New York City Stormwater Manual

Appendix B
NITROGEN NO-NET-INCREASE CALCULATOR GUIDE

NYC Environmental Protection

NYC MS4 No-Net-Increase Calculator for Nitrogen

Non-negligible land use changes can increase the amount of nitrogen within stormwater runoff. This increase can be calculated by comparing the existing site conditions before a project has begun (pre-construction) and after a project is completed (post-construction). The simplified procedures for using DEP's interactive tool, the NYC MS4 No-Net-Increase Calculator for Nitrogen, are described below.

DEP developed the NYC MS4 No-Net-Increase Calculator for Nitrogen to aid applicants in demonstrating NNI of nitrogen resulting from a project subject to NNI requirements. The calculator compares existing site conditions (pre-construction) to post-construction conditions and outputs the net change in nitrogen loads based on the calculated WQv.

Overview of Calculator

The NYC MS4 No-Net-Increase Calculator for Nitrogen input and output page is shown in Figure 3-4. The online version of the calculator is located on the DEP MS4 web page (https://www1.nyc.gov/assets/dep/downloads/pdf/water/stormwater/ms4/nni-calculator.xlsx).

Figure 3-4. NYC MS4 No-Net-Increase Calculator for Nitrogen

NYC MS4 No-Net-Increase Calculator

Project Name:	*{Enter Name}*	Prepared For:	*{Enter Owner Name}*
DEP Application Number:	*{Enter Number}*	Prepared By:	*{Enter Company Name}*
Borough; Block, and Lot:	*{Enter Borough; Block #, Lot #}*	Date:	*{Enter Date}*

Step 1: Nitrogen Load Calculation (DRAFT)

This section calculates the change in nitrogen load from pre- to post-construction site conditions (see Nitrogen Load Calculation tab). Please fill in shaded cells.
Any increase in nitrogen load must be removed using stormwater management practices (SMPs).

Pre-Construction	
Project Area (acres)	
Impervious Area (acres)	
Current Land Use	
Runoff Coefficient (R_v)	

Post-Construction	
Project Area (acres)	
Impervious Area (acres)	
Proposed Land Use	
Runoff Coefficient (R_v)	

Total Nitrogen Load (Pre)		lbs
Total Nitrogen Load (Post)		lbs
Required Nitrogen Load Reduction		lbs
Percent Reduction Required		%

Step 2: SMP Nitrogen Removal Calculation (DRAFT)

This section calculates the nitrogen load reduction for proposed SMPs. Load reduction calculation considers both pervious and impervious areas within SMP catchment area.
Fill in shaded cells for post-construction conditions. Use a separate row for each catchment area draining to an SMP. SMP must be sized to manage the entire SMP catchment area.
For alternative SMPs not in drop down (manufactured technologies or treatment trains), see NYC SWDM and enter SMP type and removal rate in Rows 7-10 (must attach documentation).

	SMP Catchment Area (acres)	Impervious Area (acres)	SMP Type	Total Nitrogen Removal Rate (%)	Total Nitrogen Load Reduction (lbs)
1					
2					
3					
4					
5					
6					
7			*[Enter Other SMP Type]*		
8			*[Enter Other SMP Type]*		
9			*[Enter Other SMP Type]*		
10			*[Enter Other SMP Type]*		
	0.0	0.0			0.00

Step 3: No-Net Increase Verification (DRAFT)

This section verifies that proposed SMPs will reduce the post-construction nitrogen load equal to or less than the pre-construction nitrogen load, resulting in no net increase.

	Load (lbs)	Percent (%)	
Required Nitrogen Load Reduction			(from Step 1)
Actual Nitrogen Load Reduction			(from Step 2)

PLEASE COMPLETE STEPS 1 AND 2

The TN load change is calculated by subtracting the pre-construction TN load from the post-construction TN load, using the equation below. The TN load for pre- and post-construction conditions is determined by multiplying the water quality volume (WQv) for the project area by the event mean concentration (EMC) for TN for its associated land use type, as per Table 3-1. The WQv is found using the formula from Chapter 4 of the NYS SWMDM, with a minimum value for the volumetric runoff coefficient Rv of 0.2.

WQv (post) * EMCTN (post) – WQv (pre) * EMCTN (pre) = TN load change

If the post-construction load is greater than the pre-construction load, the calculated value for the net increase serves as the basis for the stormwater management recommendations and should be included in the SWPPP. Any resulting net TN load increase must be removed using appropriately selected and designed SMPs, detailed in Table 3-2.

