Part 1: Analyzing the D.C. Greenroofing Market

Capitol Greenroofs

Gregory Long, RLA

February 27, 2009

Designing a Vegetated Roofing System

Vegetation Layer

Soil mix/Growing Media

Drainage and Water Retention

Waterproofing & Root Barrier

Insulation

Structural Decking

Environmental and Economic Benefits of Greenroofs

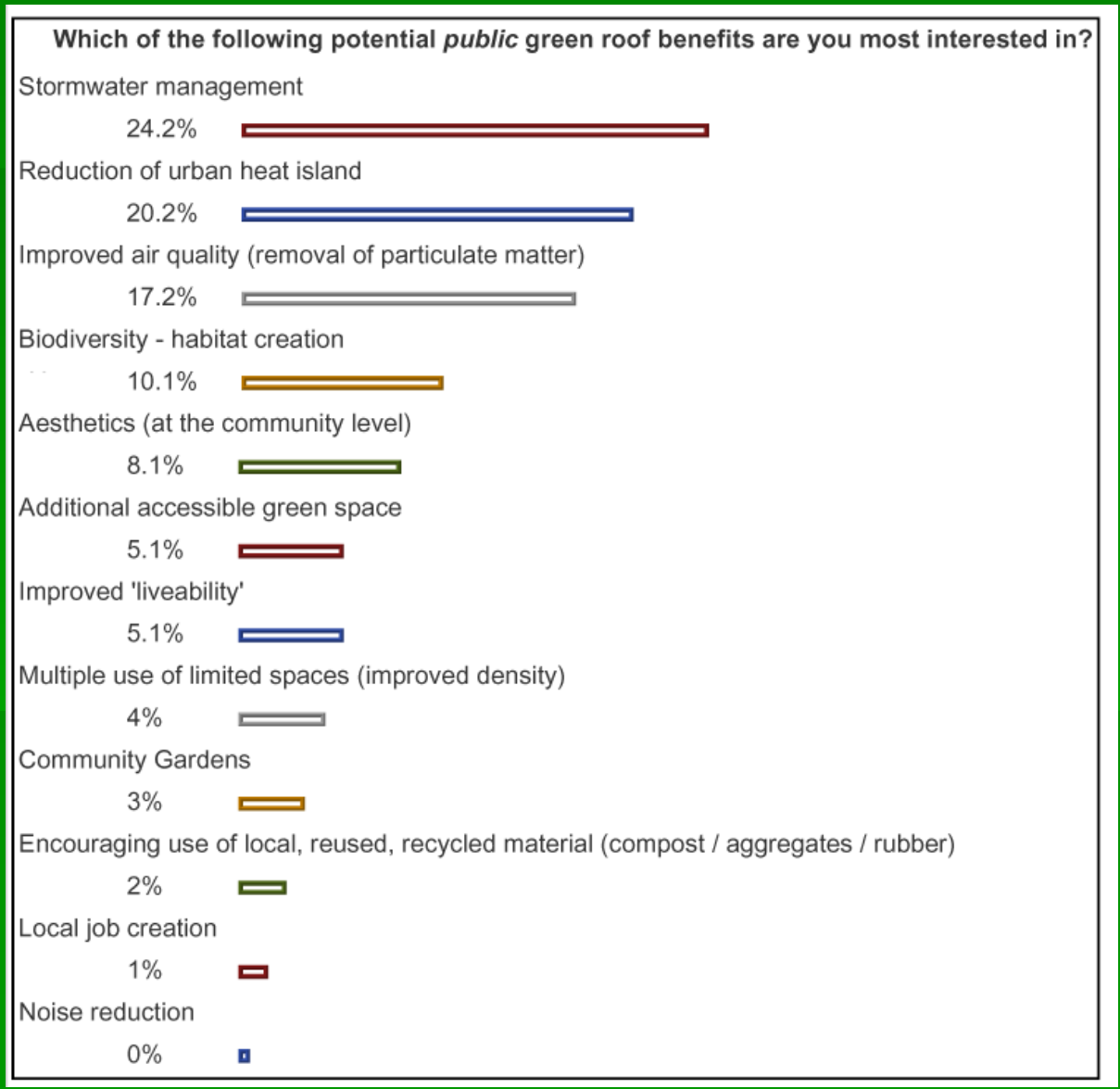


Image credit: Greenroofs for Healthy Cities

Complying with the EPA's Clean Water Act

- 1/3 of the District's land (12,478 Acres) are served by a combined sewer system.
- 2,291 Million gallons of untreated effluent is discharged directly into our watersheds.
- WASA needs to invest close to $3 billion dollars over the next 20 years to get the CSO problem into compliance with EPA CWA.

