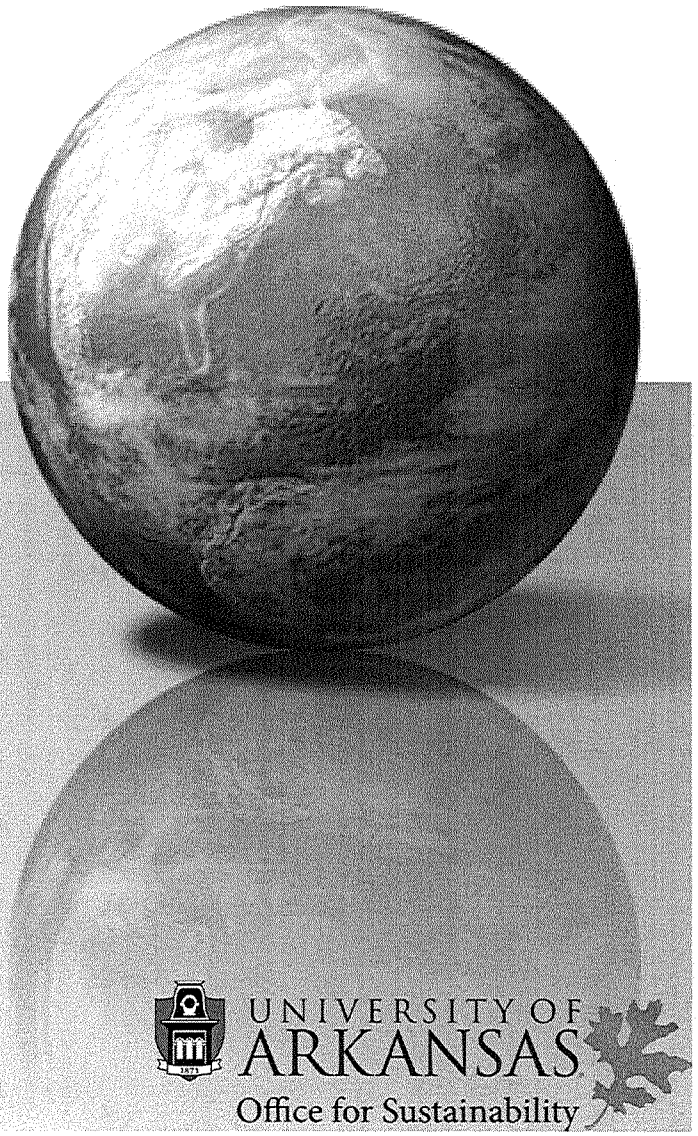
Stormwater Management Programs under USEPA Phase 1 and 2 Rules



17th Annual EPA Region 6 Stormwater Conference Hot Springs, AR October 18-22, 2015

Marty Matlock, PhD, PE, BCEE

Executive Director, Office for Sustainability

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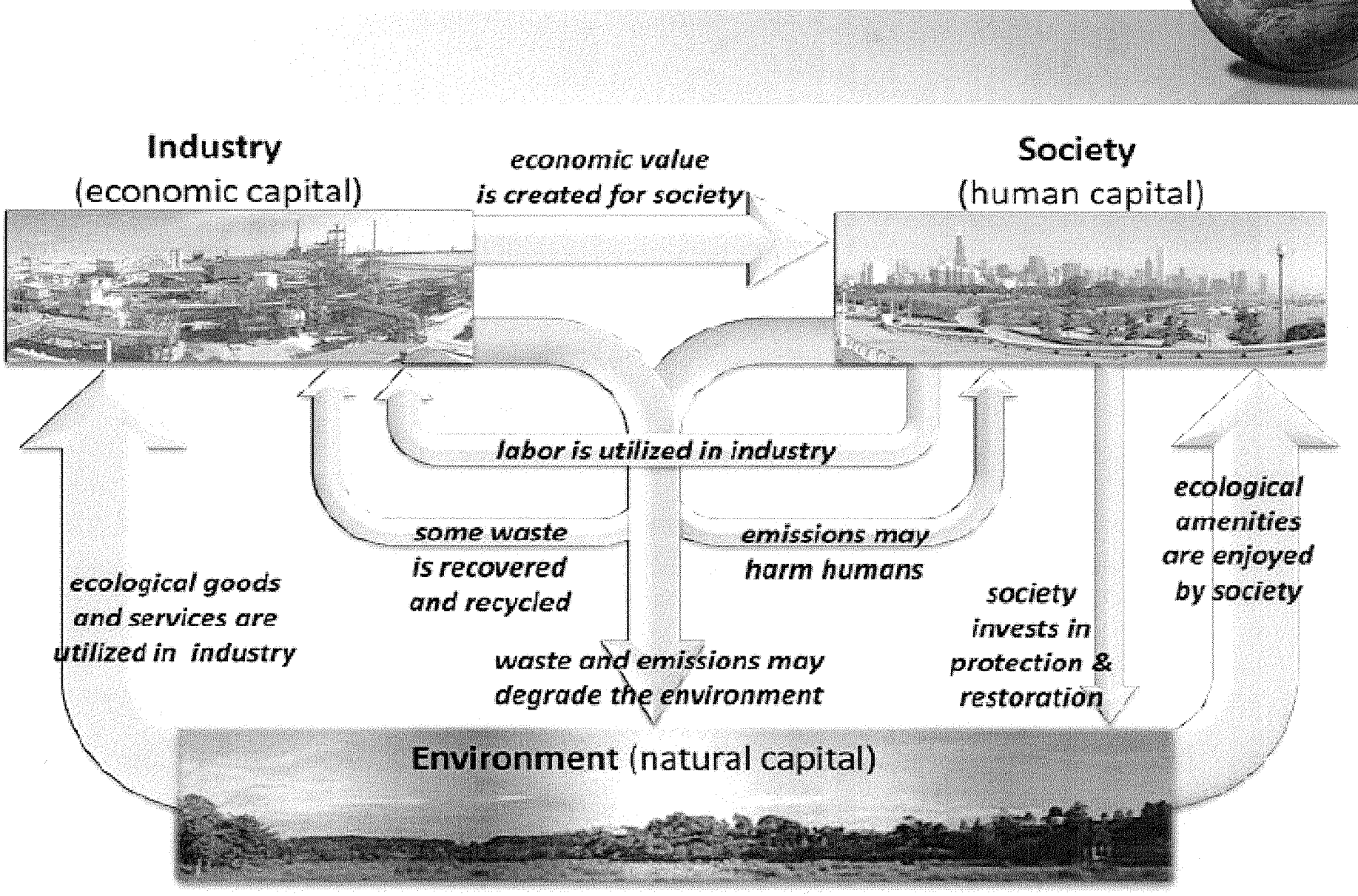
University of Arkansas

