

Permeable Pavement Systems



EGRA Stone

ECO Stone

CONSERVATION DESIGN FORUM

Permeable Pavement Economic Considerations & Case Studies

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

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Green vs Gray Economic Factors

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

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BMP Impacts on Cost

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

+ Positive Impact, - Negative Impact

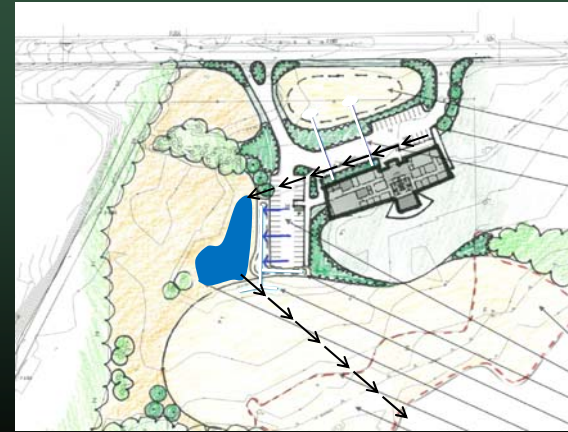
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Fox River Water Reclamation District



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Fox River Water Reclamation District



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FRWRD Cost Comparison

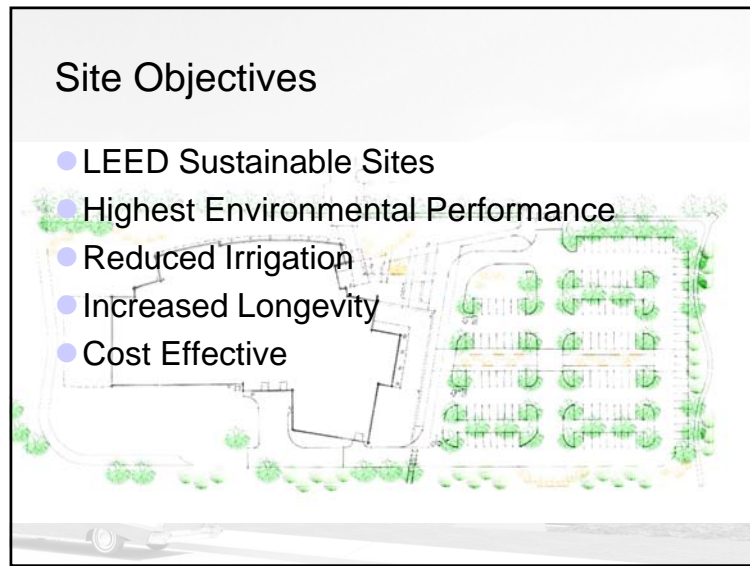
Gray Infrastructure

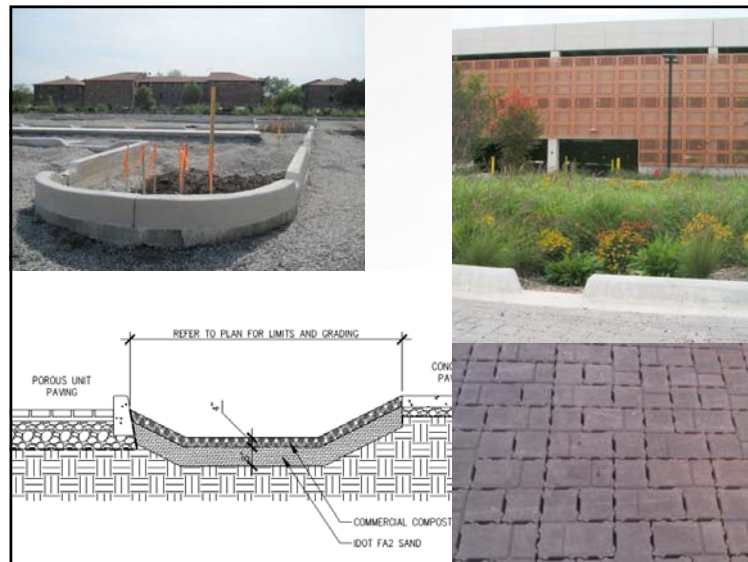
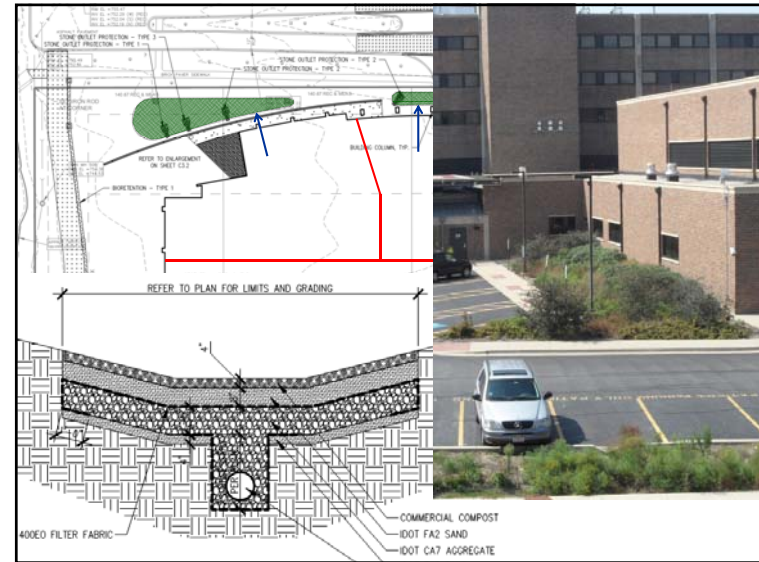
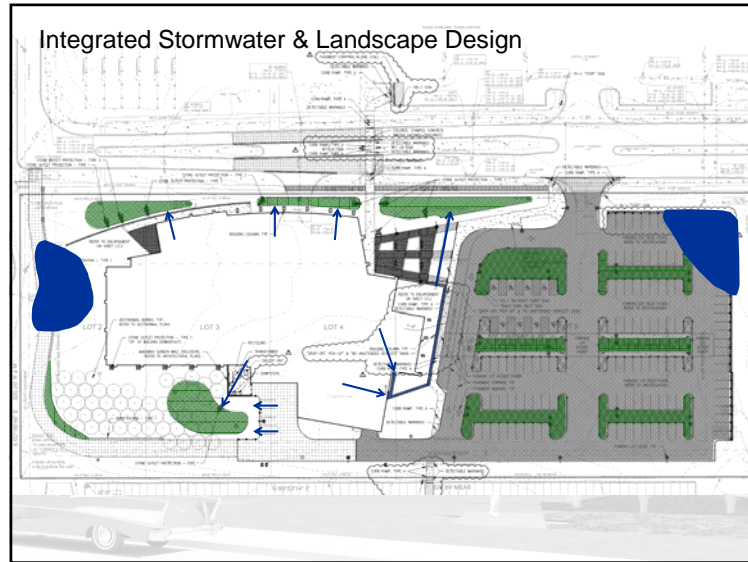
- Asphalt Paving
- Storm sewer
- Detention
- Wetland permitting
- \$153,000

