

# Cost-Effectiveness of Inline, Offline, and Nested Stormwater Control Measures in an Ultra- Urban Watershed

Tefera Shibeshi<sup>1\*</sup> and Temesgen Mekuriaw Manderso<sup>2</sup>

<sup>1</sup>Department of Civil and Environmental Engineering,  
Villanova university, PA, USA

## \*Corresponding Author

Tefera Shibeshi, Department of Civil and Environmental Engineering, Villanova university, PA, USA.

<sup>2</sup>Department of Hydraulic and Water Resources Engineering, Debre Tabor University, Ethiopia

Submitted: 2026, Jan 01; Accepted: 2026, Feb 06; Published: 2026, Feb 10

**Citation:** Tefera. S., Temesgen. M. M. (2026). Cost-Effectiveness of Inline, Offline, and Nested Stormwater Control Measures in an Ultra- Urban Watershed. *J Water Res*, 4(1), 01-25.

## Abstract

Urban watersheds characterized by extensive impervious surfaces and combined sewer systems face ongoing challenges related to excessive runoff, pollutant loading, and flooding. Despite the widespread implementation of green and gray stormwater control measures (SCMs), empirical guidance on the relative cost-effectiveness of different SCM configurations in space-constrained urban settings is limited. This study conducted a performance-based modeling assessment to compare inline, offline, and nested SCM strategies within a 471-acre ultra-urban sub-watershed draining into the tidal Delaware River in Philadelphia, USA. Utilizing the python script(pysewer) in conjunction with a scenario-based optimization framework, various SCM configurations were evaluated based on annual runoff reduction, annual zinc (Zn) load reduction, and estimated implementation cost. The results indicated that a strategically located inline bioretention system achieved the highest cost-effectiveness, providing approximately 180 lb yr<sup>-1</sup> of zinc reduction at minimal cost, whereas offline systems demonstrated moderate performance at significantly higher costs. Nested SCM configurations exhibited the lowest cost-effectiveness owing to hydraulic redundancy and inefficient flow diversion, despite the higher total investment. These findings demonstrate that simpler, well-sized SCMs can outperform more complex treatment trains in ultra- urban environments and underscore the importance of performance-based design for stormwater planning under constrained conditions in ultra-urban environments.

**Keywords:** Stormwater Management; SWMM; Cost-Effectiveness; Green Infrastructure; Urban Watershed

## 1. Introduction

Urbanization significantly transforms watershed hydrology by increasing impervious surface coverage, thereby reducing infiltration capacity and accelerating surface runoff generation [1]. In urban areas serviced by combined sewer systems, these hydrological alterations often lead to combined sewer overflows (CSOs), nuisance flooding, and degradation of the receiving water quality during rainfall events [2]. To mitigate these issues, municipalities are increasingly implementing a combination of green and gray stormwater control measures (SCMs), such as bioretention systems, detention facilities, and distributed green streets, to manage stormwater runoff [3]. Despite their widespread adoption, there remains uncertainty regarding the relative cost-effectiveness of different SCM configurations, particularly in ultra-urban environments, where land availability, hydraulic

constraints, and constructability limitations restrict design flexibility [3]. While previous studies have demonstrated the hydrologic and water quality benefits of individual SCMs, fewer studies have systematically compared inline, offline, and nested SCM strategies under consistent watershed conditions using quantitative performance metrics.

The Delaware River watershed in Philadelphia exemplifies a quintessential ultra-urban system characterized by high levels of impervious surfaces, flat topography, tidal backwater influence, and a legacy of combined sewer networks [4]. These conditions offer a valuable testbed for assessing whether increased complexity in stormwater control measures (SCM), such as nested treatment trains, necessarily leads to enhanced performance compared to simpler configurations. The objectives of this study are to: (1)

quantify and compare the cost-effectiveness of inline, offline, and nested SCM configurations using performance metrics derived from a Python script, and (2) identify the design conditions under which increased system complexity results in diminishing or negative returns in pollutant reduction per unit cost. By explicitly linking hydraulic performance, pollutant removal, and economic cost, this study aims to inform stormwater-planning decisions in space-constrained urban watersheds.

## 2. Study Area

### 2.1 Watershed Characteristics

The study area is a 471-acre sub-watershed located along the

Delaware River waterfront in Philadelphia, Pennsylvania, forming part of the city's "Delaware Direct" drainage area. The elevations within the watershed range from approximately 2.7 to 11.7 m above mean sea level, with an average surface slope of approximately 0.9%. Low-relief topography limits gravitational drainage and promotes surface ponding during moderate rainfall events.

Stormwater runoff is conveyed through a combined sewer network that frequently exceeds its capacity during storm events, resulting in CSOs that discharge directly into the tidal Delaware River [5]. Tidal influence further constrains drainage efficiency, particularly during coincidental rainfall and high tide conditions [5].



**Figure 1:** Land use and impervious cover distribution of the Delaware sub-watershed within the Philadelphia Delaware River Basin (data sources: NLCD 2021; Map My Watershed).

### 2.3 Land Use and Impervious Cover

According to the National Land Cover Database (NLCD 2021), over 90% of the watershed is categorized as developed land, with impervious surfaces accounting for approximately 72% of its total area. The area is predominantly characterized by high- and medium-intensity urban land uses, including dense residential blocks, commercial corridors and industrial parcels. The limited presence of vegetated spaces and compacted soils results in minimal infiltration capacity and a rapid runoff response to precipitation.

## 3. Hydrologic and Water-Quality Context

### 3.1 Runoff Dynamics

Hydrologic analysis has revealed that approximately 85–90% of the annual precipitation is directly transformed into surface runoff, aligning with the values reported for highly impervious urban catchments [6]. The simulated annual runoff depths ranged from 25 to 30 in., indicating minimal losses due to infiltration and evapotranspiration.

### 3.2 Pollutant Loading

Urban runoff within a watershed is responsible for transporting

significant pollutant loads, notably total suspended solids and heavy metals. Zinc (Zn) has been identified as a representative pollutant owing to its prevalence in urban runoff and its strong correlation with vehicular traffic, galvanized infrastructure, and roofing materials [7]. Zinc concentrations are frequently elevated during first-flush events, contributing to the degradation of water quality in the tidal Delaware River. The estimated annual zinc loads ranged from approximately 130 to 230 lb yr<sup>-1</sup> across various modeled scenarios [8].

## 4. Methods

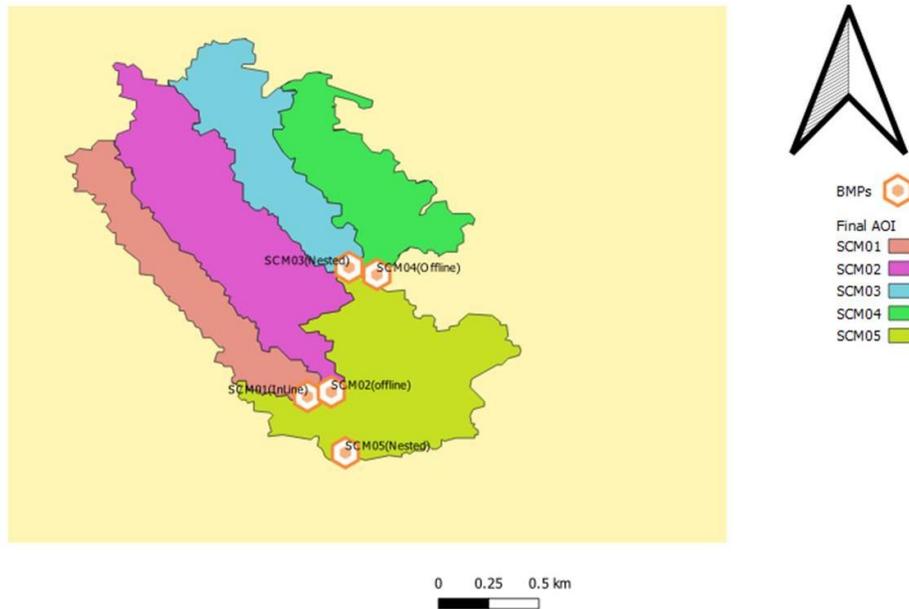
### 4.1 Identification and Classification of Stormwater Control Measures (SCM)

Five potential sites for stormwater control measures (SCMs) were identified based on criteria

such as drainage area size, concentration of impervious surfaces, availability of right-of-way, and constraints related to constructability of the facilities. SCMs were categorized into three distinct configuration types:

- **Inline SCMs** intercept and treat runoff directly within the primary conveyance path.