UNIVERSITY OF ARKANSAS

Office for Sustainability

Everything is Connected

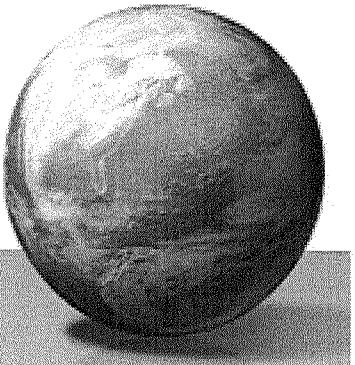


Everything is changing

USEPA Phase 1 and 2 Stormwater Permit Rules

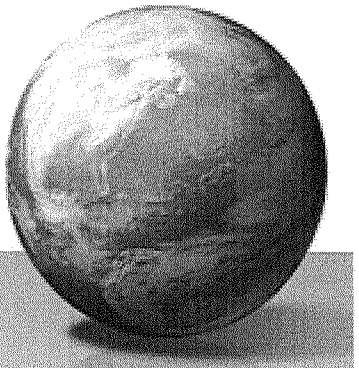
- Municipal Separate Storm Sewer System (MS4) permits through June 2014 include:
  - 250 individual MS4 permits cover approximately 855 Phase I MS4s.
  - 54 general MS4 permits cover approximately 6,589 Phase II MS4s.
  - 100 individual MS4 permits cover approximately 106 Phase II MS4s.
  - 3 watershed MS4 permits cover approximately 3 Phase I and 40 Phase II MS4s.
- From USEPA 833-R-14-003, June 2014

MS4 Rules



- For almost 20 years USEPA has been phasing in implementation of stormwater permit programs.
- Focus has been on water quality based effluent limits (WQBELs) for stormwater permits.
- Approach has been expanded implementation of Best Management Practices (BMPs).
- The use of adaptive management for BMP-based permitting has proven to be effective, especially under TMDL criteria for WLA.

MS4 Permit Strategies

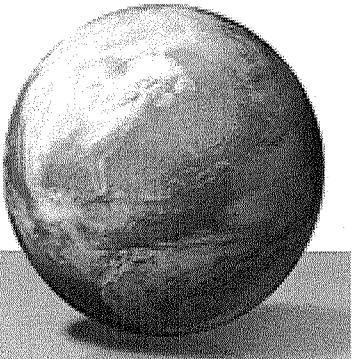


- Permitting authorities (ADEQ and USEPA) can express WQBELs "as system-wide requirements rather than as individual discharge location requirements such as effluent limitations on discharges from individual outfalls. Moreover, the inclusion of numeric limitations in an MS4 permit does not, by itself, mandate the type of controls that a permittee will use to meet the limitation."
  - Andrew Sawyers, Director, Office of Wastewater Management, USEPA, in Nov 26, 2014 memorandum regarding WLAs in TMDLs

MS4 Permit Strategies (continued)

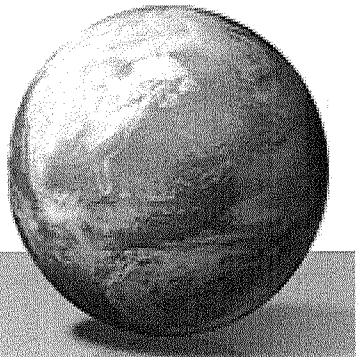
- EPA recommends that NPDES permitting authorities establish clear, specific, and measurable permit requirements to implement the minimum control measures in MS4 permits.
- Post-construction stormwater management, consistent with guidance in the 1999 Phase II Rule, should include numeric requirements that attempt to maintain pre-development runoff conditions (40 CFR § 122.34(b)(5))

MS4 Permit Strategies (continued)



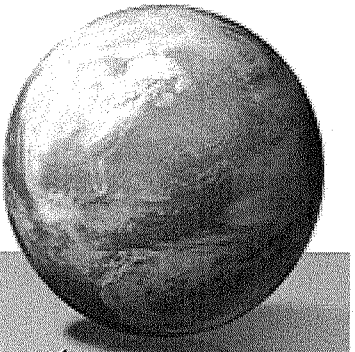
- Permits should contain clear, specific, and measurable elements associated with BMP implementation:
  - schedule for BMP installation,
  - frequency of a practice,
  - level of BMP performance
- These should be supported by documentation that implementation of selected BMPs will result in achievement of water quality standards.