Green Infrastructure

- Permeable paving
- Bioretention
- \$140,000

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Life Cycle Cost Analysis

Carol Stream Park District Recreation Center
Porous Unit Paving Parking Lot Life Cycle Cost Analysis

Year	Porous Unit Paving				Hot Mix Asphalt Paving (+ additional borestone)			
	Item	Cost	Cumulative Cost	Notes	Item	Cost	Cumulative Cost	Notes
1	Installation	\$338,475	\$338,475	Engineer's estimate	Installation	\$229,512	\$229,512	
3	Striping	\$ 1,809	\$340,284	Engineer's estimate	Crack Filling, Seal Coating, Striping	\$ 16,587	\$ 246,100	
5	Striping & Cleaning	\$ 17,139	\$357,423	Engineer's estimate	Minor Patching, Crack Filling, Seal Coating, Striping	\$ 31,914	\$ 278,014	
7	Striping	\$ 1,809	\$359,232	Engineer's estimate	Crack Filling, Seal Coating, Striping	\$ 16,587	\$ 294,601	
9	Striping & Cleaning	\$ 17,139	\$376,371	Engineer's estimate	Minor Patching, Crack Filling, Seal Coating, Striping	\$ 47,243	\$ 341,844	
11	Striping	\$ 1,809	\$378,180	Engineer's estimate	Crack Filling, Seal Coating, Striping	\$ 16,587	\$ 358,431	
13	Striping & Cleaning	\$ 17,139	\$395,319	Engineer's estimate	Minor Patching, Crack Filling, Seal Coating, Striping	\$ 62,572	\$ 420,999	
15	Striping	\$ 1,809	\$397,128	Engineer's estimate	M/I & Overlay, Minor Patching, Striping	\$130,085	\$ 551,084	
17	Striping & Cleaning	\$ 17,139	\$414,267	Engineer's estimate	Crack Filling, Seal Coating, Striping	\$ 16,587	\$ 567,671	
19	Striping	\$ 1,809	\$416,076	Engineer's estimate	Minor Patching, Crack Filling, Seal Coating, Striping	\$ 31,914	\$ 600,585	
21	Striping & Cleaning	\$ 17,139	\$433,215	Engineer's estimate	Crack Filling, Seal Coating, Striping	\$ 16,587	\$ 617,172	
23	Striping	\$ 1,809	\$435,024	Engineer's estimate	Minor Patching, Crack Filling, Seal Coating, Striping	\$ 47,243	\$ 664,415	
25	Striping & Cleaning	\$ 17,139	\$452,163	Engineer's estimate	Crack Filling, Seal Coating, Striping	\$ 16,587	\$ 681,002	
27	Striping	\$ 1,809	\$453,972	Engineer's estimate	Minor Patching, Crack Filling, Seal Coating, Striping	\$ 62,572	\$ 743,574	
29	Striping & Cleaning	\$ 17,139	\$471,111	Engineer's estimate	M/I & Overlay, Minor Patching, Striping	\$130,085	\$ 873,659	
31	Striping	\$ 1,809	\$472,920	Engineer's estimate	Crack Filling, Seal Coating, Striping	\$ 16,587	\$ 890,246	
33	Striping & Cleaning	\$ 17,139	\$490,059	Engineer's estimate	Minor Patching, Crack Filling, Seal Coating, Striping	\$ 31,914	\$ 922,160	
35	Striping	\$ 1,809	\$491,868	Engineer's estimate	Crack Filling, Seal Coating, Striping	\$ 16,587	\$ 938,747	
37	Striping & Cleaning	\$ 17,139	\$509,007	Engineer's estimate	Minor Patching, Crack Filling, Seal Coating, Striping	\$ 47,243	\$ 985,990	
39	Striping	\$ 1,809	\$510,816	Engineer's estimate	Crack Filling, Seal Coating, Striping	\$ 16,587	\$ 1,002,577	
41	Striping & Cleaning	\$ 17,139	\$527,955	Engineer's estimate	Minor Patching, Crack Filling, Seal Coating, Striping	\$ 62,572	\$ 1,065,149	
43	Striping	\$ 1,809	\$529,764	Engineer's estimate	M/I & Overlay, Minor Patching, Striping	\$130,085	\$ 1,195,234	
45	Striping & Cleaning	\$ 17,139	\$546,903	Engineer's estimate	Crack Filling, Seal Coating, Striping	\$ 16,587	\$ 1,211,821	
47	Striping	\$ 1,809	\$548,712	Engineer's estimate	Minor Patching, Crack Filling, Seal Coating, Striping	\$ 31,914	\$ 1,243,735	
49	Striping & Cleaning	\$ 17,139	\$565,851	Engineer's estimate	Crack Filling, Seal Coating, Striping	\$ 16,587	\$ 1,260,322	
51	Striping	\$ 1,809	\$567,660	Engineer's estimate	Minor Patching, Crack Filling, Seal Coating, Striping	\$ 47,243	\$ 1,307,565	
53	Striping & Cleaning	\$ 17,139	\$584,799	Engineer's estimate	Crack Filling, Seal Coating, Striping	\$ 16,587	\$ 1,324,152	
55	Striping	\$ 1,809	\$586,608	Engineer's estimate	Minor Patching, Crack Filling, Seal Coating, Striping	\$ 62,572	\$ 1,386,724	
57	Striping & Cleaning	\$ 17,139	\$603,747	Engineer's estimate	M/I & Overlay, Minor Patching, Striping	\$130,085	\$ 1,516,809	