- Offline SCMs, which divert a portion of flow from the main system for treatment; and
- Nested SCMs consist of sequential upstream and downstream treatment elements that form a treatment train.



**Figure 2:** Spatial distribution and locations of candidate stormwater control measures (SCM01–SCM05) within the study watershed.

SCM Code	Drainage Area (acres)	Type of SCM
SCM01	~116 acres	Bioretention Basin (inline)
SCM02	~221 acres	Detention Vault (offline)
SCM04	~132 acres	Green Streets (bioswales) (offline)
SCM03	~127 acres	Curb Extension Bioswale (nested - upstream)
SCM05	~145 acres	Infiltration Trench (nested - downstream)

**Table 1:** Summary of stormwater control measures and associated drainage areas.

#### 4.2 Hydrologic and Water-Quality Modeling Framework

The Python script, pysewer, was used to simulate both baseline and stormwater control measure (SCM) scenarios. Dynamic wave routing was employed to accurately represent the surcharge and backwater effects within the combined sewer system. Model simulations were conducted using representative rainfall time-series data derived from long-term precipitation records. Water quality processes were represented using the pysewer buildup and wash off formulation for zinc, with parameter values sourced from published urban runoff studies. Although site-specific calibration data were unavailable, this study emphasized relative performance comparisons across SCM configurations rather than absolute pollutant load predictions.

#### 4.3 Performance Metrics and Cost Evaluation

The performance of stormwater control measures (SCM) was assessed using three primary metrics: annual runoff reduction (volume basis), annual zinc load reduction ( $\text{lb yr}^{-1}$ ), and estimated implementation cost (USD). An optimization-based scenario framework was employed, wherein the SCM footprint area, diversion rate, and storage depth was varied to generate performance curves and identify the points of diminishing returns. Cost estimates were derived from unit costs reported in regional stormwater planning documents and engineering practices, which were applied consistently across SCM types to ensure comparability, as detailed in Table 2.

(a) Nested

BMPID	Order	DS_BMPID	Infiltration rate	Diversion length	Diversion rate	Pond septh	Footprint area
SCM3	0	SCM5	0.9	300	30	10	1.1
SCM5	1	0	0.8	300	50	10	1.3

(b) Distributed

BMPID	SCMs Type	Infiltration rate	porosity	Footprint Area	ponding depth	foot print itera	L_ORATE
SCM1	Bioretention Basin(inline)		1	0.4	1.5	10	0.01
BMPID		Diversion length	Diversio rate	Footprint Area	ponding depth	foot print itera	L_ORATE
SCM2		300	30	1.25	10	0.01	0.8
SCM4	Detention Vault (nested)	300	20	1.1	10	0.01	1.3

Table 2: Optimal design parameters for inline, offline, and nested stormwater-control measures.

5. Results

5.1 Cost-Effectiveness of SCM Configurations

The inline bioretention system (SCM01) in Figure 3 exhibited the highest cost-effectiveness, achieving a zinc reduction of

approximately 180 lb yr<sup>-1</sup> at a minimal expense. Notably, performance improvements were evident even with small footprint sizes, indicating a high pollutant removal efficiency per unit investment.

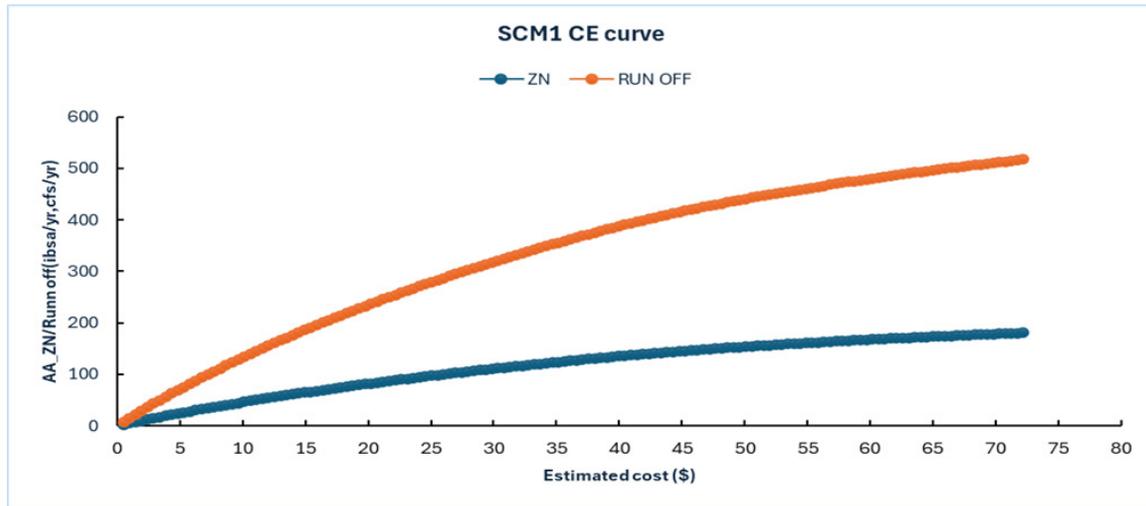
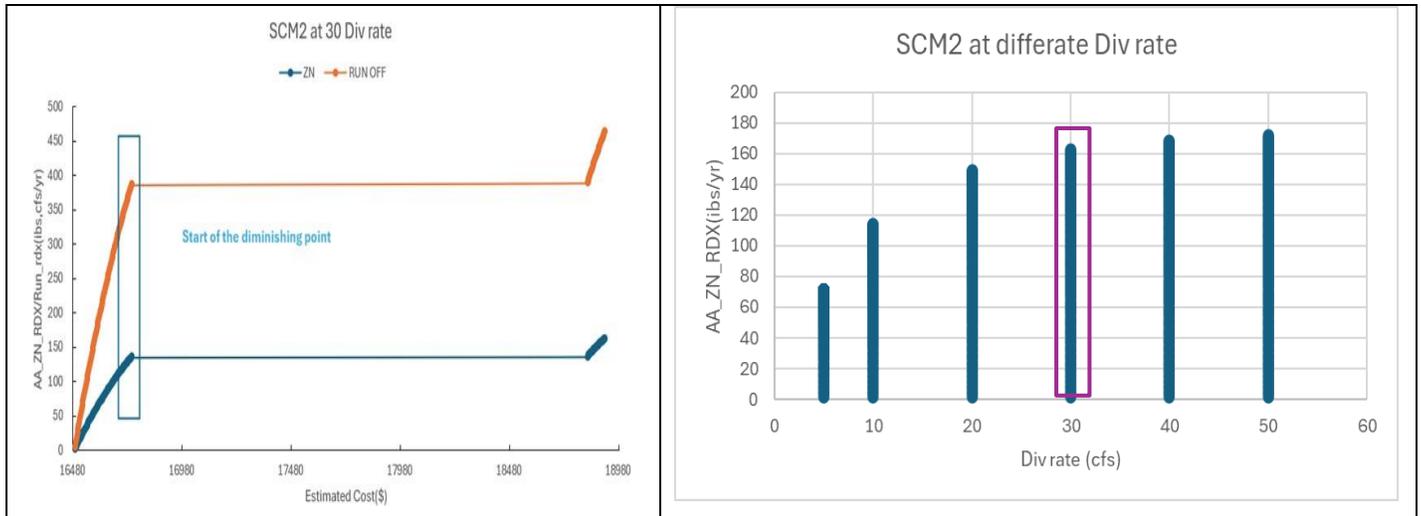


Figure 3: Cost versus zinc removal performance for the inline stormwater control measure (SCM01).