MS4 Permit Strategies (continued)



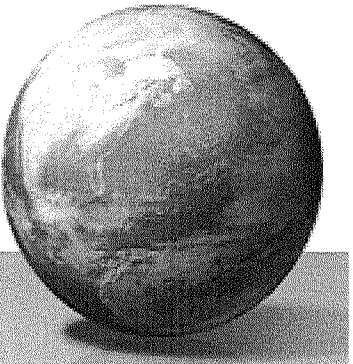
- Permitting authorities should also consider including numeric benchmarks for BMPs and associated monitoring protocols for estimating BMP effectiveness in stormwater permits.
- Benchmarks can support an adaptive approach to meeting applicable water quality standards.
- Exceeding the benchmark would typically require the permittee to take additional action:
  - evaluating the effectiveness of the BMPs,
  - implementing and/or modifying BMPs,
  - providing additional measures to protect water quality.

MS4 Permit Strategies (continued)



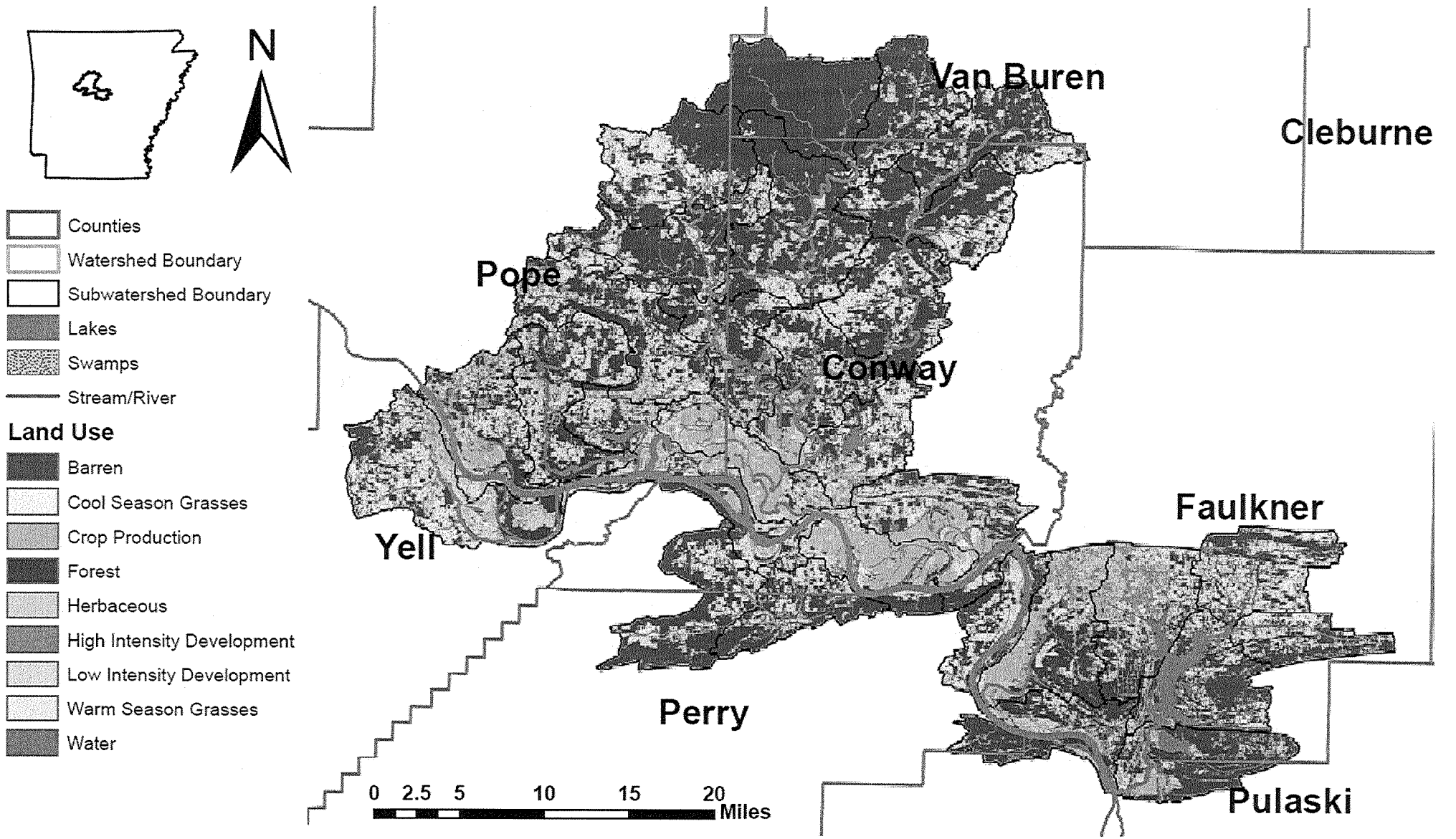
- 40 CFR § 122.47 requires that the effluent limitation(s) must be met "as soon as possible."
- By providing discretion to include "such other provisions" as deemed appropriate, CWA section 402(p)(3)(B)(iii) provides flexibility for NPDES authorities to set appropriate deadlines towards meeting WQBELs in MS4 permits consistent with the requirements for compliance schedules in NPDES permits set forth in 40 CFR § 122.47

Modeling Stormwater BMP Performance: Conway, AR



- Little Creek-Palarm Creek watershed assessment of Low Impact Development BMPs to reduce nutrient and sediment loads.
- SWAT model for the Lake Conway-Point Remove watershed was modified to include each of the HUC-14s.
- SWAT was used to identify which HUC-14s were a priority for TSS, TN, and TP using percentile rank.