Notes:
 1. Maintenance schedules taken from Morton Airport Main Parking Lots Seminar, November 18, 2004, prepared by Hanscomb Faithful & Gould.
 2. Additional Benefits for porous unit paving include: water quality improvements such as reduced thermal, metals, hydrocarbons, and chloride loadings, reduced...

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**

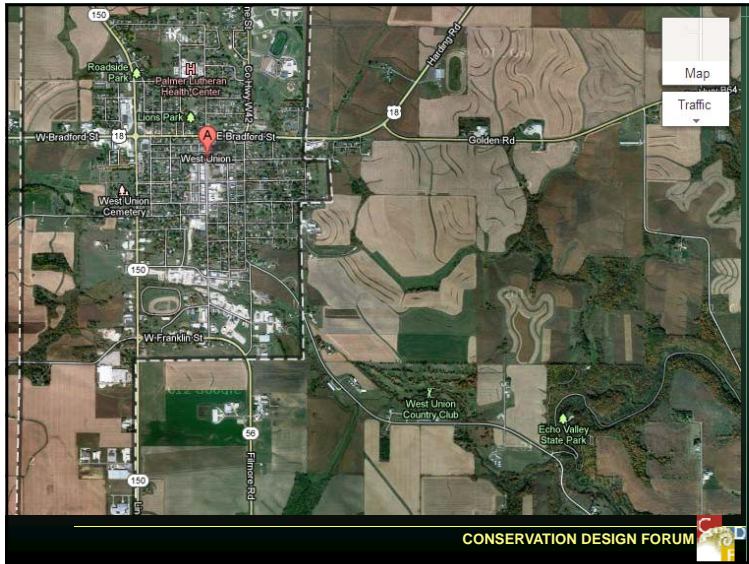





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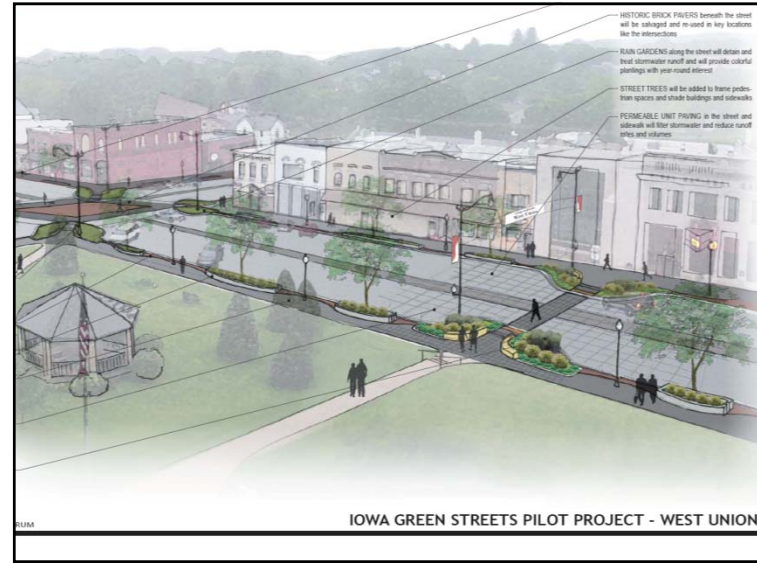
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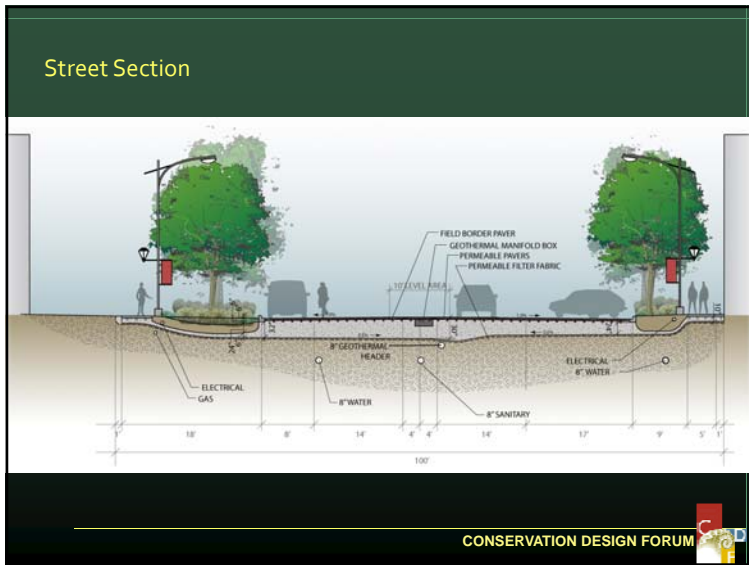
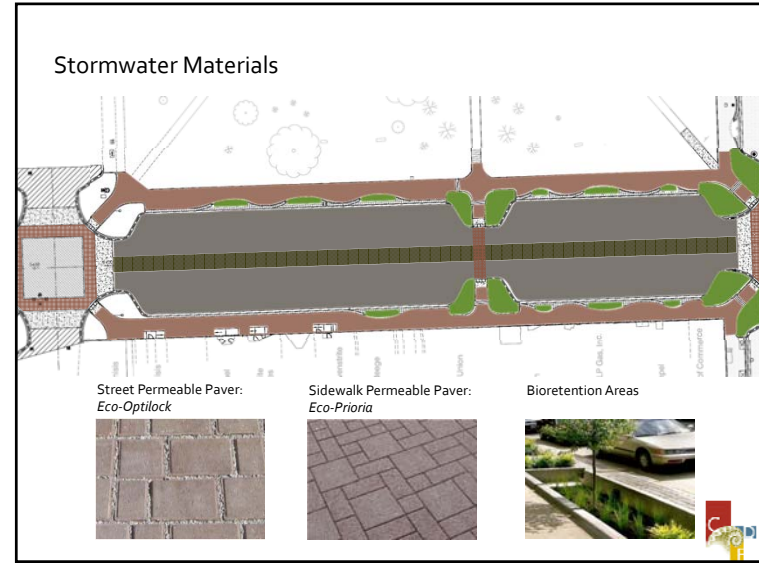
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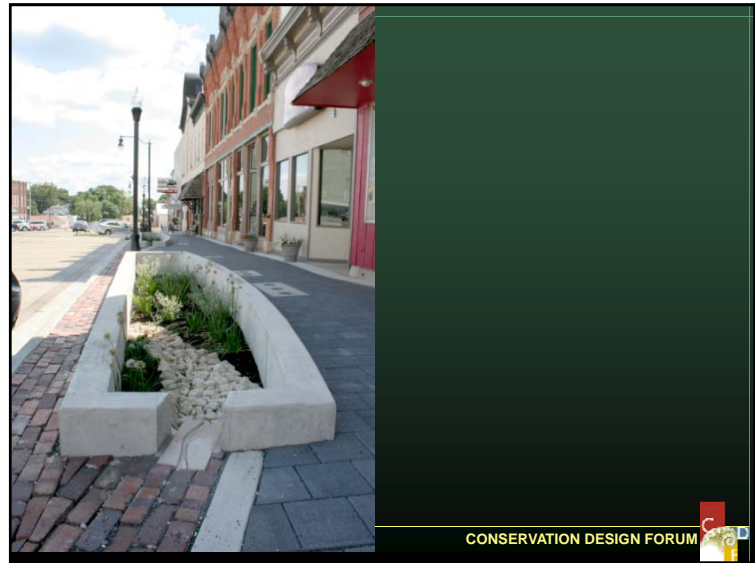