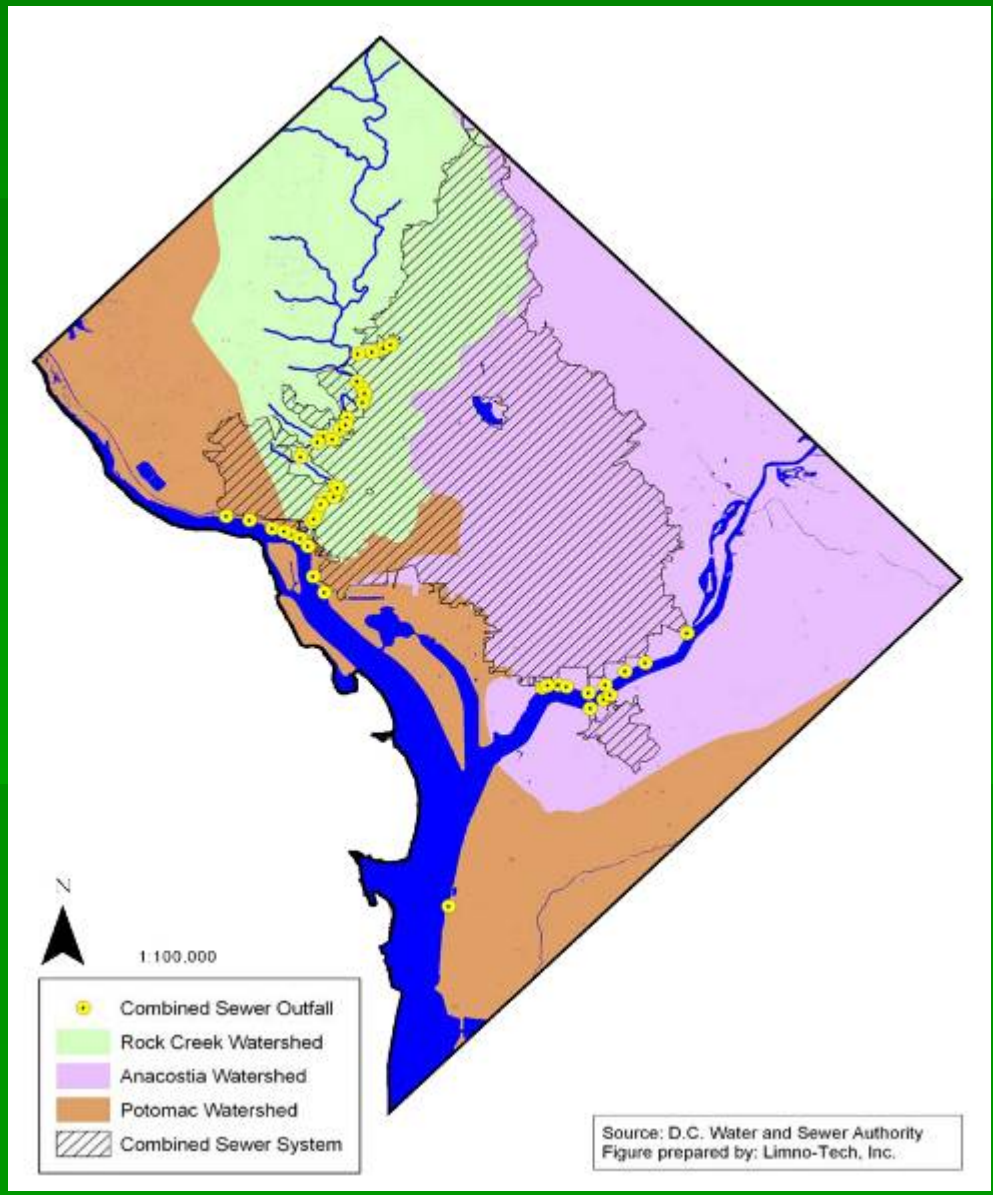