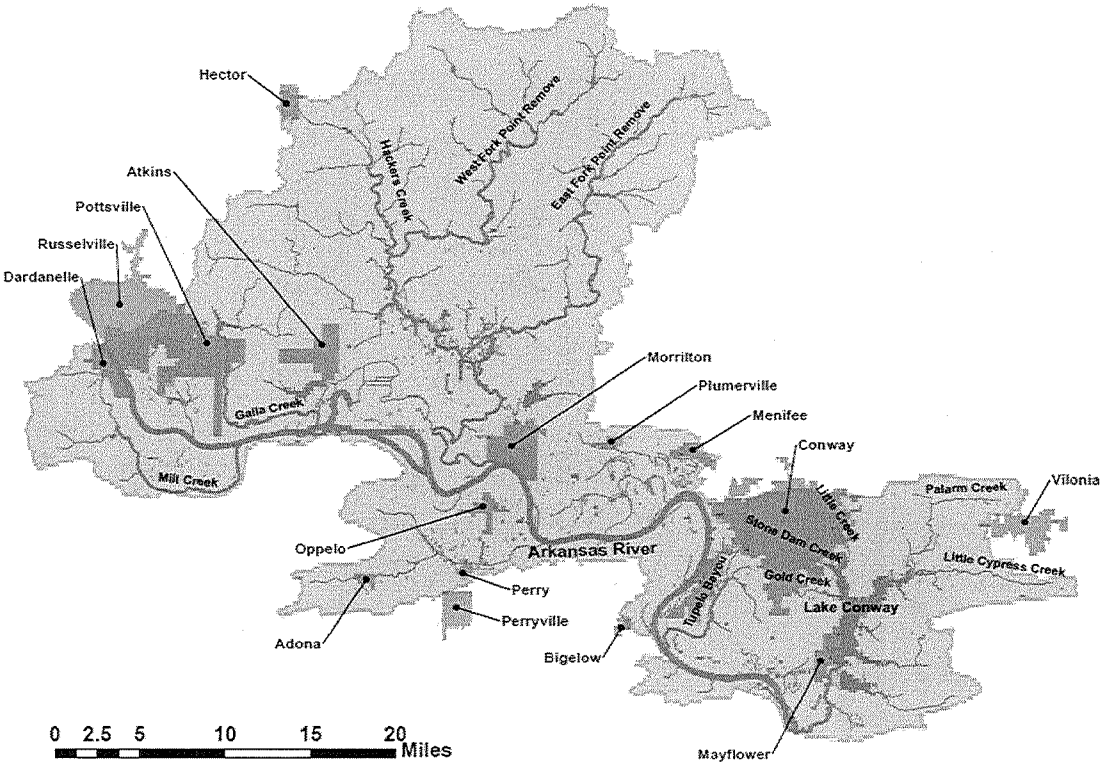
Conway Point Remove Land Use

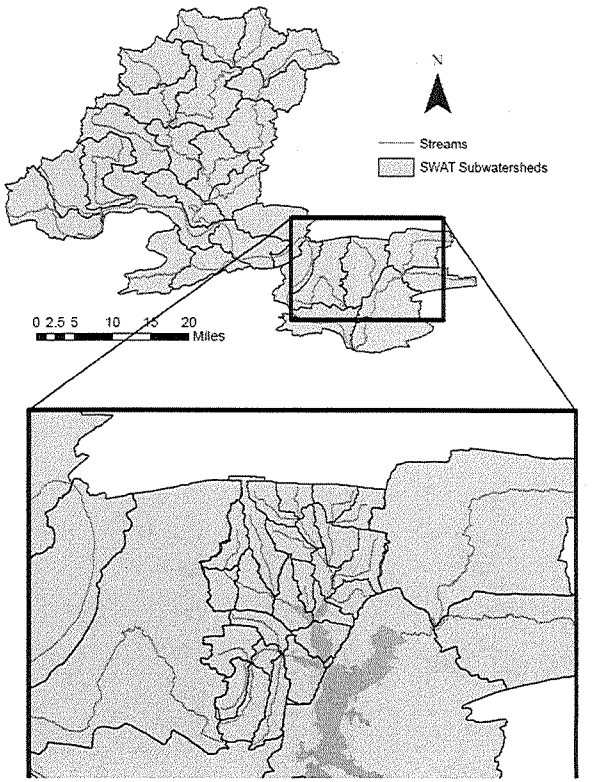


Little Creek and Palarm Creek in the Lake Conway-Point Remove Watershed

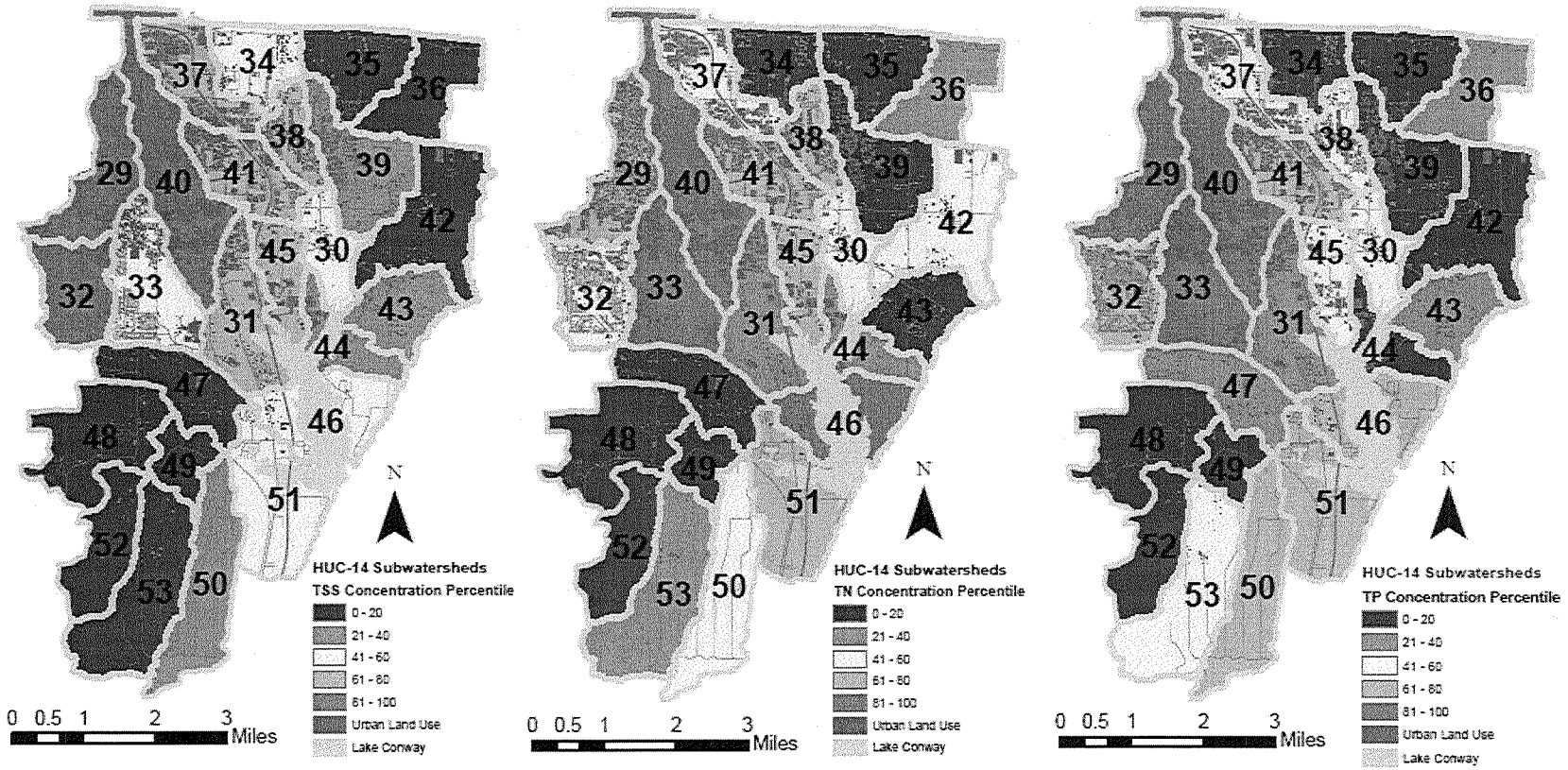
N

Cities