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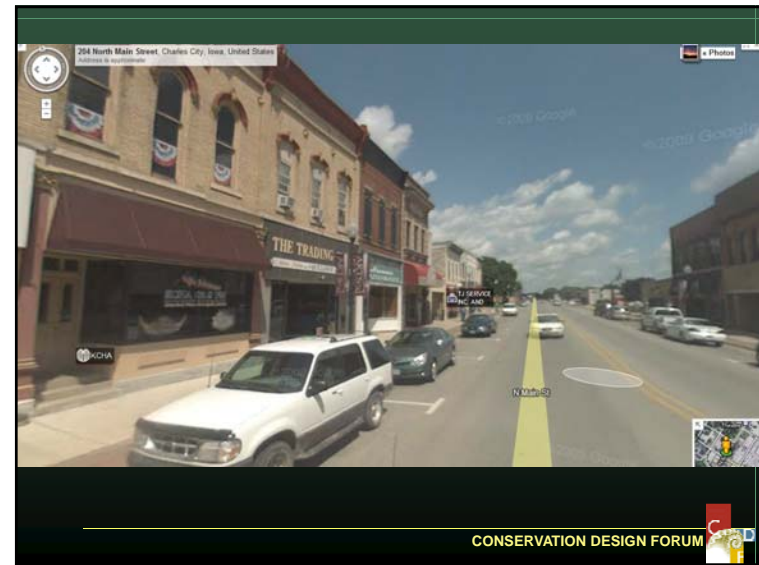
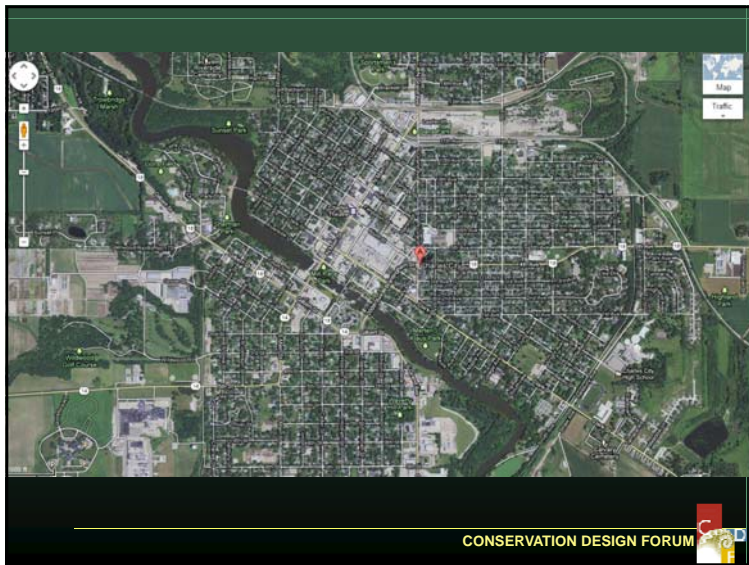
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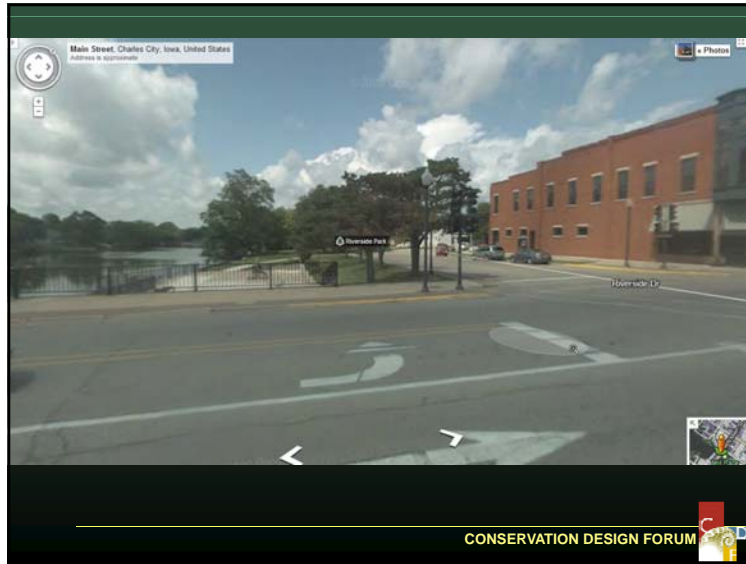
Summary of Results

	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%

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You've been wanting to learn how to get on the Charles City WhiteWater course and really know WHAT you are doing. Now here's your chance.