Accounting for Pervious and Impervious Area Conditions

Increasing pervious surface area onsite may help to avoid NNI requirements all together (see definition of "Negligible Land Use Change"). DEP encourages developers to increase pervious areas in the post-construction site condition during site planning, to the greatest extent possible. DEP considers green roofs, porous pavement, vegetated SMPs, or other landscaped pervious areas for the purpose of calculating WQv and required nitrogen load reduction in Step 1. In addition, TN removal in stormwater runoff from impervious and pervious surfaces managed by various SMPs is determined in Step 2 of the calculator as shown in Table 3-2.

Event Mean Concentrations of TN

Table 3-1 shows median values for TN EMCs for common land uses in NYC, related zoning districts, and similar or applicable land uses included in the NYSDEC Notice of Intent (NOI) form. The values in Table 3-1 were derived by comparing estimated EMCs for various land use types across 10 national studies. The NYC MS4 No-Net-Increase Calculator for Nitrogen uses the values from this table as land use loading coefficients when computing TN loadings for the project area.

Table 3-1. Median EMCs for TN

NYC Land Use	NYC Zoning Districts	Similar or Applicable Land Uses From NOI	EMC for TN (mg/L)
Commercial	C1-C8	Institutional/School, Municipal	2.08
Industrial/Manufacturing	M1-M3	Linear Utility, Well Drilling Activity (Oil, Gas, etc.), Road/ Highway, Parking Lot	2.10
Vacant/Open Space	NA	Forest, Pasture/Open Land, Cultivated Land, Recreational/ Sports Field, Bike Path/Trail, Clearing/Grading, Demolition/No Redevelopment	1.50
Lower-Density Residential	R1-R5	Single Family Home/Subdivision	2.10
Moderate- and Higher-Density Residential	R6-R10	Town Home Residential, Multifamily Residential	2.41

Note: mg/L = milligrams per liter.

User Inputs

For the NYC MS4 No-Net-Increase Calculator for Nitrogen, the SWPPP preparer will be responsible for inputting the following information:

- Total project area (acres)
- Pre-construction conditions for the total project area
  - » Impervious area (acres)
  - » Current land use type (from dropdown menu)
- Post-construction conditions for the total project area
  - » Impervious area (acres)
  - » Proposed land use type (from dropdown menu)

Calculator Outputs

Post-construction TN load will depend on land use changes and the EMCs for these land use types, as well as impervious cover changes. The calculator will compare the pre- and post-construction conditions and output the resulting net changes in TN load, as a quantity in pounds (lbs) and percentage (%).

DEP recommends reducing the post-construction impervious area to the greatest extent feasible, to mitigate stormwater runoff increases and net increases in TN load. As a next step toward compliance with NNI requirements, SMPs described in Table 3-2, must be implemented in the SWPPP to remove all net increases in TN load from the covered development project.

Post-construction conditions at a 1.7-acre site in the Jamaica Bay watershed.

SMPs for Nitrogen Removal

For projects subject to NNI requirements which drain to nitrogen-impaired receiving waterbodies, SWPPP preparers must implement SMPs to mitigate any net increases in nitrogen due to non-negligible land use changes. Table 3-2 is a list of pollutant removal rates by SMP. DEP derived these values by comparing SMP TN removal rate data from a number of different national research reports, regional design documents, and state and municipal manuals. The third column refers to the appropriate guidance in the NYS SWMDM for each SMP. However, SWPPP preparers should refer to all applicable sections in Chapters 5, 6, and 7 of the NYS SWMDM for SMP design and selection information.

Table 3-2. TN Removal by SMP

SMP	TN Removal Rate	NYS SWMDM Section
Rainwater Reuse System	100%	Section 5.3.10
Rain Garden	100%	Section 5.3.7
Bioretention	100%	Section 6.4
Porous Pavement	100%	Section 5.3.11
Infiltration Trench	100%	Section 6.3
Turf Field	40%	N/A
Sand Filter (Filtration)	40%	Section 6.4
Bioretention with Underdrain	40%	Section 6.4
Porous Pavement with Underdrain	40%	Section 5.3.11
Green Roof	35%	Section 5.3.8
Constructed Wetlands	35%	Section 6.2
Ponds	30%	Section 6.2

SMPs should be selected based on site conditions such as infiltration feasibility, available space, land use, soil suitability, site slope, depth to groundwater, and O&M requirements. The catchment areas draining to individual SMPs (or SMPs in series, as described below) need to be delineated accurately and included in the calculator to assess the overall pollutant load reduction for the entire project area.