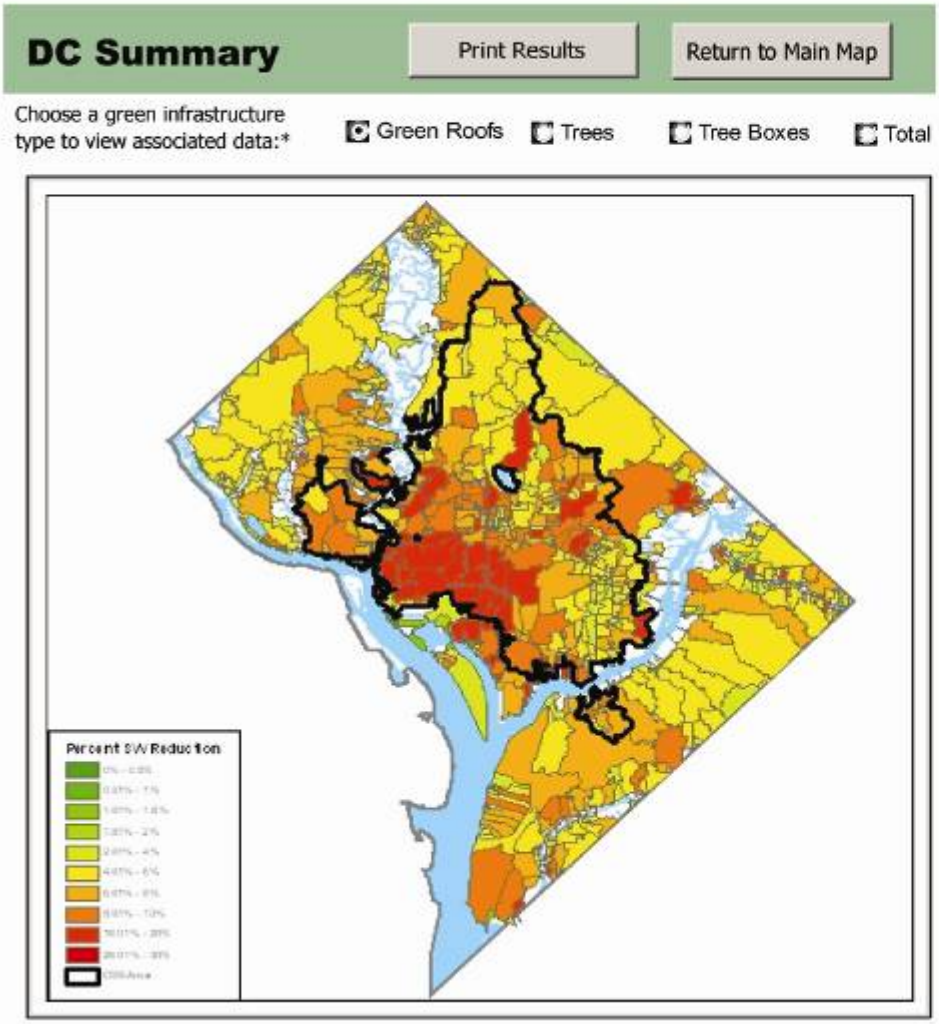


