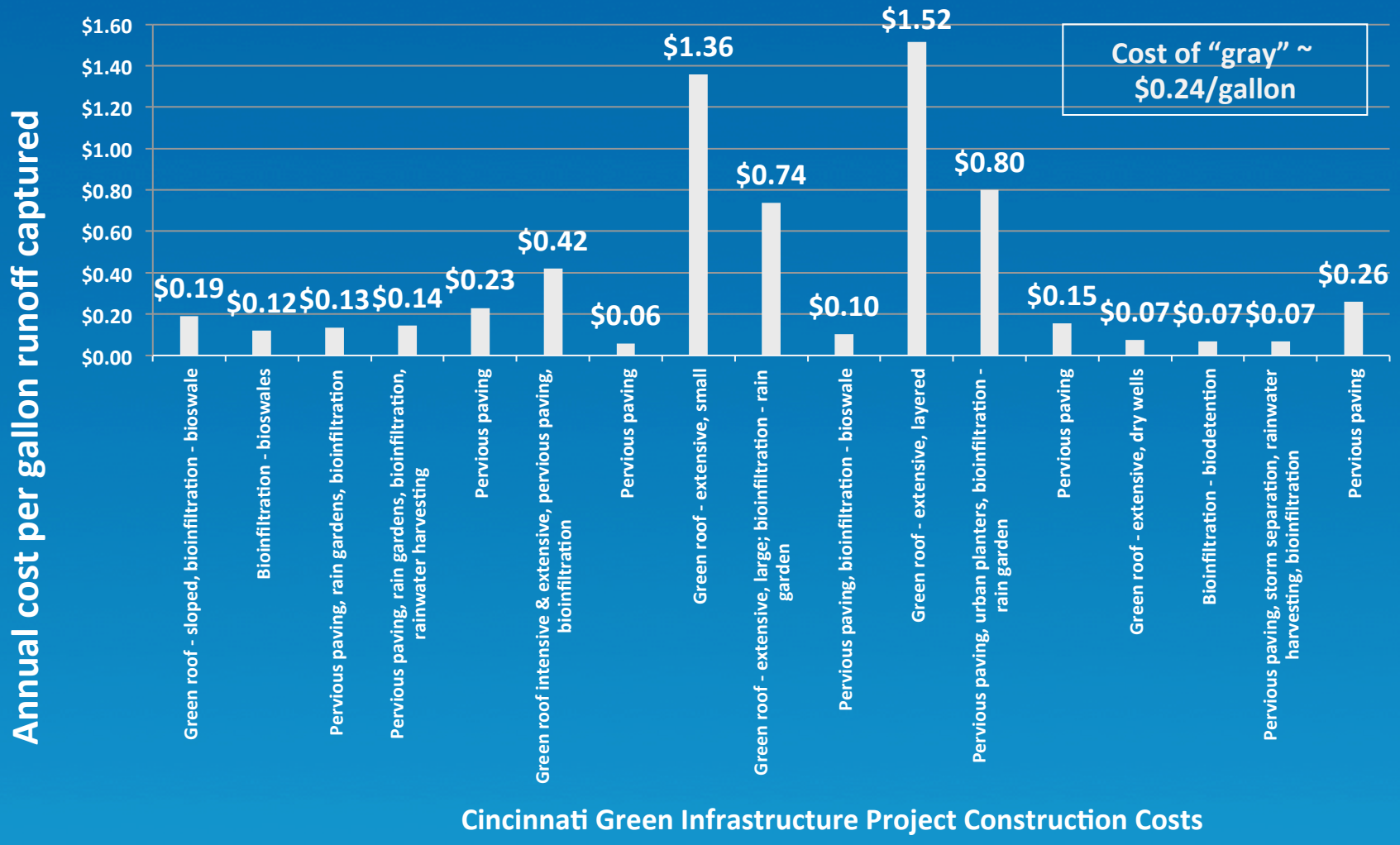
Large Scale Sites
Public, Higher Education

CSTCC Biodetention Basin by Parking Lot – Built in 2010
Five years later - After freeze: Good condition & well maintained
October 2015 K. Couch photos

Cincinnati State – A model for larger scale GI projects in CSO Communities?

CSTCC Project Phase	Estimated Gallons Runoff Captured (Typical Year)	GI Practice Type	# Practices	Size
Phase 2	8,000,000	Bioswale	1	972 sf
		Level Spreader	1	420 sf
		Rainwater Harvesting: Cistern	1	4,000 gal
		Bioinfiltration Basins	4	42,050 sf
		Rainwater Harvesting & Reuse	2	20,000 gal
		Pervious Pavement: Pavers	4	29,328 sf
		Bioinfiltration Trench	1	1,540 sf
Phase 1	4,620,000	Rain Garden: Natural	3	2700 sf
		Bioswale	2	10,000 sf
		Pervious Pavement: Concrete	1	1645 sf
		Pervious Pavement: Pavers	6	10,710 sf
		Bioswale	1	500 sf
		Pervious Pavement: Asphalt	1	2002 sf

Bonus Slide: Green Infrastructure Estimated Project Benefit Cost ($/gal captured)



Conclusions

- GI practices at the study sites were maturing well
  - No signs of control failure
  - Planted site vegetation vigorous even after droughts and extremely cold winters
- Pervious paving installations are doing well with no signs of surface failure
  - Leaf litter clogging at one site (siting issue – look out for trees)
- GI practice location/placement can have a substantial effect on maturation and long-term sustainability
- Only one site showed overdue maintenance – removal of leaf litter and replacement of sand between pavers
- Site type/practice type not a factor in success

Many thanks to:

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Any Questions?

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