Join us!
for Beginner Whitewater Kayak Training

CHARLES CITY
WHITEWATER at RIVERFRONT PARK

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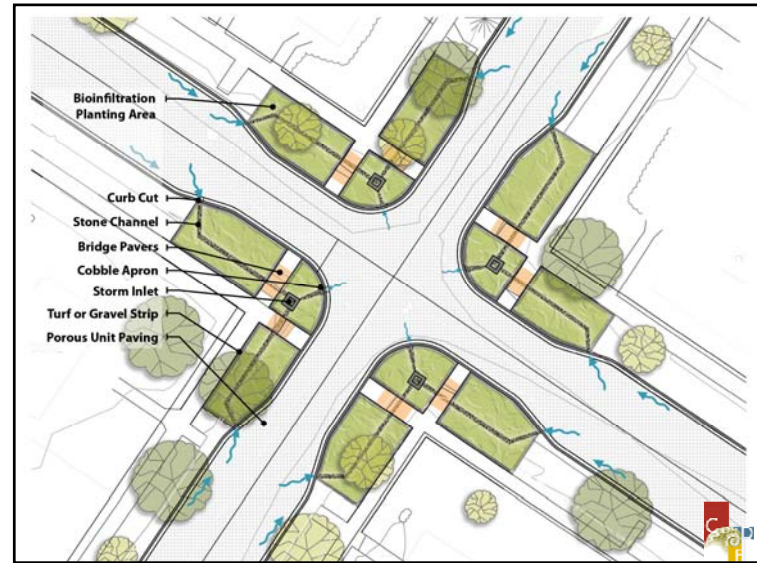
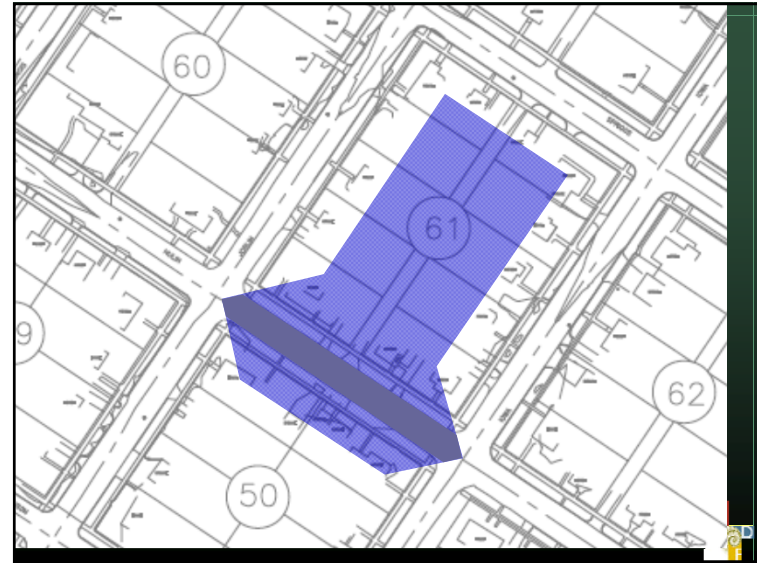
TABLE 1: EXISTING CONDITIONS MODELING RESULTS

	Storm Sewer		2-year Event		10-year Event		100-year Event	
	Size (in)	Capacity* (cfs)	Peak Flow (cfs)	Critical Duration (hrs)	Peak Flow (cfs)	Critical Duration (hrs)	Peak Flow (cfs)	Critical Duration (hrs)
Howard & Hulín	8.00	0.42	1.68	2.00	5.00	1.00	12.12	1.00
Howard & Ferguson	12.00	2.5	3.37	2.00	9.60	1.00	27.14	1.00
Joslin & Spriggs	18.00	5.4	1.00	2.00	2.70	1.00	16.91	1.00
Joslin & Hulín	18.00	8.5	2.35	2.00	6.62	1.00	22.91	1.00
Joslin & Ferguson	24.00	16.0	2.94	2.00	8.27	1.00	23.91	1.00
Johnson & Spriggs	27.00	18.6	10.44	2.00	24.96	2.00	77.32	1.00
Johnson & Hulín	27.00	17.0	12.35	2.00	33.35	2.00	80.42	1.00
Iowa & Ferguson	12.00	2.5	0.70	2.00	1.92	1.00	5.79	1.00

* Full flow capacity with no surcharging
Flow rates that exceed storm sewer capacity

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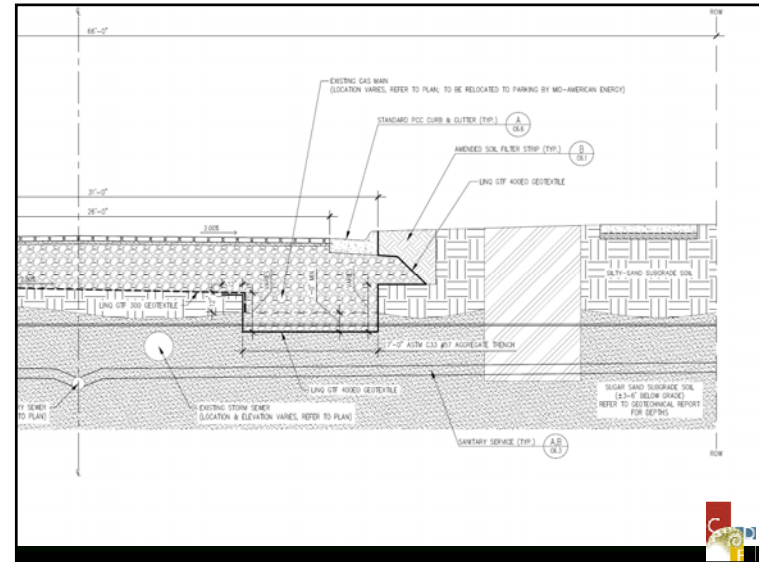