Offline stormwater control measures (SCM02 and SCM04 in Figure 4) achieved zinc reductions ranging from approximately 134 to 158 lb yr<sup>-1</sup>, with estimated costs between \$16,700 and

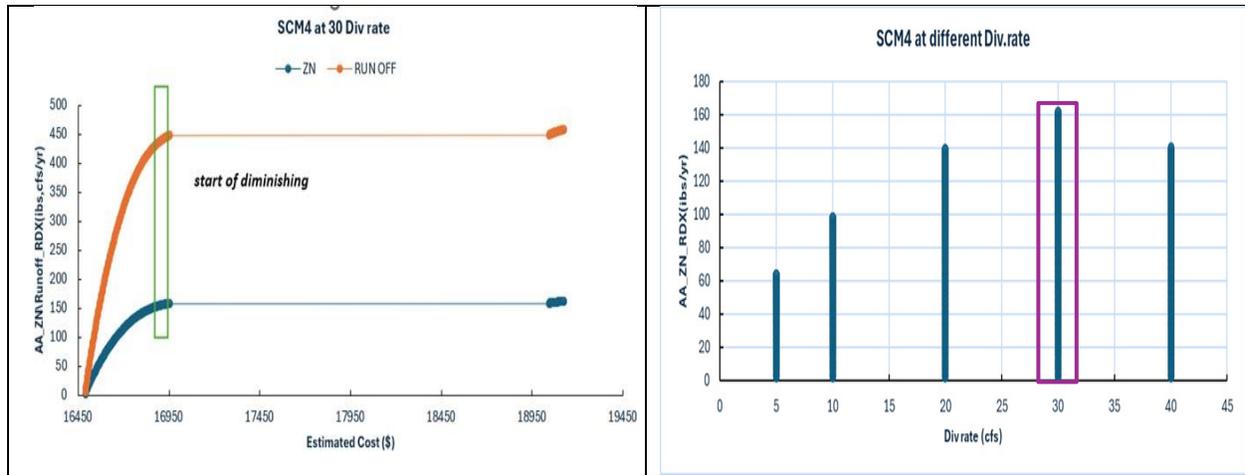
\$17,000, respectively. These systems demonstrated efficacy for larger drainage areas; however, they exhibited diminishing returns when the diversion rates exceeded the optimal levels.



**Figure 4:** Cost versus zinc removal performance for offline stormwater control measures (SCM02 and SCM04).

The nested SCM configurations (SCM03–SCM05 in Figure 4) resulted in the highest total cost, approximately \$43,756, while achieving a zinc reduction of only 132 lb yr<sup>-1</sup>. The downstream

component contributed minimally to additional treatment, indicating hydraulic redundancy and inefficient diversion in the treatment train.

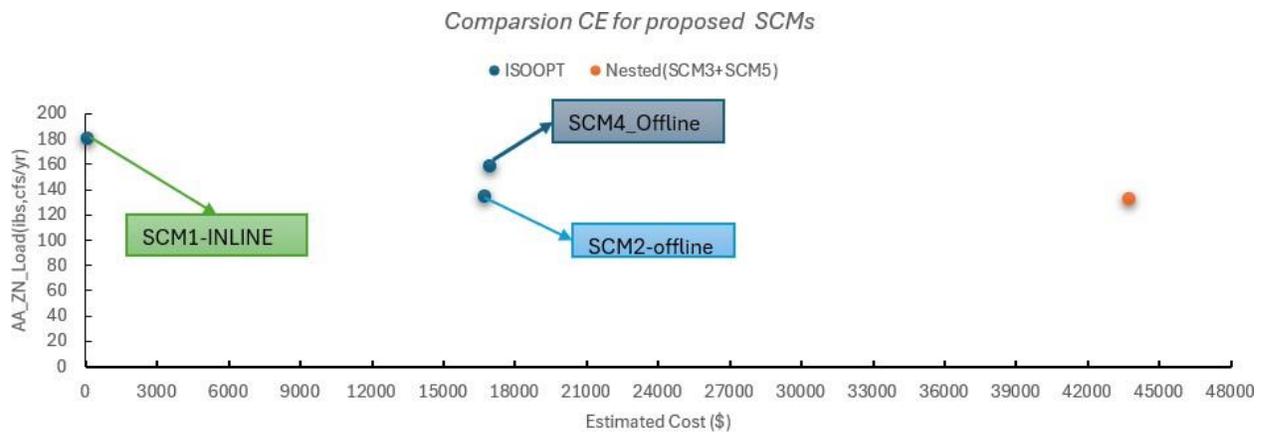


**Figure 5:** Comparison of cost-effectiveness among inline, offline, and nested stormwater control measure configurations.

## 5.2. Comparison of Stormwater Control Measure Types

Figure 6 illustrates a comparative cost-effectiveness analysis of stormwater control measures SCM01–SCM05, depicting the annual reduction in zinc (Zn) load relative to the estimated implementation cost. The inline bioretention system (SCM01) was positioned in the low-cost, high-performance quadrant of the plot, achieving an approximate Zn reduction of 180 lb yr<sup>-1</sup> at an estimated cost of \$72, thereby demonstrating the highest pollutant reduction per unit cost among all scenarios evaluated. The offline systems (SCM02 and SCM04) were situated in the mid-cost range (approximately \$16,700–\$17,000) and achieved moderate Zn

reductions between 134 and 158 lb yr<sup>-1</sup>, with SCM04 exhibiting slightly superior removal efficiency compared to SCM02 at a comparable cost. Conversely, the nested configuration (SCM03 + SCM05) was located in the high-cost, low-performance quadrant of the plot; despite a combined cost of approximately \$43,756, it achieved only 132 lb yr<sup>-1</sup> of Zn reduction, with minimal incremental contribution from the downstream component. Overall, the distribution of points in Figure 6 suggests a systematic decline in cost-effectiveness from SCM01 to SCM05 as the total system cost and configuration complexity increase.



**Figure 6:**Comparative cost-effectiveness and ranking cost wise different all SCMs

## 6. Discussion

The findings suggest that increasing the complexity of stormwater control measure (SCM) configurations does not necessarily lead to proportional improvements in performance within ultra-urban settings. When strategically positioned within the conveyance network, inline SCMs demonstrate superior cost-effectiveness by directly intercepting runoff at points of high concentration, thereby minimizing diversion losses and reducing the need for redundant storage volumes. Their performance advantage is attributed to efficient hydraulic connectivity and sustained interaction with the first-flush pollutant loads. Conversely, nested SCM configurations

exhibit diminished marginal benefits, despite higher capital investment. The reduced effectiveness observed in these systems is likely due to overdesign, constrained effective inflow, and suboptimal hydraulic coordination between the upstream and downstream components. Such inefficiencies can limit treatment synergy and result in underutilized storage or bypassed flows, particularly in highly impervious and space-restricted urban environments.

These findings align with prior research, highlighting the necessity of meticulous hydraulic integration of treatment trains to prevent diminishing returns and performance redundancy. In densely developed watersheds, where spatial and infrastructural constraints significantly influence design decisions, simpler stormwater control measure (SCM) configurations may offer superior performance-to-cost ratios compared to more complex, multistage systems. From a planning and regulatory perspective, the results emphasize the importance of performance-based evaluation frameworks for stormwater management decision-making. Quantitative assessments of pollutant reduction relative to cost facilitate the transparent prioritization of SCM investments and support optimized compliance with water quality and combined sewer overflow (CSO) reduction objectives under constrained urban conditions.