Image Credit: Limno-Tech and WASA

Calculating Stormwater Management Runoff

Green Build-Out Model Results



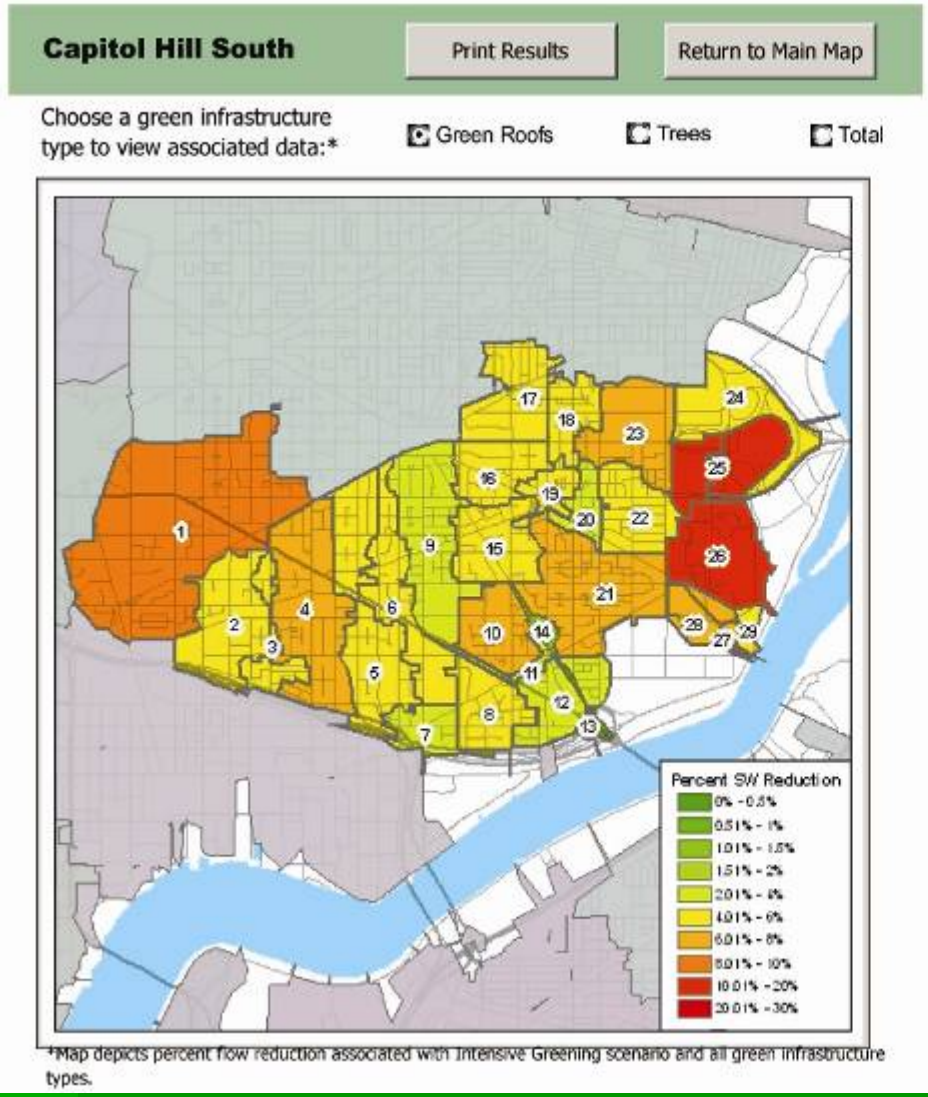
Watershed/Sewer System	Baseline Flow (MGY)	Moderate Greening Scenario Flow (MGY)	Moderate Greening Scenario Flow Reduction	Intensive Greening Scenario Flow (MGY)	Intensive Greening Scenario Flow Reduction
Anacostia CSS	4,219	4,168	1.20%	3,971	5.87%
Potomac CSS	1,013	994	1.80%	922	8.95%
Rock Creek CSS	2,437	2,406	1.24%	2,289	6.05%
Total CSS	7,668	7,569	1.29%	7,182	6.34%
Anacostia MS4	3,719	3,684	0.94%	3,545	4.68%
Potomac MS4	3,177	3,141	1.12%	3,000	5.56%
Rock Creek MS4	1,860	1,841	1.01%	1,768	4.93%
Total MS4	8,755	8,667	1.01%	8,313	5.05%
Anacostia	7,938	7,852	1.08%	7,516	5.31%
Potomac	4,189	4,135	1.28%	3,922	6.38%
Rock Creek	4,296	4,247	1.14%	4,057	5.57%
Total	16,423	16,235	1.15%	15,495	5.65%