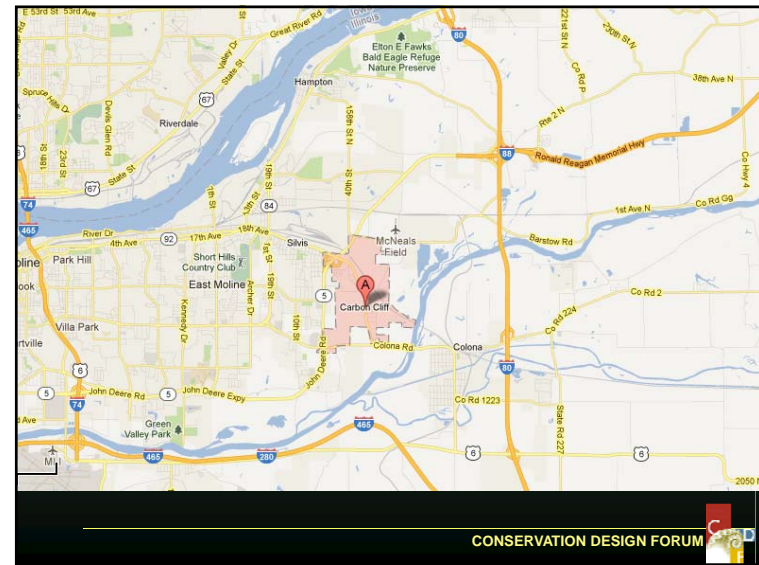
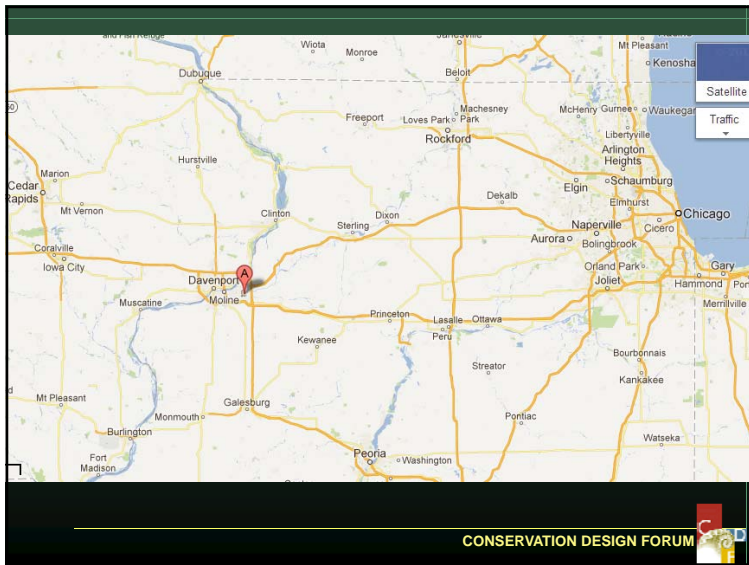


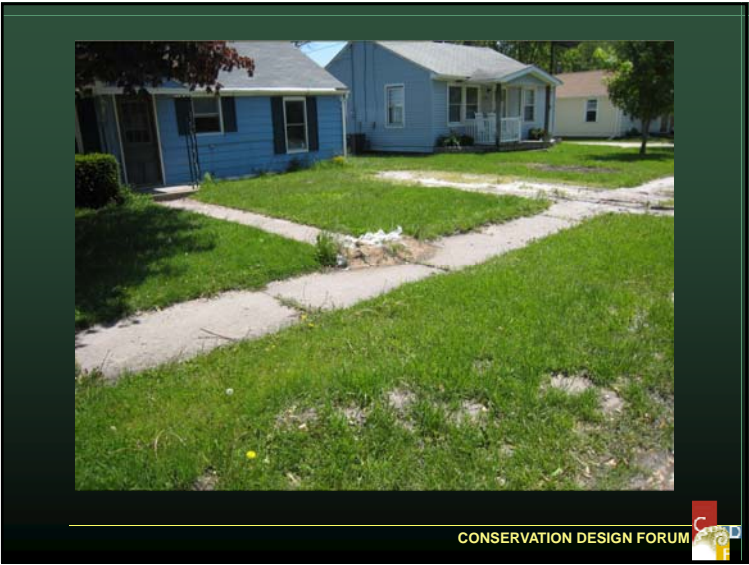
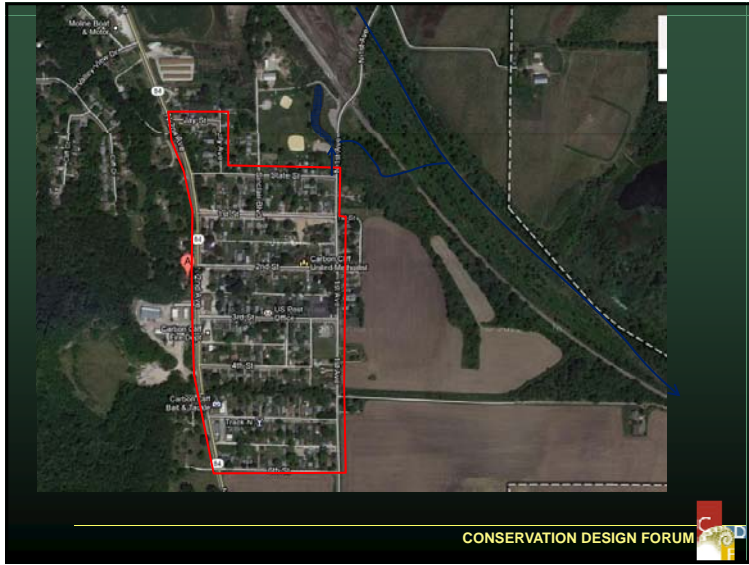
TABLE 2: PROTOTYPE MODEL RESULTS

