Electronic Supplementary Materials

Table S1 Design of test scheme

	Rainfall tests number	Rainfall recurrence interval (a)	Duration (min)	Precipitation (mm)	Water volume (L)
Water quantity	1	0.5	120	13.41	33.70
	2	1		20.67	51.91
	3	2		27.92	70.13
	4	3		32.16	80.79
	5	0.5	360	15.68	39.39
	6	1		24.16	60.69
	7	2		32.64	81.99
	8	3		37.60	94.45

	Pollutant		Concentration (mg/L)
Water quality	PAHs	NAP	1.4
		FLT	0.3
		PYR	0.3

Table S2 The specific model principal formula

Type	Model	Formulation	Parameter definition
Water flow equation	Richard equation	$\frac{\partial\theta}{\partial t}=\frac{\partial}{\partial z}\left[K(h,z)\left(\frac{\partial h}{\partial z}+\cos\varphi\right)\right]-S\ K(h,z)=K_s(z)K_r(h,z)$	Where: θ is the moisture volume percentage (cm^3/cm^3), t is the time variable (s), z is the spatial variable (cm), $K(h,z)$ is the unsaturated infiltration coefficient (cm/day), h is the hydraulic head or matric potential (cm), φ is the water flow direction and angle of the vertical direction, S is the source and sink items (g/(cm^3·s)), K_s is the saturated infiltration coefficient (cm/d), and K_r is the relative infiltration coefficient (cm/d).
Solute transport equation	Traditional convection dispersion equation and the Galerkin linear finite element method	$\frac{\partial\theta c}{\partial t}+\rho\frac{\partial s}{\partial t}=\frac{\partial}{\partial z}(\theta D\frac{\partial c}{\partial z}-\frac{\partial(qc)}{\partial z}-\Phi$	Where: c and s are the liquid and solid concentrations of the solute (g/cm^3 and g/g), respectively, ρ is the volume weight (g/cm^3), D is the combined dispersion coefficient (cm^2/day), q is the moisture Darcy flow velocity (cm/s), and Φ is the source and sink items (g/(cm^3·s))
Evapotranspiration	Penman-Monteith equation	$ET_0=\frac{0.480\Delta\times(R_n-G)+\gamma\times\frac{900}{T+273}\times u_2\times(e_s-e_a)}{\Delta+\gamma(1+0.34u_2)}$	Where: ET_0 is the evapotranspiration of plant (mm/d), R_n is the input canopy net radiation (MJ/(m^{2}d)), T is the average daily temperature at 2 m height (°C), u_2 is the wind speed at 2 m height (m/s), e_s is the saturated water vapor pressure (Kpa), e_a is the actual water vapor pressure (Kpa), Δ is the slope of saturated water vapor pressure versus temperature curve (Kpa/°C), γ is the dry and wet thermometer constants (Kpa/°C).
Mineralization	First-order decay reaction	$\frac{dc}{\partial t}=-kc$	Where: c is the concentration of dissolved phase (mg/kg), t is the time (d), k is the First-order rate for dissolved phase (d^{-1}).

Molecular diffusion coefficient	Empirical equation	$D_w = (2.71\times10^{-4})/M^{0.71}$	Where: D_w is the molecular diffusion coefficient, M is the molar mass of the solute.

Table S3 R^2 and E_{NS} values of water quantity and PAHs contents

Number		Planting soil		BSM		BSM+WTR	
		Calibration period	Validation period	Calibration period	Validation period	Calibration period	Validation period
NAP	R^2	0.72	0.71	0.67	0.72	0.64	0.63
	E_{NS}	0.62	0.64	0.51	0.68	0.68	0.68
FLT	R^2	0.86	0.78	0.65	0.64	0.66	0.61
	E_{NS}	0.61	0.80	0.77	0.71	0.61	0.60
PYR	R^2	0.75	0.71	0.61	0.74	0.65	0.71
	E_{NS}	0.64	0.60	0.68	0.70	0.64	0.70

Note: The closer the E_{NS} to 1, the higher the efficiency of the model.

Table S4 Change of PAHs contents in bioretention columns

PAHs (mg/kg)		1^{st} sampling		2^{nd} sampling		3^{rd} sampling		4^{th} sampling	
		Up	Low	Up	Low	Up	Low	Up	Low
C1	NAP	0.15	0.17	0.03	0.03	0.53	0.10	0.06	0.01
	FLT	0.44	0.47	2.28	2.70	2.89	1.54	1.90	0.29
	PYR	0.39	0.54	2.47	2.82	5.98	4.39	2.07	0.20
C2	NAP	0.02	0.01	0.05	0.10	1.37	0.54	0.04	0.01
	FLT	0.13	0.02	3.24	4.18	4.64	1.89	1.59	0.32
	PYR	0.20	0.03	2.47	6.63	4.61	2.47	1.47	0.23
C3	NAP	0.32	0.02	0.37	0.20	1.51	0.04	0.02	0.00
	FLT	0.12	0.01	3.29	3.15	1.93	1.75	1.31	0.43
	PYR	0.14	0.02	2.92	2.71	3.91	1.24	1.22	0.33