Watershed Boundary
Lakes
Swamps
Stream/River

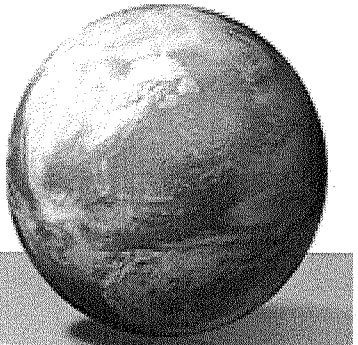




SWAT Identified Priority HUC-14s for N, P, Sediment Loads



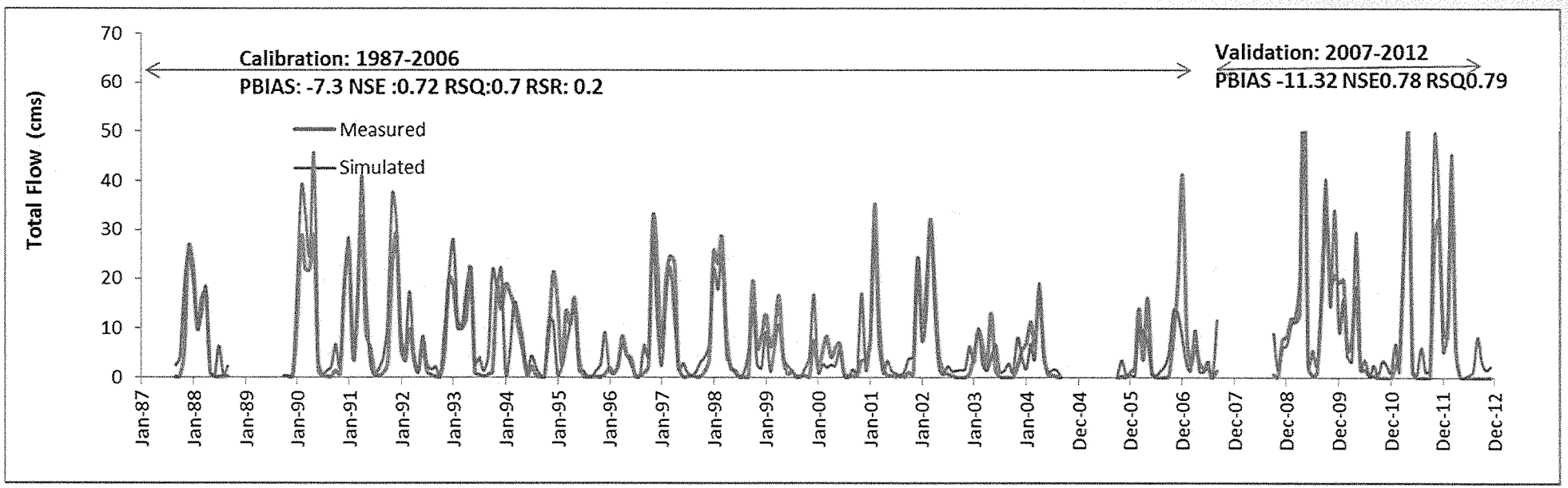
Modeling Stormwater BMP Performance: Conway, AR