The NYC MS4 No-Net-Increase Calculator for Nitrogen allows applicants to assign the TN removal rates in Table 3-2 to each SMP catchment area based on the selection and design of corresponding SMPs. The calculator estimates the total removal efficiencies across all SMP catchment areas and compares the TN removed by the SMPs to the net TN increase due to the development activity. The total post-construction TN load for the project area must be less than or equal to the total pre-construction TN loads. All NNI calculations for TN must be included and documented in the SWPPP. An example NYC MS4 No-Net-Increase Calculator for Nitrogen calculation is provided in Attachment 2.

Treatment Trains and Manufactured Technologies for Nitrogen Removal

SWPPP preparers may use alternative technologies not listed in Table 3-2 to achieve TN NNI requirements. SWPPPs that propose alternative technologies must include supporting documentation to verify TN removal efficiencies.

DEP will rely on the approval processes referenced in Chapter 3 of the NYS SWMDM, including the requirement that the alternative technology must be approved by a third party verification program (https://www.dec.ny.gov/chemical/29089.html).

For alternative technologies, including proprietary water quality treatment devices that are not included in or do not meet the standards of the NYS SWMDM, supporting documentation of TN removal rates must follow the approach currently employed by NYSDEC to verify technology effectiveness. Specifically, applicants must provide evidence of third party verification from Washington State's Technology Assistance Protocol - Ecology (TAPE) Program or the multi-state Technology Acceptance Reciprocity Partnership (TARP) Program for TN removal rates applied for each proposed alternative technology in the calculator.

SWPPP preparers may also elect to implement multiple SMPs in series, referred to as a treatment train, to treat runoff from the same SMP catchment area and achieve NNI requirements for the project area. This can be an effective way to achieve NNI requirements for sites where a single SMP for each catchment area cannot achieve the required TN load reduction, or for space-constrained sites.

For example, rooftop runoff can be treated with a green roof and outflow from the green roof can then be discharged to a sand filter or other approved treatment technology at ground level. With this post-construction condition, TN load is effectively reduced first through the green roof and remaining load is reduced further by the sand filter. In order for a treatment train to be effective, the SMPs utilized must be different types of technologies (i.e. placing two sand filters in a row is not considered a treatment train). Figure 3-5 represents a schematic of a treatment train with three different SMPs implemented in series.

SWPPP preparers should use the calculation below to identify the TN removal rate of an SMP treatment train for a specific SMP catchment area:

$$Rr = [1 - ((1 - rr1)*(1 - rr2)*(1 - rr3))] * 100$$

Where:

Rr = overall removal rate (%)

rr1, 2, 3 = removal rates for SMP1, SMP2, and SMP3, respectively (%)

The TN load of the inflow is first treated by SMP1 with a TN removal efficiency of rr1 (removal rate for SMP1), and the remainder pollutant load is then treated by SMP2 with a removal efficiency of rr2 (removal rate for SMP2), and so on.

The calculation for each SMP catchment area with a proposed treatment train needs to be provided as supporting documentation with the SWPPP. Removal rates in Table 3-2 should be used for each SMP proposed in series or, if an alternative technology is proposed, the guidance below should be used. The overall removal rate (Rr) calculated should be entered into the NYC MS4 No-Net-Increase Calculator as the TN removal rate for an SMP treatment train to demonstrate that NNI requirements are met.