## 7. Conclusions

This study conducted a performance-based comparative evaluation

of inline, offline, and nested stormwater control measures (SCMs) within an ultra-urban watershed using EPA SWMM modeling. The findings indicate that strategically located inline bioretention systems achieve the highest cost-effectiveness for zinc load reduction by directly intercepting runoff and minimizing hydraulic loss. Although offline SCMs provide significant pollutant reduction, they incur substantially higher costs. Conversely, nested SCM configurations demonstrate reduced efficiency because of hydraulic redundancy, limited effective inflow, and suboptimal coordination among treatment components. These results collectively highlight that system complexity alone does not ensure enhanced performance; rather, strategic siting and performance-based design are critical determinants of SCM effectiveness in space-constrained urban environments. The modeling framework and insights presented in this study offer a transferable basis for optimizing stormwater investment and regulatory compliance in ultra-urban watersheds facing similar hydrologic and infrastructural constraints.

## References

1. Towsif Khan, S., Chapa, F., & Hack, J. (2020). Highly resolved rainfall-runoff simulation of retrofitted green stormwater infrastructure at the micro-watershed scale. *Land*, 9(9), 339.
2. Tao, J., Li, Z., Peng, X., & Ying, G. (2017). Quantitative analysis of impact of green stormwater infrastructures on combined sewer overflow control and urban flooding control. *Frontiers of Environmental Science & Engineering*, 11(4), 11.
3. Qiu, S., Yin, H., Deng, J., & Li, M. (2020). Cost-effectiveness analysis of green-gray stormwater control measures for non-point source pollution. *International journal of environmental research and public health*, 17(3), 998.
4. Scarlett, R. D., McMillan, S. K., Bell, C. D., Clinton, S. M., Jefferson, A. J., & Rao, P. S. C. (2018). Influence of stormwater control measures on water quality at nested sites in a small suburban watershed. *Urban Water Journal*, 15(9), 868-879.
5. Nilsen, V., Lier, J. A., Bjerkholt, J. T., & Lindholm, O. G. (2011). Analysing urban floods and combined sewer overflows in a changing climate. *Journal of water and climate change*, 2(4), 260-271.

6. Yang, J. L., & Zhang, G. L. (2011). Water infiltration in urban soils and its effects on the quantity and quality of runoff. *Journal of soils and sediments*, 11(5), 751-761.
7. Li, W., Shen, Z., Tian, T., Liu, R., & Qiu, J. (2012). Temporal variation of heavy metal pollution in urban stormwater runoff. *Frontiers of Environmental Science & Engineering*, 6(5), 692-700.
8. Hathaway, J. M., Tucker, R. S., Spooner, J. M., & Hunt, W. F. (2012). A traditional analysis of the first flush effect for nutrients in stormwater runoff from two small urban catchments. *Water, Air, & Soil Pollution*, 223(9), 5903-5915.

**Appendix  
Appendix-A1**

BMPID	INLET_CFS	STORFT	ACSTOR	DP	FTAA_RUN	RDXAA_ZN	RDX	Cost
SCM1	INLINE	0.01	10	7.626704545	2.569346468	0.48148		
SCM1	INLINE	0.02	10	15.04716322	5.11893049	0.96296		
SCM1	INLINE	0.03	10	22.29836467	7.62549292	1.44444		
SCM1	INLINE	0.04	10	29.37203719	10.07686427	1.92592		
SCM1	INLINE	0.05	10	36.33974174	12.49630097	2.4074		
SCM1	INLINE	0.06	10	43.17599174	14.86810199	2.88888		
SCM1	INLINE	0.07	10	49.86288326	17.1903076	3.37036		
SCM1	INLINE	0.08	10	56.42038843	19.47109445	3.85184		
SCM1	INLINE	0.09	10	62.86063017	21.71260978	4.33332		
SCM1	INLINE	0.1	10	69.18358471	23.91344368	4.8148		
SCM1	INLINE	0.11	10	75.42859917	26.08915454	5.29628		
SCM1	INLINE	0.12	10	81.57463636	28.23139943	5.77776		
SCM1	INLINE	0.13	10	87.63813636	30.3449825	6.25924		
SCM1	INLINE	0.14	10	93.63777273	32.43861288	6.74072		
SCM1	INLINE	0.15	10	99.62125	34.52547134	7.2222		
SCM1	INLINE	0.16	10	105.5202149	36.5834599	7.70368		
SCM1	INLINE	0.17	10	111.3552459	38.61971495	8.18516		
SCM1	INLINE	0.18	10	117.1313202	40.63652411	8.66664		
SCM1	INLINE	0.19	10	122.8193223	42.62226622	9.14812		
SCM1	INLINE	0.2	10	128.4387397	44.58306301	9.6296		
SCM1	INLINE	0.21	10	133.9869019	46.51953957	10.11108		
SCM1	INLINE	0.22	10	139.4407252	48.42490554	10.59256		
SCM1	INLINE	0.23	10	144.8529463	50.31543618	11.07404		

SCM1	INLINE	0.24	10	150.2296033	52.19295814	11.55552
SCM1	INLINE	0.25	10	155.5433781	54.04873434	12.037
SCM1	INLINE	0.26	10	160.7761136	55.87671071	12.51848
SCM1	INLINE	0.27	10	165.9668244	57.69050291	12.99996
SCM1	INLINE	0.28	10	171.0785744	59.47761084	13.48144
SCM1	INLINE	0.29	10	176.1350217	61.24469722	13.96292
SCM1	INLINE	0.3	10	181.1332955	62.99107312	14.4444
SCM1	INLINE	0.31	10	186.0419731	64.70715768	14.92588
SCM1	INLINE	0.32	10	190.8746446	66.39649151	15.40736
SCM1	INLINE	0.33	10	195.6515537	68.06762307	15.88884
SCM1	INLINE	0.34	10	200.4068926	69.73118281	16.37032
SCM1	INLINE	0.35	10	205.131188	71.38426453	16.8518
SCM1	INLINE	0.36	10	209.7981116	73.01820318	17.33328
SCM1	INLINE	0.37	10	214.3994008	74.62931679	17.81476
SCM1	INLINE	0.38	10	218.978469	76.23172461	18.29624
SCM1	INLINE	0.39	10	223.5105651	77.81760378	18.77772
SCM1	INLINE	0.4	10	228.0005785	79.3890032	19.2592
SCM1	INLINE	0.41	10	232.4671725	80.95294988	19.74068
SCM1	INLINE	0.42	10	236.8981198	82.50430489	20.22216
SCM1	INLINE	0.43	10	241.3108574	84.0493655	20.70364
SCM1	INLINE	0.44	10	245.6909091	85.58333415	21.18512
SCM1	INLINE	0.45	10	250.0462242	87.10810803	21.6666
SCM1	INLINE	0.46	10	254.3657169	88.6200771	22.14808
SCM1	INLINE	0.47	10	258.5787748	90.09487312	22.62956
SCM1	INLINE	0.48	10	262.7550744	91.55680444	23.11104
SCM1	INLINE	0.49	10	266.8979793	93.00679383	23.59252
SCM1	INLINE	0.5	10	271.0029442	94.44363043	24.074
SCM1	INLINE	0.51	10	275.0751674	95.86869074	24.55548
SCM1	INLINE	0.52	10	279.0823099	97.27236429	25.03696
SCM1	INLINE	0.53	10	283.0461198	98.66122317	25.51844