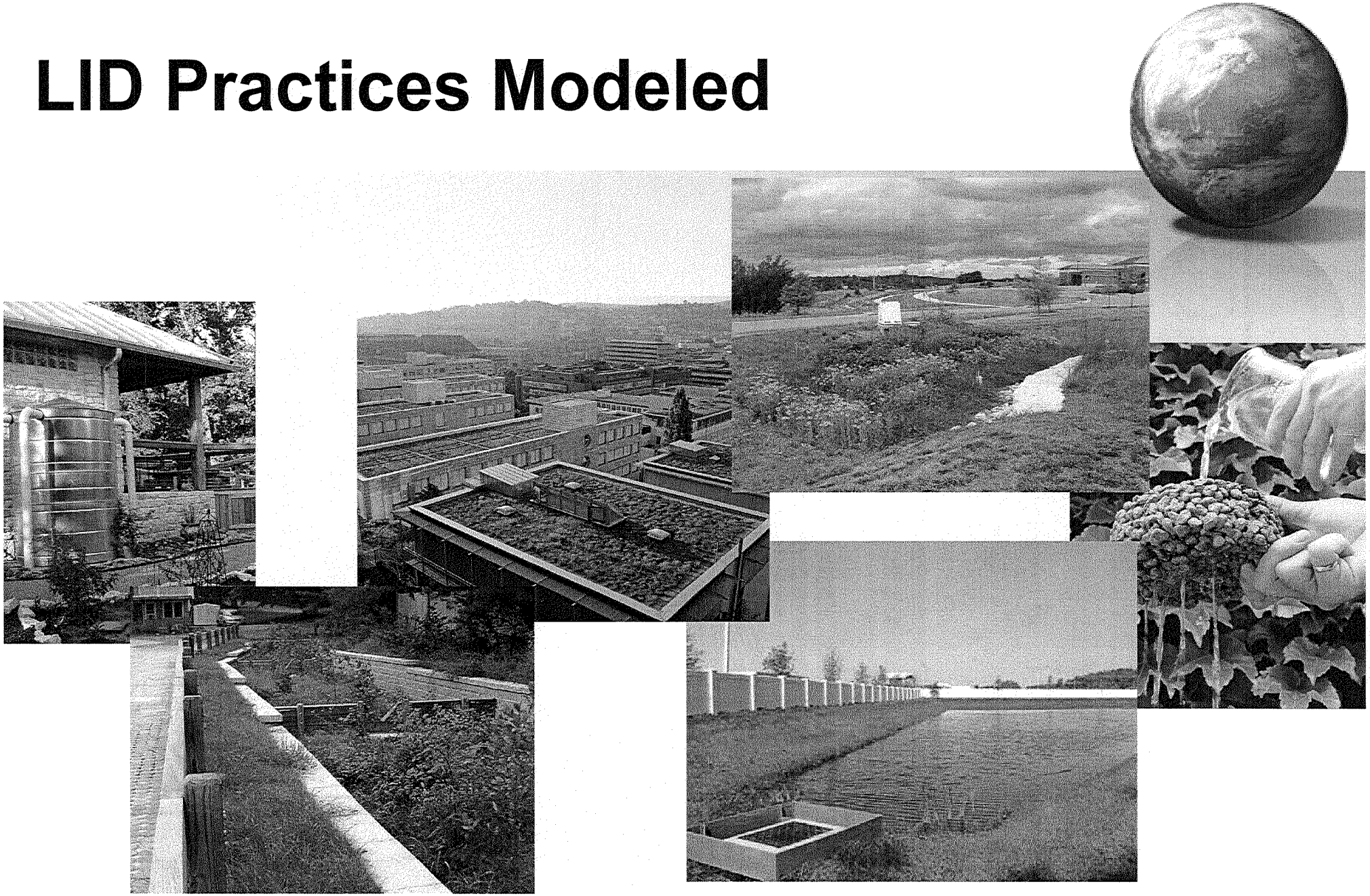
- Analyzed LID effectiveness for the watershed based on 2-yr storm events.
- Used USEPA SWMM to model LID within a watershed
  - bioretention cells,
  - cisterns,
  - green roofs,
  - porous pavement, and
  - vegetated swales