Figure 3-5. SMP Treatment Train Schematic

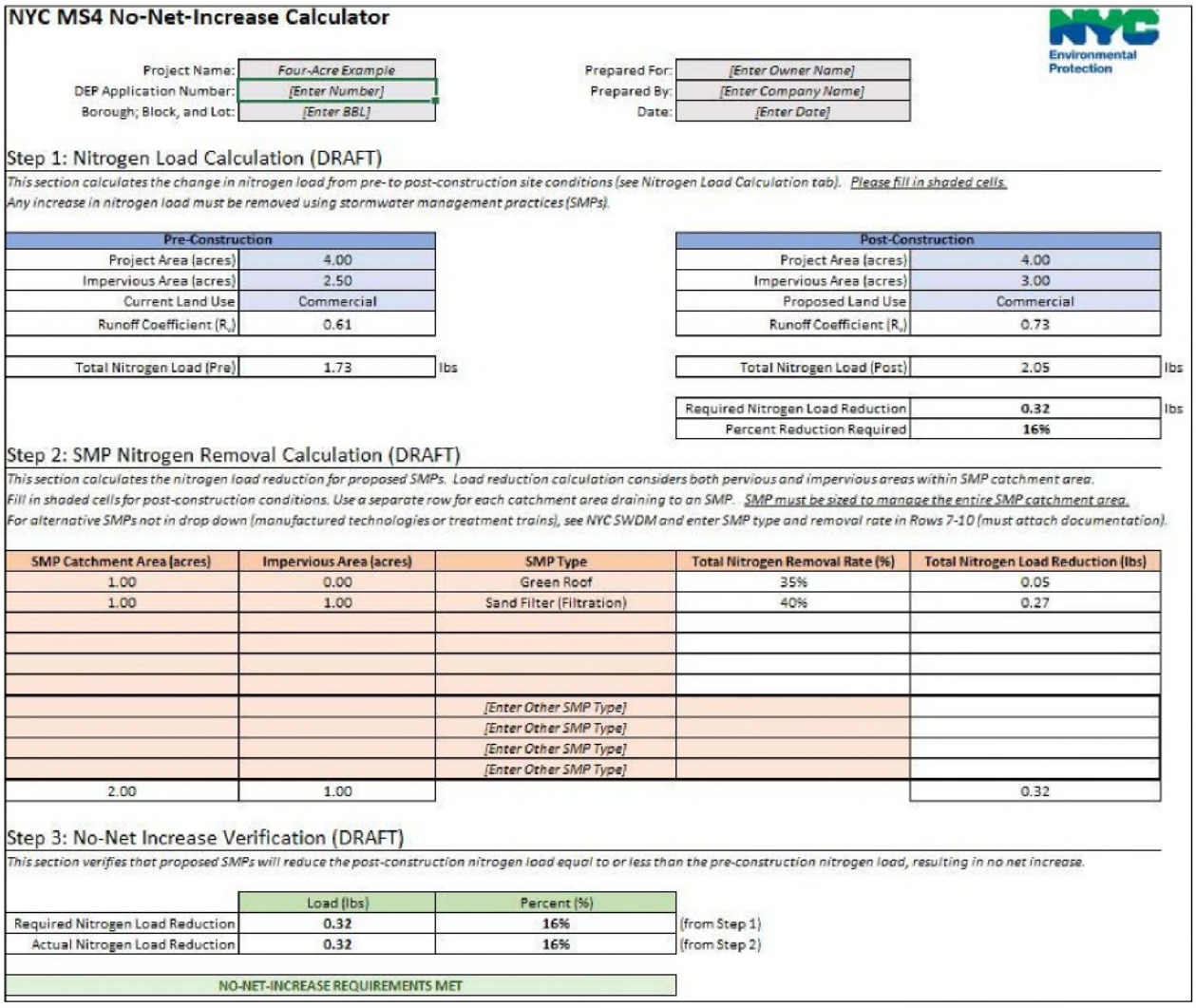
NYC MS4 No-Net-Increase Calculator for Nitrogen - Example

In this example, proposed redevelopment activities will increase the impervious area on a 4.0-acre site in the Flushing Bay watershed by 0.5 acres, which will trigger NNI requirements, Figure 1.

Figure 1 - Four-acre site in Flushing Bay watershed with proposed increase in impervious surfaces that must meet NNI requirements.

The NYC MS4 No-Net-Increase Calculator input table for the project site in Figure 1 is presented in Figure 2.

Figure 2 – NYC MS4 No-Net-Increase Calculator for the Four-acre site in Flushing Bay watershed with proposed increase in impervious surfaces that must meet NNI requirements.



NYC MS4 No-Net-Increase Calculator

Project Name:	*Four-Acre Example*	Prepared For:	*[Enter Owner Name]*
DEP Application Number:	*[Enter Number]*	Prepared By:	*[Enter Company Name]*
Borough, Block, and Lot:	*[Enter BBL]*	Date:	*[Enter Date]*

Step 1: Nitrogen Load Calculation (DRAFT)

This section calculates the change in nitrogen load from pre- to post-construction site conditions (see Nitrogen Load Calculation tab). Please fill in shaded cells.
Any increase in nitrogen load must be removed using stormwater management practices (SMPs).