MGY = million gallons per year

- **15%** of the District's land use is covered by buildings. Over **100 million sq. ft.** or **80%** of structures over **5,000 sq. ft.** can support a low profile greenroof.

Image Credit: Limno-Tech & Casey Trees

Using GIS to Determine Runoff



ID	Subshed	Sewer Area	Baseline Flow (MGY)	Moderate Greening Scenario Flow (MGY)	Moderate Greening Scenario Flow Reduction	Intensive Greening Scenario Flow (MGY)	Intensive Greening Scenario Flow Reduction
1	CSO 012-c	CSS	103.96	102.63	1.28%	97.21	6.49%
2	CSO 012-b	CSS	25.30	25.13	0.69%	24.43	3.42%
3	CSO 014-c	CSS	9.48	9.42	0.65%	9.16	3.33%
4	CSO 014-b	CSS	44.64	44.12	1.17%	42.07	5.76%
5	CSO 016-d	CSS	36.18	35.90	0.77%	34.81	3.78%
6	CSO 016-c	CSS	26.99	26.83	0.59%	26.17	3.05%
7	CSO 016-b	CSS	9.39	9.36	0.35%	9.21	1.94%
8	CSO 017-a	CSS	16.28	16.19	0.56%	15.82	2.81%
9	CSO 017-d	CSS	34.76	34.57	0.55%	33.82	2.71%
10	CSO 017-c	CSS	19.55	19.37	0.90%	18.67	4.51%
11	CSO 017-b	CSS	2.46	2.45	0.56%	2.41	2.05%
12	CSO 018-b	CSS	19.71	19.62	0.42%	19.29	2.10%
13	CSO 018-a	CSS	3.36	3.36	0.00%	3.36	0.00%
14	CSO 018-c	CSS	2.57	2.57	0.00%	2.56	0.35%
15	CSO 018-d	CSS	20.63	20.48	0.74%	19.88	3.66%
16	CSO 017-h	CSS	16.55	16.44	0.69%	15.99	3.42%
17	CSO 019-g-5	CSS	22.69	22.53	0.72%	21.89	3.52%
18	CSO 019-c-1	CSS	11.51	11.44	0.68%	11.10	3.59%
19	CSO 017-g	CSS	7.60	7.56	0.55%	7.42	2.34%
20	CSO 019-b-1	CSS	7.03	7.00	0.34%	6.91	1.62%
21	CSO 017-e	CSS	48.08	47.67	0.84%	46.06	4.20%
22	CSO 019-b-2	CSS	17.49	17.42	0.40%	17.15	1.98%
23	CSO 019-c-2	CSS	18.84	18.65	1.03%	17.89	5.08%
24	SW-ANA13	MS4	38.11	37.85	0.68%	36.81	3.40%
25	CSO 019-b-3	CSS	25.70	25.21	1.89%	23.27	9.44%
26	CSO 019-a	CSS	27.43	26.83	2.18%	24.42	10.96%
27	SW-ANA16	MS4	1.44	1.41	2.61%	1.28	11.19%
28	SW-ANA27	MS4	6.59	6.39	3.13%	5.59	15.21%
29	SW-ANA29	MS4	2.99	2.99	0.00%	2.99	0.00%

MGY = million gallons per year

- Storm water fee is being proposed to pay for infrastructure improvements in D.C. and a Sanitary Tax has been set in Arlington.