SWAT Hydrology Calibration and Validation

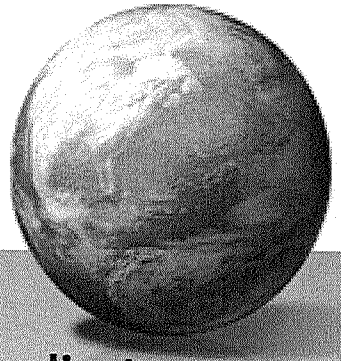
- Designed for Two Year Storm Events



LID Practices Modeled



SUSTAIN LID Placement Criteria

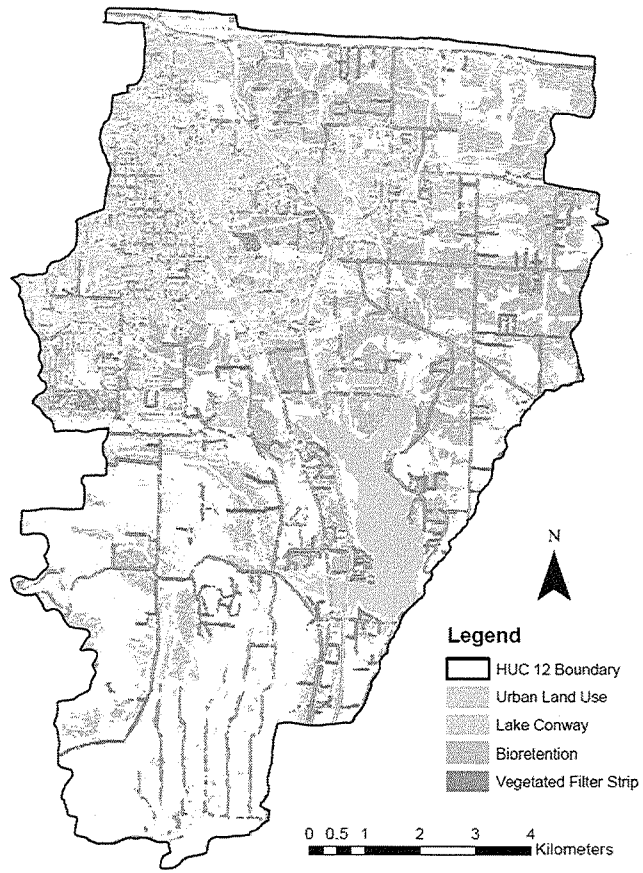


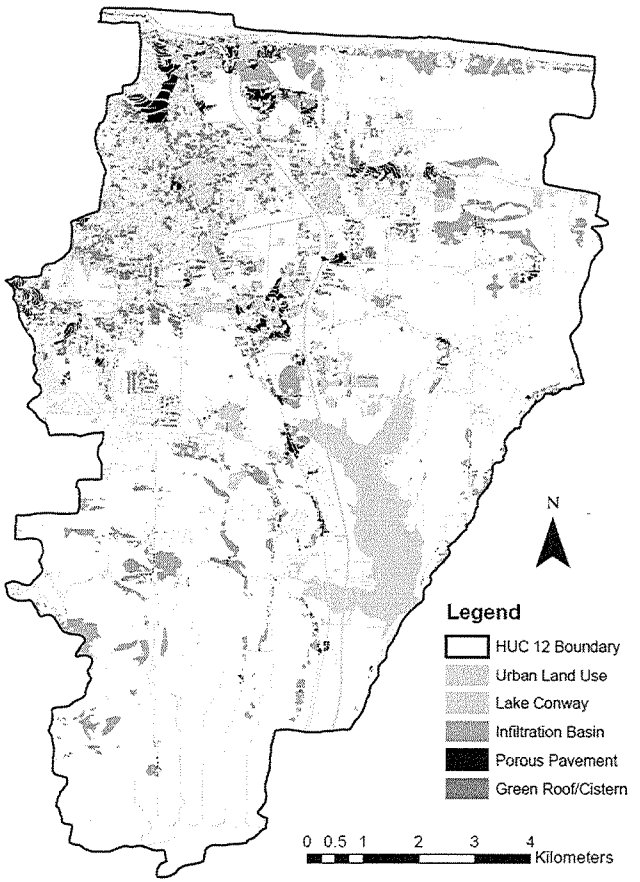
Site selection criteria and weighted criteria for SUSTAIN BMPs. Dashes indicate parameters that were not required or not used for site selection. Parameters that employed a weighted criteria are designated WC.

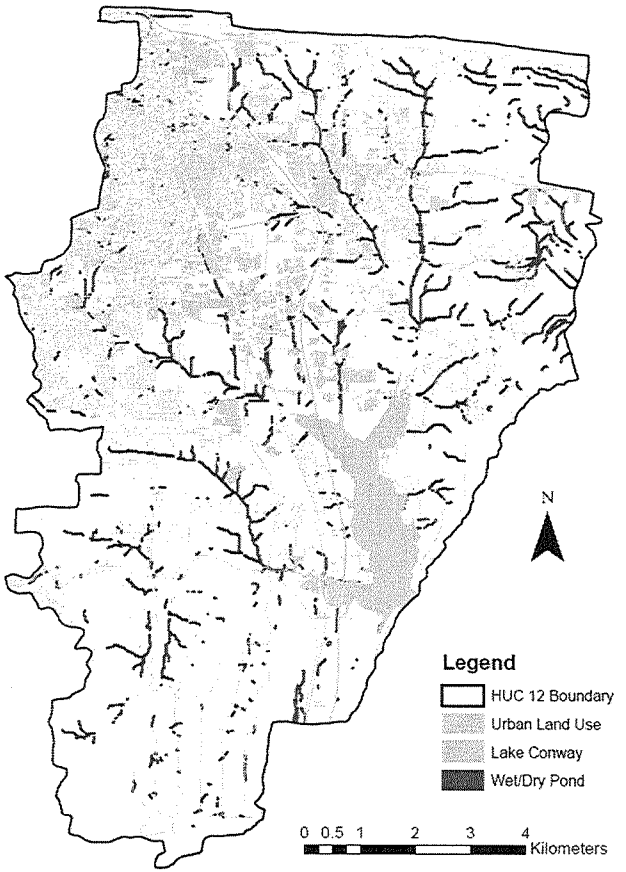
	Cisterns	Green Roofs	Infil Basin	Wet Pond	Dry Pond	Vegetated Filterstrip	Porous Pavement	Bioretention
Drainage Area (ac)	-	-	<5	>20	>15	-	<3	<2
Slope %	-	-	WC	WC	WC	WC	<2	WC
Imp %	>50	>50	<20	<50	<50	<30	>0	<15
HSG	-	C-D	WC	WC	WC	WC	WC	WC
Water Depth (ft)	-	-	-	-	-	-	-	-
Road Buffer (ft)	-	-	>100	-	-	<75	-	>100
Stream Buffer (ft)	-	-	>100	-	-	-	-	>100
Bldg Buffer (ft)	<30	<30	>100	>200	>100	>50	-	>50
Land Ownership	-	-	-	-	-	-	-	-