SCM1	INLINE	0.54	10	286.9768244	100.0375202	25.99992
SCM1	INLINE	0.55	10	290.8544628	101.3951538	26.4814
SCM1	INLINE	0.56	10	294.718719	102.7480289	26.96288
SCM1	INLINE	0.57	10	298.5436756	104.0869299	27.44436
SCM1	INLINE	0.58	10	302.3518388	105.420074	27.92584
SCM1	INLINE	0.59	10	306.126562	106.7416556	28.40732
SCM1	INLINE	0.6	10	309.8675413	108.0516652	28.8888
SCM1	INLINE	0.61	10	313.5851322	109.3536288	29.37028
SCM1	INLINE	0.62	10	317.2662438	110.643204	29.85176
SCM1	INLINE	0.63	10	320.9393099	111.9302638	30.33324
SCM1	INLINE	0.64	10	324.5838347	113.2074636	30.81472
SCM1	INLINE	0.65	10	328.190749	114.4703351	31.2962
SCM1	INLINE	0.66	10	331.7728574	115.7254056	31.77768
SCM1	INLINE	0.67	10	335.3237221	116.9690882	32.25916
SCM1	INLINE	0.68	10	338.8380826	118.2001189	32.74064
SCM1	INLINE	0.69	10	342.3033657	119.4136556	33.22212
SCM1	INLINE	0.7	10	345.7179752	120.6099942	33.7036
SCM1	INLINE	0.71	10	349.1118306	121.7994668	34.18508
SCM1	INLINE	0.72	10	352.4620083	122.9733713	34.66656
SCM1	INLINE	0.73	10	355.791625	124.1405604	35.14804
SCM1	INLINE	0.74	10	359.1033595	125.3010687	35.62952
SCM1	INLINE	0.75	10	362.4039411	126.4575327	36.111
SCM1	INLINE	0.76	10	365.6622479	127.599434	36.59248
SCM1	INLINE	0.77	10	368.8956074	128.7332315	37.07396
SCM1	INLINE	0.78	10	372.1030826	129.8572593	37.55544
SCM1	INLINE	0.79	10	375.2815826	130.9704567	38.03692
SCM1	INLINE	0.8	10	378.4521488	132.0812826	38.5184
SCM1	INLINE	0.81	10	381.5698864	133.1742878	38.99988
SCM1	INLINE	0.82	10	384.6287727	134.2467255	39.48136
SCM1	INLINE	0.83	10	387.6569948	135.308286	39.96284

SCM1	INLINE	0.84	10	390.6169463	136.3456563	40.44432
SCM1	INLINE	0.85	10	393.5042769	137.3573006	40.9258
SCM1	INLINE	0.86	10	396.3639442	138.359212	41.40728
SCM1	INLINE	0.87	10	399.1749886	139.3437061	41.88876
SCM1	INLINE	0.88	10	401.9599835	140.3193006	42.37024
SCM1	INLINE	0.89	10	404.7092324	141.2828224	42.85172
SCM1	INLINE	0.9	10	407.4324483	142.2373717	43.3332
SCM1	INLINE	0.91	10	410.1026694	143.1729341	43.81468
SCM1	INLINE	0.92	10	412.7245702	144.0915165	44.29616
SCM1	INLINE	0.93	10	415.2989959	144.9937081	44.77764
SCM1	INLINE	0.94	10	417.8113017	145.8739396	45.25912
SCM1	INLINE	0.95	10	420.283874	146.740628	45.7406
SCM1	INLINE	0.96	10	422.6696033	147.5767675	46.22208
SCM1	INLINE	0.97	10	425.0151849	148.3986732	46.70356
SCM1	INLINE	0.98	10	427.3405041	149.2135427	47.18504
SCM1	INLINE	0.99	10	429.6337903	150.017439	47.66652
SCM1	INLINE	1	10	431.8976653	150.810842	48.148
SCM1	INLINE	1.01	10	434.147969	151.5995916	48.62948
SCM1	INLINE	1.02	10	436.3649731	152.3764618	49.11096
SCM1	INLINE	1.03	10	438.5704101	153.1497462	49.59244
SCM1	INLINE	1.04	10	440.741124	153.9107061	50.07392
SCM1	INLINE	1.05	10	442.8664566	154.6556215	50.5554
SCM1	INLINE	1.06	10	444.9346632	155.3806478	51.03688
SCM1	INLINE	1.07	10	446.9714256	156.0947113	51.51836
SCM1	INLINE	1.08	10	448.9839421	156.8004886	51.99984
SCM1	INLINE	1.09	10	450.9810775	157.5010136	52.48132
SCM1	INLINE	1.1	10	452.9356818	158.1864029	52.9628
SCM1	INLINE	1.11	10	454.8724101	158.865509	53.44428
SCM1	INLINE	1.12	10	456.7962314	159.5399335	53.92576
SCM1	INLINE	1.13	10	458.7103079	160.2106529	54.40724

SCM1	INLINE	1.14	10	460.6112645	160.8770034	54.88872
SCM1	INLINE	1.15	10	462.4986054	161.5388477	55.3702
SCM1	INLINE	1.16	10	464.3750992	162.196971	55.85168
SCM1	INLINE	1.17	10	466.2324256	162.848383	56.33316
SCM1	INLINE	1.18	10	468.0879256	163.4992148	56.81464
SCM1	INLINE	1.19	10	469.9357479	164.1472304	57.29612
SCM1	INLINE	1.2	10	471.7492562	164.7830363	57.7776
SCM1	INLINE	1.21	10	473.540311	165.4108641	58.25908
SCM1	INLINE	1.22	10	475.3172769	166.0338211	58.74056
SCM1	INLINE	1.23	10	477.0755176	166.6503058	59.22204
SCM1	INLINE	1.24	10	478.8079587	167.2578575	59.70352
SCM1	INLINE	1.25	10	480.5272624	167.8608063	60.185
SCM1	INLINE	1.26	10	482.2200868	168.4543713	60.66648
SCM1	INLINE	1.27	10	483.8789804	169.0360799	61.14796
SCM1	INLINE	1.28	10	485.4757355	169.5961139	61.62944
SCM1	INLINE	1.29	10	487.0383306	170.1442096	62.11092
SCM1	INLINE	1.3	10	488.5937293	170.6898985	62.5924
SCM1	INLINE	1.31	10	490.1343543	171.2303486	63.07388
SCM1	INLINE	1.32	10	491.6736033	171.7702748	63.55536
SCM1	INLINE	1.33	10	493.2066033	172.3080492	64.03684
SCM1	INLINE	1.34	10	494.7302665	172.8425709	64.51832
SCM1	INLINE	1.35	10	496.248094	173.3748836	64.9998
SCM1	INLINE	1.36	10	497.7467603	173.9006786	65.48128
SCM1	INLINE	1.37	10	499.2213936	174.4181114	65.96276
SCM1	INLINE	1.38	10	500.6744711	174.927921	66.44424
SCM1	INLINE	1.39	10	502.1071632	175.4303204	66.92572
SCM1	INLINE	1.4	10	503.5289463	175.9289025	67.4072
SCM1	INLINE	1.41	10	504.9307438	176.4205315	67.88868
SCM1	INLINE	1.42	10	506.3163926	176.9066353	68.37016
SCM1	INLINE	1.43	10	507.6872593	177.3875414	68.85164

SCM1	INLINE	1.44	10	509.0558843	177.8676416	69.33312
SCM1	INLINE	1.45	10	510.4245093	178.3478306	69.8146
SCM1	INLINE	1.46	10	511.7825393	178.8242287	70.29608
SCM1	INLINE	1.47	10	513.1372955	179.2992881	70.77756
SCM1	INLINE	1.48	10	514.474814	179.7683477	71.25904
SCM1	INLINE	1.49	10	515.8073089	180.2356688	71.74052
SCM1	INLINE	1.5	10	517.1391839	180.7026477	72.222

### Appendix-A3

SCM2	BMPI	INLET_CF	STORFT_A	STORDP_F	AA_RUN_RD	AA_ZN_RDX	
D	S	C	T	X			
SCM2		30	0.01	10	5.181	1.8	16491.5
SCM2		30	0.02	10	10.34943	3.6	5
							16494.3
							16497.0
SCM2		30	0.03	10	15.49435	5.4	6
							16499.8
SCM2		30	0.04	10	20.59712	7.1	1
							16502.5
SCM2		30	0.05	10	25.67677	8.9	6
							16505.3
SCM2		30	0.06	10	30.75408	10.7	1
							16508.0
SCM2		30	0.07	10	35.81778	12.4	7
							16510.8
SCM2		30	0.08	10	40.84443	14.2	2
							16513.5
SCM2		30	0.09	10	45.81361	15.9	7
							16516.3
SCM2		30	0.1	10	50.74483	17.7	2
							16519.0
SCM2		30	0.11	10	55.65094	19.4	8
							16521.8
SCM2		30	0.12	10	60.54091	21.1	3
							16524.5
SCM2		30	0.13	10	65.41834	22.8	8
							16527.3
SCM2		30	0.14	10	70.28108	24.5	3
							16530.0
SCM2		30	0.15	10	75.12904	26.2	8