Image Credit: Limno-Tech, Inc. and Casey Trees

Adopting "Green Roof Policies" for D.C.

Photo Credit: Casey Trees and D.C. Greenworks

- Green Roof Subsidy Program was available for 2008 funding should continue in 2009. ($3/ sq. ft. up to a $12,000 cap)
- Expedited permit review and processing for "green" projects. DCRA to enforce and administer this program.
- In Arlington, a development density bonus is available for buildings that are designed to the LEED standard.

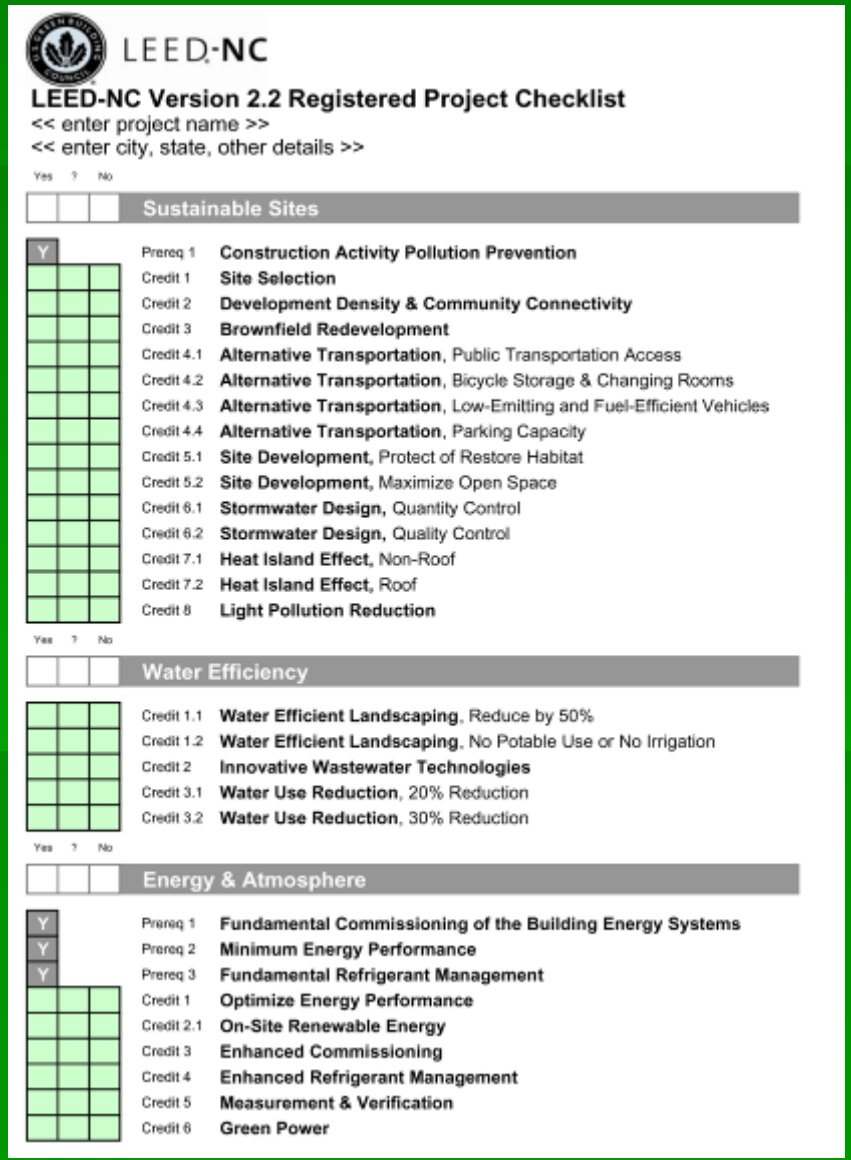
Market Analysis

Greenroof Installation and Projections					
Year	Square Foot	Installation Cost	Market Share (2.0%)	Total Company Sales	DC % Sales
2004	90,137	$ 2,028,083	$ 40,562	$ 144,384	28%
2005	206,900	$ 4,655,250	$ 93,105	$ 180,480	52%
2006	301,751	$ 6,789,398	$ 135,788	$ 225,600	60%
2007	377,189	$ 8,486,747	$ 169,735	$ 282,000	60%
2008	433,767	$ 9,759,759	$ 195,195	$ 338,400	58%
2009	498,832	$ 11,223,723	$ 224,474	$ 406,080	55%
2010	573,657	$ 12,907,281	$ 258,146	$ 437,296	59%
2011	659,705	$ 14,843,373	$ 296,867	$ 584,755	51%
2012	758,661	$ 17,069,879	$ 341,398	$ 701,706	49%
2013	872,460	$ 19,630,361	$ 392,607	$ 842,047	47%
2014	1,003,330	$ 22,574,915	$ 451,498	$ 1,010,457	45%
2015	1,153,829	$ 25,961,153	$ 519,223	$ 1,212,548	43%
2016	1,326,903	$ 29,855,326	$ 597,107	$ 1,455,058	41%
2017	1,525,939	$ 34,333,624	$ 686,672	$ 1,746,070	39%

- D.C. market has grown by approximately 68% over the last 3 years.
- Market likely to continue to grow by at least 50% over the next 10 years.
- Estimated costs at $30/ sq. ft. to install these systems but likely to increase by around 4% in 2009 as building materials become more expensive.
