Supporting materials

Appendix A: supplementary data

(a) Hydrological and hydraulic parameters

parameter symbol	description	unit	value
slope	average slope of subcatchment	%	0.25
width	characteristic width of subcatchment	m	refer to [1]
curve No.	SCS curve Number	–	74
N-imperv	Manning's coefficient for overland flow over the impervious sub-area	–	0.012
N-perv	Manning's coefficient for overland flow over the pervious sub-area	–	0.25
S-imperv	depression storage for impervious sub-area	mm	1.5
S-perv	depression storage for pervious sub-area	mm	3.9
roughness	Manning's roughness coefficient for rainwater pipes	–	0.013
roughness	Manning's roughness coefficient for green corridors	–	0.030

(b) Measured EMC, parameters, and standard limits of COD/TSS/TN/TP in the three types of underlying surfaces

parameter		measured EMC /($mg{\cdot}L^{-1}$)	C1	C2	C3	C4	standard limits /($mg{\cdot}L^{-1}$, ≤)
COD	road	174	385	1.1	0.066	1.65	30
	roof	56	290	0.9	0.025	1.35	
	green space	70	440	1	0.065	1.6	
TSS	road	359	580	1.3	0.11	1.65	20
	roof	201	500	1	0.075	1.45	
	green space	128	610	1.1	0.11	1.6	
TN	road	4.4	15	0.8	0.045	1.65	1.5
	roof	3.9	15	0.6	0.045	1.5	
	green space	2.5	25	0.8	0.05	1.55	
TP	road	0.20	1.6	0.8	0.02	1.65	1
	roof	0.09	0.4	0.6	0.02	1.5	
	green space	0.12	1.6	0.8	0.01	1.55	

(c) Results of site-scale LID-BMP chain layout optimization

land use type	area ratio /(%, R_{LID} = 95%)				area ratio /(%, R_{LID} = 99%)			
	RG	VS	RFB	PP	RG	VS	RFB	PP
R1	6.605	8	3.368	1	7.285	8	3.39	1.24
R2	6.851	8	3.108	1.261	7.692	8	3.072	1.343
R3	4.381	11	2.384	1	5.154	11	2.306	1
E	7	7	3.972	2.163	7	7	3.642	7.353
A	4.975	7	5.404	3.238	5.708	7	5.516	3.07
C1	4	4	5.63	23.334	4	4	5.63	27.283
C2	4	4	6.46	18.535	4	4	6.166	23.487
M1	4.975	7	5.404	3.238	5.708	7	5.516	3.07
M2	6.869	7	4.118	1.207	7	7	4.328	3.576
W	4.975	7	5.404	3.238	5.708	7	5.516	3.07

(d) Cost composition of the four LID-BMPs planning schemes

facilities	unit cost /(CNY·m^{-2})	LID95	LID99	LID95+GP	LID95+CG
rain garden	500	84701795	93208931	84701795	84701795
vegetative swale	120	25689624	25689624	25689624	25689624
raised flower bed	400	37316717	36957425	37316717	37316717
permeable pavement	120	7828783	10411113	24056383	24056383
green corridor	80	5054400	5054400	5054400	5054400
concave-down greenbelt	50	–	–	–	3710250
traditional green space	40	37445417	36800775	37445417	34477217
impervious area	20	20248897	19818508	17544297	17544297

Notes: total cost (ten thousand CNY): LID95, 21828.56; LID99, 22794.08; LID95+GP, 23180.86; LID95+CG, 23255.07

References

1. Rossman L A, Huber W C. Storm Water Management Model Reference Manual. USEPA, 2016: volume 1, 69–73, volume 3, 125–135. Available online at https://www.epa.gov/water-research/storm-water-management-model-swmm#downloads (accessed February 9, 2017)

Appendix B: a brief introduction of the enhanced SWMM

The enhanced SWMM was built via python 2.7. Figure B1 illustrates the framework that comprises three python modules. Module 1 is an encapsulation of the SWMM computational engine. This module receives the SWMM input file (i.e., inp file) created by Module 2 and transmits the output to Module 3 to continue the optimization procedure. Module 2 is a useful tool to update the SWMM input file according to the random sample of the decision variables. Module 3 is the modularization of NSGA-II. Moreover, a python multi-processing pool was called to accelerate optimization process and save computational time.

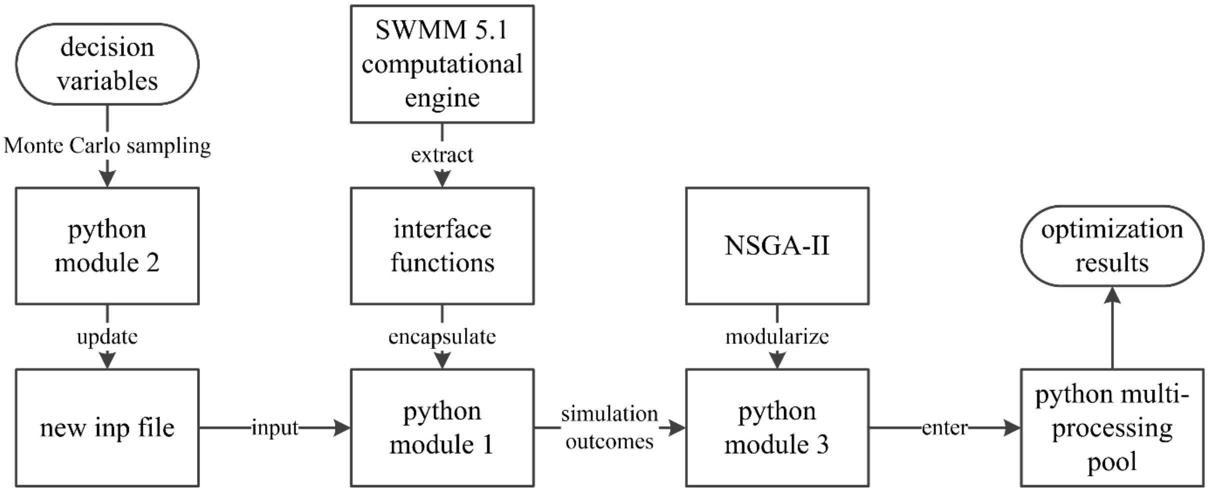

Fig. B1 Framework of the enhanced SWMM