	Criteria	Weight
Slope % Grassed Swale	<4	10
	<10	2
	<15	1
	>=15	0
Slope % All Other BMPs	<5	10
	<10	7
	<15	5
	>=15	0
HSG	A	10
	B	7
	C	5
	D	3

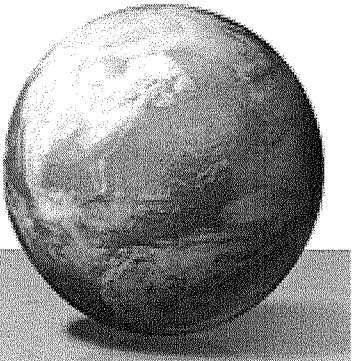
SUSTAIN LID Placement Maps







Predicted BMP Performance
Runoff Reduction



Runoff (in) Reduction %

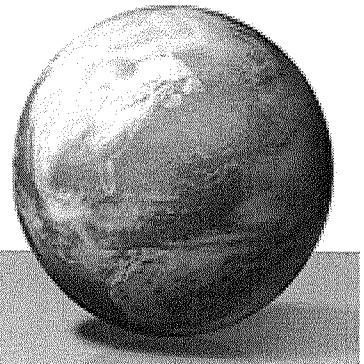
Subcatchment	Full LID	Bioretention Cell	Cistern	Green Roof	Porous Pavement	Vegetated Swale
29	14.4%	5.0%	1.3%	1.3%	5.6%	1.9%
31	49.0%	27.6%	1.0%	1.0%	15.3%	8.2%
32	27.1%	14.6%	1.0%	1.0%	6.2%	4.2%
33	24.8%	20.4%	0.9%	0.9%	0.9%	2.7%
37	25.7%	8.6%	0.6%	0.6%	15.4%	0.6%
38	20.1%	13.6%	1.3%	1.3%	3.2%	1.9%
40	18.0%	5.2%	0.5%	1.5%	10.8%	0.5%
41	17.1%	12.9%	0.6%	1.2%	2.9%	1.8%
45	74.5%	74.5%	0.0%	0.0%	0.0%	0.7%
Average	42.6%	33.6%	25.3%	25.4%	31.0%	26.4%

Predicted BMP Performance
Peak Flow Reduction

Peak Flow (cfs) Reduction %

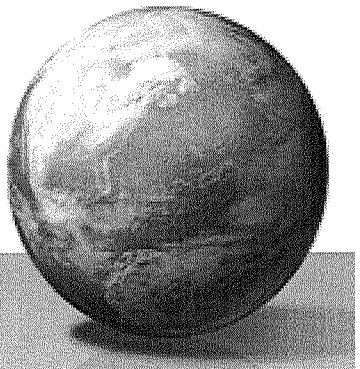
Subcatchment	Full LID	Bioretention Cell	Cistern	Green Roof	Porous Pavement	Vegetated Swale
29	29.6%	5.4%	3.9%	4.2%	8.3%	8.7%
31	61.8%	29.5%	1.6%	1.4%	17.3%	14.2%
32	52.2%	18.5%	4.7%	4.6%	7.7%	18.8%
33	41.8%	24.2%	3.7%	4.2%	0.9%	10.2%
37	38.9%	9.5%	2.5%	2.1%	21.5%	4.7%
38	31.8%	15.0%	3.2%	3.3%	3.2%	8.1%
40	35.7%	5.4%	3.0%	3.4%	21.2%	3.7%
41	30.9%	13.7%	2.3%	2.7%	3.5%	9.9%
45	92.2%	86.9%	0.7%	0.7%	0.2%	7.0%
Average	51.3%	29.4%	21.8%	22.0%	30.4%	25.8%

LID Implementation Cost Comparisons



Subcatchment	LID Process	Units	LID Area (ft2)	Total Area (ft2)	Cost per ft2	Total Cost	Cost per Runoff % Reduction	Cost per Flow % reduction
29	Bioretention Cell	73	10000	725272	$ 13.00	$ 9,428,531	$ 1,885,706	$ 1,740,301
29	Cistern	268	-		$ 500.00	$ 134,178	$ 107,342	$ 34,754
29	Green Roof	237	2700	641164	$ 16.00	$ 10,258,620	$ 8,206,896	$ 2,418,960
29	Porous Pavement	-	349396	349396	$ 6.00	$ 2,096,377	$ 372,689	$ 252,439
29	Vegetated Swale	117	6000	703313	$ 1.50	$ 1,054,970	$ 562,651	$ 121,411

Resources for BMP Selection



- The International Stormwater BMP Database provides analysis and summary from more than 500 BMP studies.
- Focus on urban pollutant load reductions for solids, bacteria, nutrients, and metals
- Available at: http://bmpdatabase.org/
- Provides statistical analysis of effectiveness of BMPs