- In 10 years, the greenroof installation industry could add $34 million every year to the tax base and could generate 500+ new jobs. Over 2 million sq. ft. of vegetated roofs could be installed annually by 2020.

D.C. "Green Building Bill" and LEED Certification

- Starting 2009 All publicly funded new construction commercial projects will need to be meet LEED Silver standards.
- Starting 2012 All new private non-residential and institutional buildings will need to exceed LEED Certified standards.
- Green roofs could receive as many as 12 credits.
- SS 5.1- Protect and Restore Habitat
- SS 5.2- Maximize Open Space
- SS 6.1- Stormwater Quantity Control
- SS 6.2- Stormwater Quality Control
- SS 7.1- Heat Island Effect (non-roof)
- SS 7.2- Heat Island Effect (roof)
- WE 1.1-1.2- Water Efficient Landscaping
- IDP 1.1-1.4- Innovation in Design



LEED-NC

LEED-NC Version 2.2 Registered Project Checklist

<< enter project name >>

<< enter city, state, other details >>

Yes ? No

Sustainable Sites

Y	Prereq 1	**Construction Activity Pollution Prevention**
	Credit 1	**Site Selection**
	Credit 2	**Development Density & Community Connectivity**
	Credit 3	**Brownfield Redevelopment**
	Credit 4.1	**Alternative Transportation**, Public Transportation Access
	Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms
	Credit 4.3	**Alternative Transportation**, Low-Emitting and Fuel-Efficient Vehicles
	Credit 4.4	**Alternative Transportation**, Parking Capacity
	Credit 5.1	**Site Development**, Protect of Restore Habitat
	Credit 5.2	**Site Development**, Maximize Open Space
	Credit 6.1	**Stormwater Design**, Quantity Control
	Credit 6.2	**Stormwater Design**, Quality Control
	Credit 7.1	**Heat Island Effect**, Non-Roof
	Credit 7.2	**Heat Island Effect**, Roof
	Credit 8	**Light Pollution Reduction**

