Permeable Pavement

Systems

Economic Considerations & Case Studies

- Economic Considerations
- Public Facility Parking Lots
- Main Street Streetscape
- Residential Streets

Green vs Gray Economic Factors

- Construction Cost
- Site Utilization
- Marketing/Aesthetics
- Maintenance/Longevity

BMP Impacts on Cost

<table>
<thead>
<tr>
<th>BMP</th>
<th>Construction Cost</th>
<th>Site Utilization</th>
<th>Marketing/Aesthetics</th>
<th>Maintenance/Longevity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Roof</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Permeable Pavers</td>
<td>0/-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bioretention</td>
<td>+/-</td>
<td>+</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Native Landscapes</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Natural Drainage</td>
<td>+</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

+ Positive Impact, - Negative Impact
Fox River Water Reclamation District

CONSERVATION DESIGN FORUM

Fox River Water Reclamation District

CONSERVATION DESIGN FORUM

FRWRD Cost Comparison

Gray Infrastructure
- Asphalt Paving
- Storm sewer
- Detention
- Wetland permitting
- $153,000

Green Infrastructure
- Permeable paving
- Bioretention
- $140,000
Site Objectives

- LEED Sustainable Sites
- Highest Environmental Performance
- Reduced Irrigation
- Increased Longevity
- Cost Effective
**Life Cycle Cost Analysis**

<table>
<thead>
<tr>
<th>Category</th>
<th>Initial Cost</th>
<th>Annual Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Street Surfacing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paving</td>
<td>30,000</td>
<td>1,500</td>
<td>90,000</td>
</tr>
<tr>
<td><strong>Street Lighting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED Lights</td>
<td>50,000</td>
<td>2,000</td>
<td>100,000</td>
</tr>
<tr>
<td><strong>Street Furniture</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benches</td>
<td>20,000</td>
<td>1,000</td>
<td>40,000</td>
</tr>
</tbody>
</table>

**West Union – Iowa’s Green Street Pilot Project**

**Green Pilot Streetscape Project**
A Sustainable Vision for West Union

The City of West Union
Main Street West Union
Iowa Department of Economic Development

Conservation Design Forum
Stormwater Materials

Street Permeable Paver: Eco-Optilock
Sidewalk Permeable Paver: Eco-Prioria
Bioretention Areas

Street Section

CONSERVATION DESIGN FORUM
### Summary of Results

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Pre-Project Runoff Volume (inches)</th>
<th>Pre-Project Peak Flow (cfs)</th>
<th>Post-Project Runoff Volume (inches)</th>
<th>Post-Project Peak Flow (cfs)</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold Event</td>
<td>0.05&quot;</td>
<td>1&quot;</td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>2-Year Event (2.91&quot; rain)</td>
<td>2.2</td>
<td>19.2</td>
<td>1.38</td>
<td>3.8</td>
<td>37%</td>
</tr>
<tr>
<td>10-Year Event (4.31&quot; rain)</td>
<td>3.49</td>
<td>29.8</td>
<td>2.53</td>
<td>5.8</td>
<td>28%</td>
</tr>
<tr>
<td>100-Year Event (6.36&quot; rain)</td>
<td>5.44</td>
<td>45.8</td>
<td>4.35</td>
<td>8.3</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>82%</td>
</tr>
</tbody>
</table>
Charles City Permeable Streets
TABLE 2: PROTOTYPE MODEL RESULTS

<table>
<thead>
<tr>
<th>Event</th>
<th>Rainfall (inches)*</th>
<th>Existing</th>
<th>Proposed</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-Month Event</td>
<td>1.91</td>
<td>0.28</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>1-Year Event</td>
<td>2.36</td>
<td>0.45</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>2-Year Event</td>
<td>2.98</td>
<td>0.75</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>10-Year Event</td>
<td>4.38</td>
<td>1.59</td>
<td>0.59</td>
<td>63%</td>
</tr>
<tr>
<td>100-Year Event</td>
<td>7.07</td>
<td>3.6</td>
<td>2.46</td>
<td>32%</td>
</tr>
</tbody>
</table>

* Based on 24-hour rainfall
** Based on critical duration storm

Project Costs

- Remove & replace existing pavement & curbs
  - 17 City Blocks
  - 112,000 square feet
- Excavation
- Gravel Base
- Permeable Paving
- Water main & services
- Sanitary sewer services
- $3.7M construction cost
- $3.9M construction, engineering, fees
Questions?

Carbon Cliff Permeable Streets
10-Year Event

- Pond Elevation: 572.21
- 15.4 CFS
- 31.7 CFS
- 6.1 CFS
- 26.6 CFS
- 3.9 CFS
- 17.6 CFS

Storm Sewer Flows

Permeable Paving Flows

12.9 CFS

6th STREET

5th STREET

4th STREET

3rd STREET

2nd STREET

1st STREET

STATE STREET

100-Year Event

- Pond Elevation: 572.92
- 48.5 CFS
- 79.3 CFS
- 21.8 CFS
- 64.4 CFS
- 13.4 CFS
- 42.3 CFS

Storm Sewer Flows

Permeable Paving Flows

3.1 CFS

9.3 CFS

Street View Character - 48/50/60/66' Right-of-Way Streets

Proposed Alternate 1

Permeable Paving

Green Infrastructure - Storm Channel

Proposed Alternate 2: perennial edge

Permeable Paving

Green Infrastructure - Storm Channel

Permeable Paving

Green Infrastructure - Storm Channel
Street View Character - 48/50/60/66' Right-of-Way Streets
Proposed Alternate 2: turf edge

Phase 1 Complete
Phase 2 Complete
Phase 3 Pending
Summary of Results
Carbon Cliff Green Streets – Phase 2 (10.4 acres)

<table>
<thead>
<tr>
<th></th>
<th>Pre-Project</th>
<th>Post-Project</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold Event</td>
<td>0.05&quot;</td>
<td>1.10&quot;</td>
<td>-</td>
</tr>
<tr>
<td>2-Year Event (2.91&quot; rain)</td>
<td>1.09</td>
<td>0.22</td>
<td>80%</td>
</tr>
<tr>
<td>Runoff Volume (inches)</td>
<td>5.4</td>
<td>0.3</td>
<td>94%</td>
</tr>
<tr>
<td>Peak Flow (cfs)</td>
<td>8.8</td>
<td>2.0</td>
<td>77%</td>
</tr>
<tr>
<td>10-Year Event (4.31&quot; rain)</td>
<td>2.18</td>
<td>1.24</td>
<td>43%</td>
</tr>
<tr>
<td>Runoff Volume (inches)</td>
<td>8.8</td>
<td>2.0</td>
<td>77%</td>
</tr>
<tr>
<td>Peak Flow (cfs)</td>
<td>21.9</td>
<td>6.0</td>
<td>73%</td>
</tr>
<tr>
<td>100-Year Event (6.36&quot; rain)</td>
<td>4.43</td>
<td>3.44</td>
<td>22%</td>
</tr>
<tr>
<td>Runoff Volume (inches)</td>
<td>21.9</td>
<td>6.0</td>
<td>73%</td>
</tr>
<tr>
<td>Peak Flow (cfs)</td>
<td>21.9</td>
<td>6.0</td>
<td>73%</td>
</tr>
</tbody>
</table>
Questions?