SCM2	30	0.16	10	79.97069	27.9	16532.84
SCM2	30	0.17	10	84.78757	29.6	16535.59
SCM2	30	0.18	10	89.58274	31.2	16538.34
SCM2	30	0.19	10	94.36247	32.9	16541.09
SCM2	30	0.2	10	99.12577	34.6	16543.85
SCM2	30	0.21	10	103.853	36.2	16546.6
SCM2	30	0.22	10	108.5622	37.9	16549.35
SCM2	30	0.23	10	113.2532	39.5	16552.1
SCM2	30	0.24	10	117.918	41.2	16554.86
SCM2	30	0.25	10	122.5627	42.8	16557.61
SCM2	30	0.26	10	127.1551	44.4	16560.36
SCM2	30	0.27	10	131.7193	46.0	16563.11
SCM2	30	0.28	10	136.2487	47.6	16565.86
SCM2	30	0.29	10	140.7635	49.1	16568.62
SCM2	30	0.3	10	145.2743	50.7	16571.37
SCM2	30	0.31	10	149.7403	52.3	16574.12
SCM2	30	0.32	10	154.1842	53.8	16576.87
SCM2	30	0.33	10	158.6184	55.4	16579.63
SCM2	30	0.34	10	163.0436	56.9	16582.38
SCM2	30	0.35	10	167.4417	58.5	16585.13
SCM2	30	0.36	10	171.813	60.0	16587.88
SCM2	30	0.37	10	176.1512	61.5	16590.64
SCM2	30	0.38	10	180.4443	63.0	16593.39
SCM2	30	0.39	10	184.7103	64.5	16596.14
SCM2	30	0.4	10	188.9354	66.0	16598.89

SCM2	30	0.41	10	193.1448	67.5	16601.6
SCM2	30	0.42	10	197.3386	69.0	16604.4
SCM2	30	0.43	10	201.5167	70.4	16607.1
SCM2	30	0.44	10	205.6869	71.9	16609.9
SCM2	30	0.45	10	209.8444	73.3	16612.6
SCM2	30	0.46	10	213.9647	74.8	16615.4
SCM2	30	0.47	10	218.072	76.2	16618.1
SCM2	30	0.48	10	222.1644	77.6	16620.9
SCM2	30	0.49	10	226.2287	79.1	16623.6
SCM2	30	0.5	10	230.245	80.5	16626.4
SCM2	30	0.51	10	234.2491	81.9	16629.1
SCM2	30	0.52	10	238.2359	83.3	16631.9
SCM2	30	0.53	10	242.1828	84.7	16634.6
SCM2	30	0.54	10	246.1231	86.0	16637.4
SCM2	30	0.55	10	250.0313	87.4	16640.1
SCM2	30	0.56	10	253.8959	88.8	16642.9
SCM2	30	0.57	10	257.7475	90.1	16645.6
SCM2	30	0.58	10	261.5876	91.5	16648.4
SCM2	30	0.59	10	265.4147	92.8	16651.1
SCM2	30	0.6	10	269.2385	94.1	16653.9
SCM2	30	0.61	10	273.042	95.5	16656.6
SCM2	30	0.62	10	276.8088	96.8	16659.4
SCM2	30	0.63	10	280.56	98.1	16662.1
SCM2	30	0.64	10	284.2787	99.4	16664.9
SCM2	30	0.65	10	287.9739	100.7	16667.7
						16670.4

SCM2	30	0.66	10	291.6206	102.0	16670.4
SCM2	30	0.67	10	295.213	103.2	16673.2
SCM2	30	0.68	10	298.8019	104.5	16675.9
SCM2	30	0.69	10	302.3769	105.8	16678.7
SCM2	30	0.7	10	305.9262	107.0	16681.4
SCM2	30	0.71	10	309.4415	108.2	16684.2
SCM2	30	0.72	10	312.9324	109.5	16686.9
SCM2	30	0.73	10	316.404	110.7	16689.7
SCM2	30	0.74	10	319.8655	111.9	16692.4
SCM2	30	0.75	10	323.3013	113.1	16695.2
SCM2	30	0.76	10	326.7052	114.3	16697.9
SCM2	30	0.77	10	330.097	115.5	16700.7
SCM2	30	0.78	10	333.4636	116.7	16703.4
SCM2	30	0.79	10	336.8068	117.8	16706.2
SCM2	30	0.8	10	340.0958	119.0	16708.9
SCM2	30	0.81	10	343.3559	120.1	16711.7
SCM2	30	0.82	10	346.6121	121.3	16714.4
SCM2	30	0.83	10	349.8381	122.4	16717.2
SCM2	30	0.84	10	353.0399	123.5	16719.9
SCM2	30	0.85	10	356.2165	124.6	16722.7
SCM2	30	0.86	10	359.3605	125.7	16725.5
SCM2	30	0.87	10	362.4689	126.8	16728.2
SCM2	30	0.88	10	365.5345	127.9	16731
SCM2	30	0.89	10	368.5563	129.0	16733.7
SCM2	30	0.9	10	371.5481	130.0	16736.5

SCM2	30	0.91	10	374.5246	131.0	16739.26
SCM2	30	0.92	10	377.4815	132.1	16742.01
SCM2	30	0.93	10	380.4293	133.1	16744.76
SCM2	30	0.94	10	383.3643	134.1	16747.52
SCM2	30	0.95	10	386.2918	135.2	16750.27
SCM2	30	0.96	10	389.2024	136.2	10493.22
SCM2	30	0.97	10	392.0809	137.2	10495.97
SCM2	30	0.98	10	394.921	138.2	10498.73
SCM2	30	0.99	10	397.744	139.2	10501.48
SCM2	30	1	10	400.5494	140.2	10504.23
SCM2	30	1.01	10	403.3488	141.2	10506.98
SCM2	30	1.02	10	406.1323	142.1	10509.73
SCM2	30	1.03	10	408.8965	143.1	10512.49
SCM2	30	1.04	10	411.638	144.1	10515.24
SCM2	30	1.05	10	414.3475	145.0	10517.99
SCM2	30	1.06	10	417.0336	146.0	10520.74
SCM2	30	1.07	10	419.6817	146.9	10523.5
SCM2	30	1.08	10	422.3143	147.8	10526.25
SCM2	30	1.09	10	424.9264	148.7	10529
SCM2	30	1.1	10	427.5225	149.6	10531.75
SCM2	30	1.11	10	430.1038	150.5	10534.51
SCM2	30	1.12	10	432.6622	151.4	10537.26
SCM2	30	1.13	10	435.2164	152.3	10540.01
SCM2	30	1.14	10	437.7604	153.2	10542.76
SCM2	30	1.15	10	440.2872	154.1	10545.51

SCM2	30	1.16	10	442.7881	155.0	10548.27
SCM2	30	1.17	10	445.28	155.9	10551.02
SCM2	30	1.18	10	447.7499	156.7	10553.77
SCM2	30	1.19	10	450.1867	157.6	10556.52
SCM2	30	1.2	10	452.5814	158.4	10559.28
SCM2	30	1.21	10	454.9684	159.2	10562.03
SCM2	30	1.22	10	457.3449	160.1	10564.78
SCM2	30	1.23	10	459.6649	160.9	10567.53
SCM2	30	1.24	10	461.9448	161.7	10570.29
SCM2	30	1.25	10	464.2153	162.5	10573.04