Pre-Construction	
Project Area (acres)	4.00
Impervious Area (acres)	2.50
Current Land Use	Commercial
Runoff Coefficient (R_v)	0.61
Total Nitrogen Load (Pre)	1.73 lbs

Post-Construction	
Project Area (acres)	4.00
Impervious Area (acres)	3.00
Proposed Land Use	Commercial
Runoff Coefficient (R_v)	0.73
Total Nitrogen Load (Post)	2.05 lbs
Required Nitrogen Load Reduction	**0.32** lbs
Percent Reduction Required	**16%**

Step 2: SMP Nitrogen Removal Calculation (DRAFT)

This section calculates the nitrogen load reduction for proposed SMPs. Load reduction calculation considers both pervious and impervious areas within SMP catchment area.
Fill in shaded cells for post-construction conditions. Use a separate row for each catchment area draining to an SMP. SMP must be sized to manage the entire SMP catchment area.
For alternative SMPs not in drop down (manufactured technologies or treatment trains), see NYC SWDM and enter SMP type and removal rate in Rows 7-10 (must attach documentation).

SMP Catchment Area (acres)	Impervious Area (acres)	SMP Type	Total Nitrogen Removal Rate (%)	Total Nitrogen Load Reduction (lbs)
1.00	0.00	Green Roof	35%	0.05
1.00	1.00	Sand Filter (Filtration)	40%	0.27
		[Enter Other SMP Type]		
		[Enter Other SMP Type]		
		[Enter Other SMP Type]		
		[Enter Other SMP Type]		
2.00	1.00			0.32

Step 3: No-Net Increase Verification (DRAFT)

This section verifies that proposed SMPs will reduce the post-construction nitrogen load equal to or less than the pre-construction nitrogen load, resulting in no net increase.

	Load (lbs)	Percent (%)	
Required Nitrogen Load Reduction	**0.32**	**16%**	(from Step 1)
Actual Nitrogen Load Reduction	**0.32**	**16%**	(from Step 2)

NO-NET-INCREASE REQUIREMENTS MET

As shown in Figure 2, the pre- and post-development conditions for the inputs for Step 1: Nitrogen Load Calculation are below, together with the calculated total nitrogen load:

Pre-Construction:

- Project Area: 4.0 acres
- Impervious Area: 2.5 acres
- Current Land Use: Commercial
- Total Nitrogen Load (pre): 1.73 lbs.

Post-Construction:

- Project Area: 4.0 acres
- Impervious Area: 3.0 acres
- Proposed Land Use: Commercial
- Total Nitrogen Load (post): 2.05 lbs.

Note that the pervious surface area of green roofs, porous pavement, vegetated SMPs, or other landscaped areas should not be included in the impervious area cell under Step 1 or Step 2. In this example, a green roof is considered pervious area not impervious area and, consequently, the WQv and required nitrogen load reduction is less than if considered a regular roof. The green roof also provides limited nitrogen removal in Step 2 given a minimum runoff coefficient of 0.2 for all surfaces (impervious and pervious).

Therefore, in this example, the SWPPP preparer is required to install SMPs to remove 0.32 lbs. (or 16%) of total nitrogen, which represents the load increase between pre- and post-development.

The SWPPP preparer proposes multiple SMPs and enters their associated catchment areas into the upper rows of the table in Step 2: SMP Nitrogen Removal Calculation. The calculator assigns the appropriate nitrogen removal rates and identifies the total nitrogen load removed per SMP.

SMP 1 Type: Green Roof

Impervious Area (First SMP Catchment Area): 0.0 acres

Total Nitrogen Removal Rate: 35%

Total Nitrogen Load Reduction: 0.05 lbs.

SMP 2 Type: Porous Pavement

Impervious Area (Second SMP Catchment Area): 1.0 acre

Total Nitrogen Removal Rate: 40%

Total Nitrogen Load Reduction: 0.27 lbs.

The total nitrogen load removal for the proposed SMPs is 0.32 lbs. (or 16%), which equals the NNI requirements as verified in Step 3: No-Net Increase Verification. The developer should print the calculator results as confirmation and include it in their SWPPP submittal.