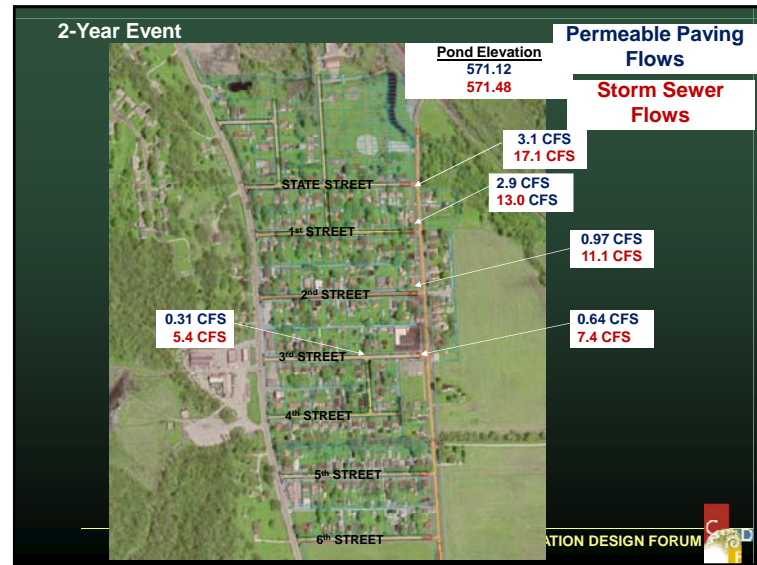
	Rainfall*	Existing	Proposed	% Reduction
6-Month Event				
Runoff volume (inches)*	1.91	0.28	0	100%
Runoff Rate (cfs)**	-	0.59	0	100%
1-Year Event				
Runoff volume (inches)*	2.36	0.45	0	100%
Runoff Rate (cfs)**	-	0.79	0	100%
2-Year Event				
Runoff volume (inches)*	2.98	0.75	0	100%
Runoff Rate (cfs)**	-	1.1	0	100%
10-Year Event				
Runoff volume (inches)*	4.38	1.59	0.59	63%
Runoff Rate (cfs)**	-	1.7	0.12	93%
100-Year Event				
Runoff volume (inches)*	7.07	3.6	2.46	32%
Runoff Rate (cfs)**	-	3.3	2.2	33%

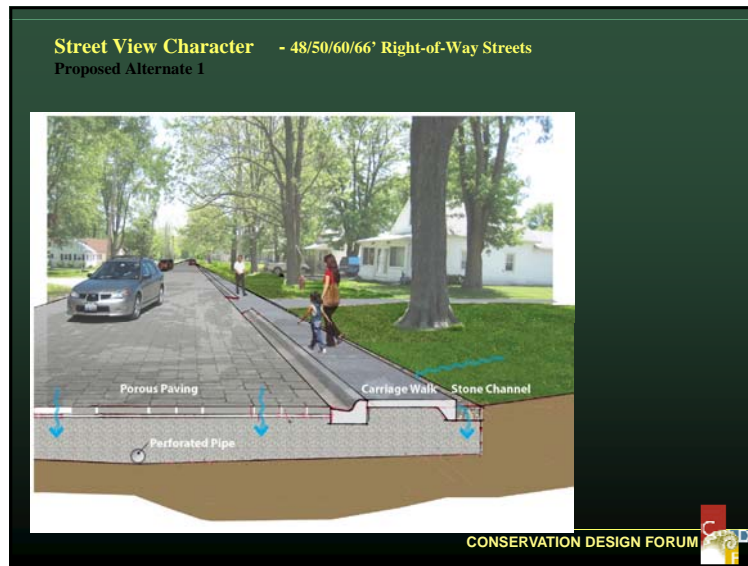
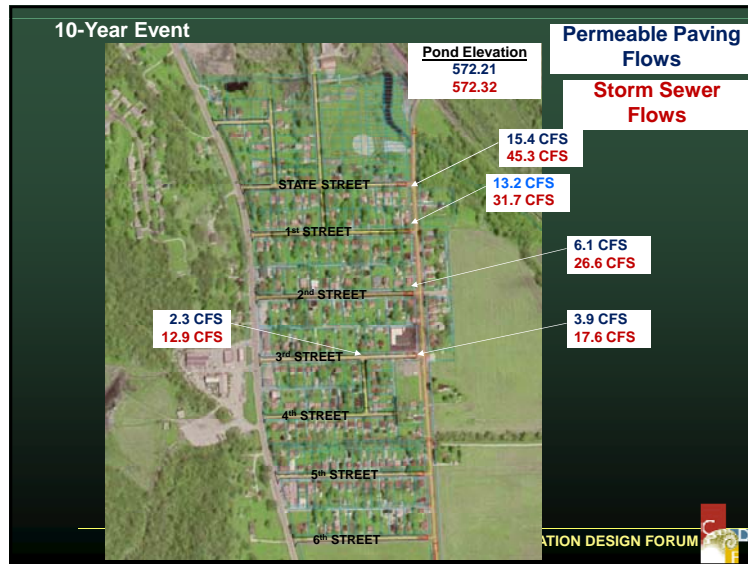
* Based on 24-hour rainfall
 ** Based on critical duration storm