**Appendix-A3**

BMPI D	INLET_CF S	STORFT_A C	STORDP_F T	AA_RUN_RD X	AA_ZN_RD X	cost
SCM4	30	0.01	10	6.061737	2.221840525	16491.55
SCM4	30	0.02	10	12.05902	4.378057376	16494.3
SCM4	30	0.03	10	17.95943	6.485986881	16497.06
SCM4	30	0.04	10	23.78343	8.555537801	16499.81
SCM4	30	0.05	10	29.51573	10.58827933	16502.56
SCM4	30	0.06	10	35.19264	12.59808964	16505.31
SCM4	30	0.07	10	40.80714	14.58576297	16508.07
SCM4	30	0.08	10	46.38179	16.55633066	16510.82
SCM4	30	0.09	10	51.90985	18.50929282	16513.57
SCM4	30	0.1	10	57.39736	20.44440303	16516.32
SCM4	30	0.11	10	62.82614	22.35684761	16519.08
SCM4	30	0.12	10	68.17593	24.24219204	16521.83
SCM4	30	0.12	10	68.17593	24.24219204	16524.53

SCM4	30	0.13	10	73.47257	26.1093966	8
SCM4	30	0.14	10	78.69385	27.94932412	16527.3
SCM4	30	0.15	10	83.87164	29.77413665	3
SCM4	30	0.16	10	89.00623	31.58225259	16530.0
SCM4	30	0.17	10	94.086	33.37143816	8
SCM4	30	0.18	10	99.1512	35.15507524	16532.8
SCM4	30	0.19	10	104.1658	36.92104831	4
SCM4	30	0.2	10	109.13	38.66995315	16535.5
SCM4	30	0.21	10	114.0626	40.40688738	9
SCM4	30	0.22	10	118.9677	42.13379493	16538.3
SCM4	30	0.23	10	123.8497	43.85187596	4
SCM4	30	0.24	10	128.6976	45.55906971	16541.0
SCM4	30	0.25	10	133.4881	47.24552968	9
SCM4	30	0.26	10	138.1913	48.90218485	16543.8
SCM4	30	0.27	10	142.8342	50.53692442	5
SCM4	30	0.28	10	147.466	52.16581702	16546.6
SCM4	30	0.29	10	152.0806	53.78831253	16549.3
SCM4	30	0.3	10	156.6298	55.38820754	5
SCM4	30	0.31	10	161.1405	56.97355189	16552.1
SCM4	30	0.32	10	165.6081	58.54327894	16554.8
SCM4	30	0.33	10	170.0399	60.10048691	6
SCM4	30	0.34	10	174.4221	61.64083316	16557.6
SCM4	30	0.35	10	178.7233	63.15334129	1
SCM4	30	0.36	10	182.974	64.64751742	16560.3
SCM4	30	0.37	10	187.1713	66.12306827	6
						16563.1
						1
						16565.8
						6
						16568.6
						2
						16571.3
						7
						16574.1
						2
						16576.8
						7
						16579.6
						3
						16582.3
						8
						16585.1
						3
						16587.8
						8
						16590.6
						4
						16593.3

SCM4	30	0.38	10	191.3133	67.57891913	9
						16596.1
SCM4	30	0.39	10	195.4209	69.02279252	4
						16598.8
SCM4	30	0.4	10	199.494	70.4546453	9
						16601.6
SCM4	30	0.41	10	203.5378	71.8756228	4
SCM4	30	0.42	10	207.5442	73.28282675	16604.4
						16607.1
SCM4	30	0.43	10	211.49	74.66943958	5
SCM4	30	0.44	10	215.3453	76.02421931	16609.9
						16612.6
SCM4	30	0.45	10	219.1633	77.36561375	5
						16615.4
SCM4	30	0.46	10	222.9468	78.69507658	1
						16618.1
SCM4	30	0.47	10	226.6829	80.00755041	6
						16620.9
SCM4	30	0.48	10	230.3812	81.30781633	1
						16623.6
SCM4	30	0.49	10	234.0548	82.60047313	6
						16626.4
SCM4	30	0.5	10	237.6885	83.87820592	2
						16629.1
SCM4	30	0.51	10	241.2514	85.13086224	7
						16631.9
SCM4	30	0.52	10	244.7671	86.36632993	2
						16634.6
SCM4	30	0.53	10	248.2596	87.59339463	7
						16637.4
SCM4	30	0.54	10	251.7129	88.80688968	2
						16640.1
SCM4	30	0.55	10	255.1309	90.00842772	8
						16642.9
SCM4	30	0.56	10	258.5187	91.19917286	3
						16645.6
SCM4	30	0.57	10	261.8999	92.38747495	8
						16648.4
SCM4	30	0.58	10	265.2608	93.56802511	3
						16651.1
SCM4	30	0.59	10	268.5909	94.73758578	9
						16653.9
SCM4	30	0.6	10	271.8793	95.89252007	4
						16656.6
SCM4	30	0.61	10	275.1008	97.02434868	9
						16659.4
SCM4	30	0.62	10	278.2954	98.14654081	4
						16662.1

SCM4	30	0.63	10	281.4386	99.2508572	9 16664.9
SCM4	30	0.64	10	284.5657	100.349493	5
SCM4	30	0.65	10	287.6817	101.4447598	16667.7 16670.4
SCM4	30	0.66	10	290.7706	102.5301758	5
SCM4	30	0.67	10	293.8147	103.5995747	16673.2 16675.9
SCM4	30	0.68	10	296.8127	104.6527686	6 16678.7
SCM4	30	0.69	10	299.7581	105.6874015	1 16681.4
SCM4	30	0.7	10	302.677	106.7131731	6 16684.2
SCM4	30	0.71	10	305.5549	107.7245499	1 16686.9
SCM4	30	0.72	10	308.4004	108.7239289	7 16689.7
SCM4	30	0.73	10	311.2253	109.7162024	2 16692.4
SCM4	30	0.74	10	314.0292	110.7011949	7 16695.2
SCM4	30	0.75	10	316.8258	111.6836907	2 16697.9
SCM4	30	0.76	10	319.606	112.6605905	7 16700.7
SCM4	30	0.77	10	322.3489	113.6246023	3 16703.4
SCM4	30	0.78	10	325.0471	114.5720997	8 16706.2
SCM4	30	0.79	10	327.7186	115.5098225	3 16708.9
SCM4	30	0.8	10	330.3467	116.432132	8 16711.7
SCM4	30	0.81	10	332.9591	117.3493554	4 16714.4
SCM4	30	0.82	10	335.5608	118.2635424	9 16717.2
SCM4	30	0.83	10	338.1084	119.1584062	4 16719.9
SCM4	30	0.84	10	340.5945	120.0314121	9 16722.7
SCM4	30	0.85	10	343.0375	120.8889114	5
SCM4	30	0.86	10	345.4168	121.7238961	16725.5 16728.2
SCM4	30	0.87	10	347.7656	122.54807	5
SCM4	30	0.88	10	350.0651	123.3551624	16731 16733.7

SCM4	30	0.89	10	352.3399	124.1533963	5
SCM4	30	0.9	10	354.5696	124.9354446	16736.5
SCM4	30	0.91	10	356.7969	125.7167256	16739.2
SCM4	30	0.92	10	359.0071	126.4926763	16742.0
SCM4	30	0.93	10	361.1775	127.2547647	16744.7
SCM4	30	0.94	10	363.3152	128.0056172	16747.5
SCM4	30	0.95	10	365.4005	128.7382871	16750.2
SCM4	30	0.96	10	367.4423	129.455298	16753.0
SCM4	30	0.97	10	369.4415	130.1563996	16755.7
SCM4	30	0.98	10	371.4091	130.8464992	16758.5
SCM4	30	0.99	10	373.3471	131.526373	16761.2
SCM4	30	1	10	375.2538	132.1955452	16764.0
SCM4	30	1.01	10	377.1387	132.8571256	16766.7
SCM4	30	1.02	10	378.995	133.5087597	16769.5
SCM4	30	1.03	10	380.8237	134.1504507	16772.2
SCM4	30	1.04	10	382.6076	134.7768098	16775.0
SCM4	30	1.05	10	384.3424	135.385818	16777.7
SCM4	30	1.06	10	386.046	135.9837484	16780.5
SCM4	30	1.07	10	387.7278	136.5741221	16783.3
SCM4	30	1.08	10	389.3844	137.1557015	16786.0
SCM4	30	1.09	10	391.0181	137.7294355	16788.8
SCM4	30	1.1	10	392.6223	138.2924006	16791.5
SCM4	30	1.11	10	394.2136	138.8507973	16794.3
SCM4	30	1.12	10	395.7781	139.4004734	16797.0
SCM4	30	1.13	10	397.283	139.9286646	16799.8