Yes ? No

Water Efficiency

	Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%
	Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation
	Credit 2	**Innovative Wastewater Technologies**
	Credit 3.1	**Water Use Reduction**, 20% Reduction
	Credit 3.2	**Water Use Reduction**, 30% Reduction

Yes ? No

Energy & Atmosphere

Y	Prereq 1	**Fundamental Commissioning of the Building Energy Systems**
Y	Prereq 2	**Minimum Energy Performance**
Y	Prereq 3	**Fundamental Refrigerant Management**
	Credit 1	**Optimize Energy Performance**
	Credit 2.1	**On-Site Renewable Energy**
	Credit 3	**Enhanced Commissioning**
	Credit 4	**Enhanced Refrigerant Management**
	Credit 5	**Measurement & Verification**
	Credit 6	**Green Power**

Image courtesy of: U.S. Green Building Council

SS Credit 5.1 Sustainable Sites: Protect or Restore Habitat (1 point)

- On previously developed sites, restore or protect a minimum of 50% of the site area (excluding the building footprint) with native vegetation.
- Vegetated roofs may include roof surface area in these calculations as long as they meet SS credit 2 for development density.

Image courtesy of: D.C. Greenworks

SS Credit 5.2 Sustainable Sites: Maximize Open Space (1 point)

- Exceed the local zoning's open space requirement by 25% or provide vegetated open space equal to 20% of the project's site area.
- Vegetated roofs may include roof surface area in these calculations as long as they meet SS credit 2 for development density.

Image courtesy of: Mori Building Company

SS Credit 6.1 Sustainable Sites: SWM Quantity Control (1 point)

- If existing imperviousness is less than or equal to 50%: You can implement a plan the prevents post-development peak discharge rate and quantity from exceeding the pre-development peak flows for the one and two year 24 hour storms.
- If greater than 50% existing impervious surfaces: You can create a swm plan that results in a 25% reduction in volume of runoff from the two year 24 hour design storm.

Image courtesy of: Mori Building Company

SS Credit 6.2 Sustainable Sites: SWM Quality Control (1 point)

- Implement a stormwater management plan that treats 90% of the average annual rainfall using BMP's.
- BMP's must be capable of removing 80% of the average annual post development total suspended solids (TSS).

Image courtesy of: Chesapeake Bay Foundation

SS Credit 7.1 Sustainable Sites: Heat Island Reduction Non-Roof (1 point)

- Place a minimum of 50% of parking spaces under cover (The roof needs to have a solar reflectance index of at least 29). Vegetative roofs over parking garages normally meet this requirement.
- You can often obtain an innovation in design credit if you place 100% of the parking in an underground structure.

Image courtesy of: Daniel Roehr

SS Credit 7.2 Sustainable Sites: Heat Island Reduction Roof (1 point)

- Install a vegetated roof for at least 50% of the roof area.
- Or install a high albedo roof with a SRI value of 79 for low sloped roofs under 2:12 pitch or 29 for steep pitch roofs over 2:12 over 75% of the roof.

Image courtesy of: D.C. Greenworks

WE Credit 1.1 Water Efficient Landscape 50% Reduction (1 point)

- Reduce the water consumption by 50% from a calculated mid-summer baseline by using recycled wastewater, captured rainwater, efficient irrigation systems, or drought tolerant plant species.
- Stormwater Harvesting is an effective way to obtain this credit for collecting roof runoff. You can actually get another point if you eliminate irrigation altogether (WE Credit 1.2)

Image courtesy of: Arlington County

ID Credit 1.1-1.4 Innovated Design Credit (1 point)

- If you exceed open space requirements and reduce heat island effects by vegetating more roof area you can get extra credits.
- Combining “green roofs” with photovoltaic panels could give you another credit.

Image courtesy of: Zinco

Thanks For Your Time….

Photo credit: Building Logics