- ## 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

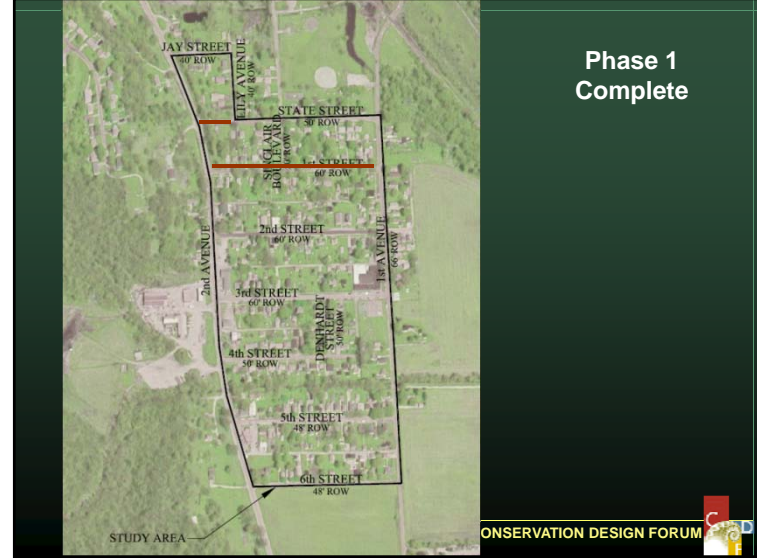
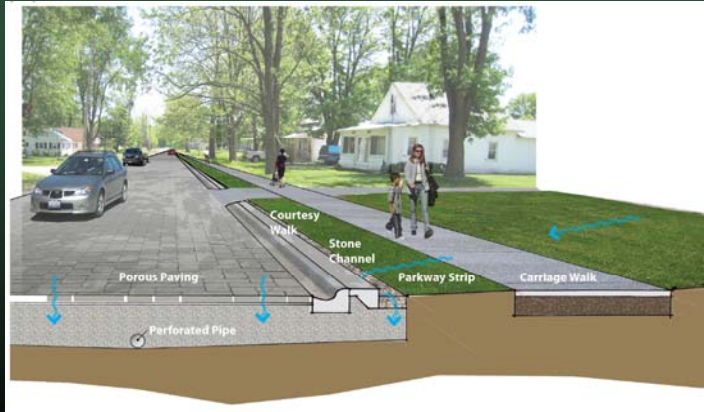




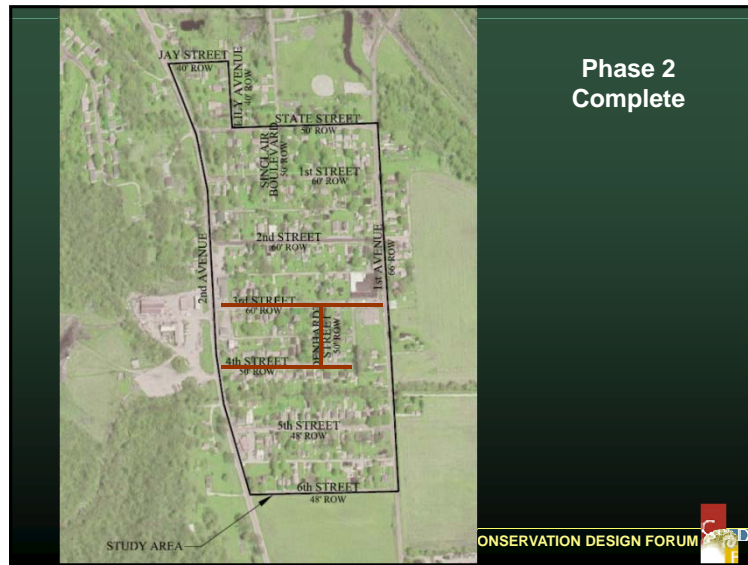




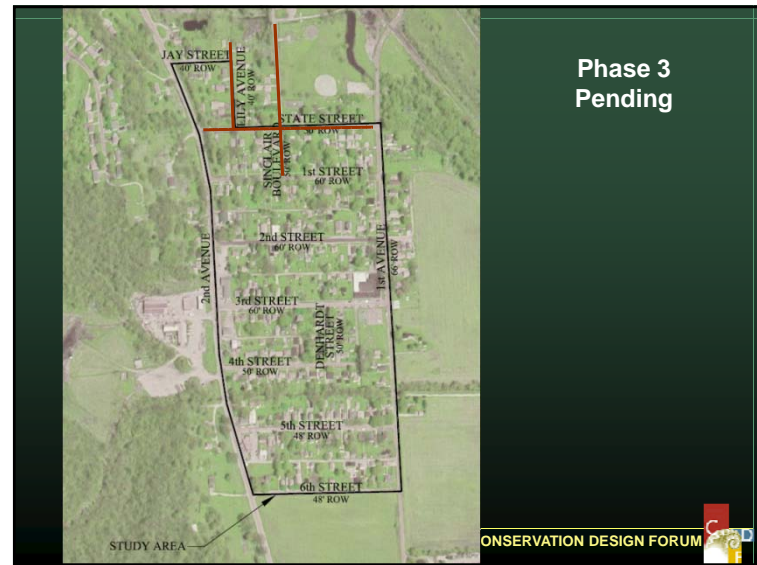
Street View Character - 48/50/60/66' Right-of-Way Streets
Proposed Alternate 2: turf edge



Phase 1 Complete



Phase 2 Complete



Phase 3 Pending



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Summary of Results

Carbon Cliff Green Streets – Phase 2 (10.4 acres)

	Pre-Project	Post-Project	% Reduction
Threshold Event	0.05"	1.10"	-
2-Year Event (2.91" rain)			
Runoff Volume (inches)	1.09	0.22	80%
Peak Flow (cfs)	5.4	0.3	94%
10-Year Event (4.31" rain)			
Runoff Volume (inches)	2.18	1.24	43%
Peak Flow (cfs)	8.8	2.0	77%
100-Year Event (6.36" rain)			
Runoff Volume (inches)	4.43	3.44	22%
Peak Flow (cfs)	21.9	6.0	73%

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