SCM4	30	1.14	10	398.7723	140.4514656	16802.56
SCM4	30	1.15	10	400.2356	140.9656721	16805.31
SCM4	30	1.16	10	401.6821	141.4739192	16808.07
SCM4	30	1.17	10	403.1115	141.9760299	16810.82
SCM4	30	1.18	10	404.509	142.4670934	16813.57
SCM4	30	1.19	10	405.8632	142.9425567	16816.32
SCM4	30	1.2	10	407.1974	143.4107401	16819.08
SCM4	30	1.21	10	408.5015	143.8680851	16821.83
SCM4	30	1.22	10	409.7678	144.3125781	16824.58
SCM4	30	1.23	10	411.0069	144.7470953	16827.33
SCM4	30	1.24	10	412.2369	145.1783472	16830.09
SCM4	30	1.25	10	413.4534	145.605083	16832.84
SCM4	30	1.26	10	414.6387	146.0209285	16835.59
SCM4	30	1.27	10	415.8087	146.4312535	16838.34
SCM4	30	1.28	10	416.9463	146.8303266	16841.09
SCM4	30	1.29	10	418.0661	147.2230837	16843.85
SCM4	30	1.3	10	419.1853	147.6154798	16846.6
SCM4	30	1.31	10	420.2905	148.0028819	16849.35
SCM4	30	1.32	10	421.3844	148.3868542	16852.1
SCM4	30	1.33	10	422.4544	148.7623849	16854.86
SCM4	30	1.34	10	423.5031	149.1305647	16857.61
SCM4	30	1.35	10	424.5438	149.4959797	16860.36
SCM4	30	1.36	10	425.5559	149.8519192	16863.11
SCM4	30	1.37	10	426.5384	150.1973295	16865.87

SCM4	30	1.38	10	427.4695	150.5244535	16868.6 2
SCM4	30	1.39	10	428.3652	150.8387963	16871.3 7
SCM4	30	1.4	10	429.2533	151.1501563	16874.1 2
SCM4	30	1.41	10	430.1204	151.4540678	16876.8 7
SCM4	30	1.42	10	430.9612	151.7488131	16879.6 3
SCM4	30	1.43	10	431.7914	152.0395945	16882.3 8
SCM4	30	1.44	10	432.6125	152.327559	16885.1 3
SCM4	30	1.45	10	433.4136	152.6085762	16887.8 8
SCM4	30	1.46	10	434.2043	152.8858897	16890.6 4
SCM4	30	1.47	10	434.964	153.1526679	16893.3 9
SCM4	30	1.48	10	435.6898	153.4077963	16896.1 4
SCM4	30	1.49	10	436.3913	153.6542822	16898.8 9
SCM4	30	1.5	10	437.0707	153.8930439	16901.6 5
SCM4	30	1.51	10	437.7432	154.1295567	16904.4 16907.1
SCM4	30	1.52	10	438.3905	154.3572906	5
SCM4	30	1.53	10	439.0089	154.5744753	16909.9 16912.6
SCM4	30	1.54	10	439.6122	154.7860638	5
SCM4	30	1.55	10	440.2062	154.9943197	16915.4 1
SCM4	30	1.56	10	440.7948	155.2006986	16918.1 6
SCM4	30	1.57	10	441.3834	155.4074263	16920.9 1
SCM4	30	1.58	10	441.9616	155.6103717	16923.6 6
SCM4	30	1.59	10	442.5387	155.8126819	16926.4 2
SCM4	30	1.6	10	443.0926	156.0068026	16929.1 7
SCM4	30	1.61	10	443.6315	156.1957745	16931.9 2

SCM4	30	1.62	10	444.1688	156.3842638	16934.6
						7
SCM4	30	1.63	10	444.7062	156.572747	16937.4
						2
SCM4	30	1.64	10	445.2383	156.7593741	16940.1
						8
SCM4	30	1.65	10	445.7556	156.9408826	16942.9
						3
SCM4	30	1.66	10	446.2487	157.1142305	16945.6
						8
SCM4	30	1.67	10	446.7122	157.2769852	16948.4
						3
SCM4	30	1.68	10	447.1757	157.4395248	16951.1
						9
SCM4	30	1.69	10	447.6341	157.6002371	16953.9
						4
SCM4	30	1.7	10	448.0842	157.7581682	16956.6
						9
SCM4	30	1.71	10	448.5343	157.9160858	10699.6
						4
SCM4	30	1.72	10	448.9661	158.0676475	10702.4
						10705.1
SCM4	30	1.73	10	449.3736	158.2106964	5
SCM4	30	1.74	10	449.7771	158.3523462	10707.9
						10710.6
SCM4	30	1.75	10	450.1807	158.4938462	5
SCM4	30	1.76	10	450.5818	158.6345159	10713.4
						10716.1
SCM4	30	1.77	10	450.9738	158.7720001	6
						10718.9
SCM4	30	1.78	10	451.3553	158.905708	1
						10721.6
SCM4	30	1.79	10	451.72	159.0334204	6
						10724.4
SCM4	30	1.8	10	452.0729	159.1572663	1
						10727.1
SCM4	30	1.81	10	452.4259	159.2810405	7
						10729.9
SCM4	30	1.82	10	452.764	159.3995391	2
						10732.6
SCM4	30	1.83	10	453.071	159.5073545	7
						10735.4
SCM4	30	1.84	10	453.3637	159.6099107	2
						10738.1
SCM4	30	1.85	10	453.6451	159.708545	8

SCM4	30	1.86	10	453.9266	159.8071728	10740.93
SCM4	30	1.87	10	454.1981	159.902391	10743.68
SCM4	30	1.88	10	454.4609	159.9945343	10746.43
SCM4	30	1.89	10	454.7193	160.0851852	10749.18
SCM4	30	1.9	10	454.9778	160.175808	10751.94
SCM4	30	1.91	10	455.23	160.264231	10754.69
SCM4	30	1.92	10	455.4767	160.3507591	10757.44
SCM4	30	1.93	10	455.7235	160.4371741	10760.19
SCM4	30	1.94	10	455.9702	160.523535	10762.95
SCM4	30	1.95	10	456.217	160.6098874	10765.7
SCM4	30	1.96	10	456.4579	160.6943259	10768.45
SCM4	30	1.97	10	456.6932	160.7767932	10771.2
SCM4	30	1.98	10	456.9284	160.8592043	10773.96
SCM4	30	1.99	10	457.1637	160.9415816	10776.71
SCM4	30	2	10	457.3989	161.0240035	10779.46

#### B1. Nested

NESTID	PROJID	DSPROJ	DIVRATE	STOR_AF	OTYPE	ORATE	AARUN_BAS	AARUN_DIVA	AARUN_BYA	AARUN_BMPOUT	AARUN_RDX	AAZN_BASE	AAZN_DIVABLE	AAZN_BYP	AAZN_BMPOUT	AAZN_RDX
NEST001	SCM3	SCM5	30	11	INF	0.9	711.7843	448.072314	71.43627		376.6360393	249.536	157.0294511	25.0527286		( 131.976722
NEST001	SCM5	0	50	13	INF	0.8	0	0	(	(	(	(	(	(	(	(

**Copyright:** ©2026 Tefera Shibeshi, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.