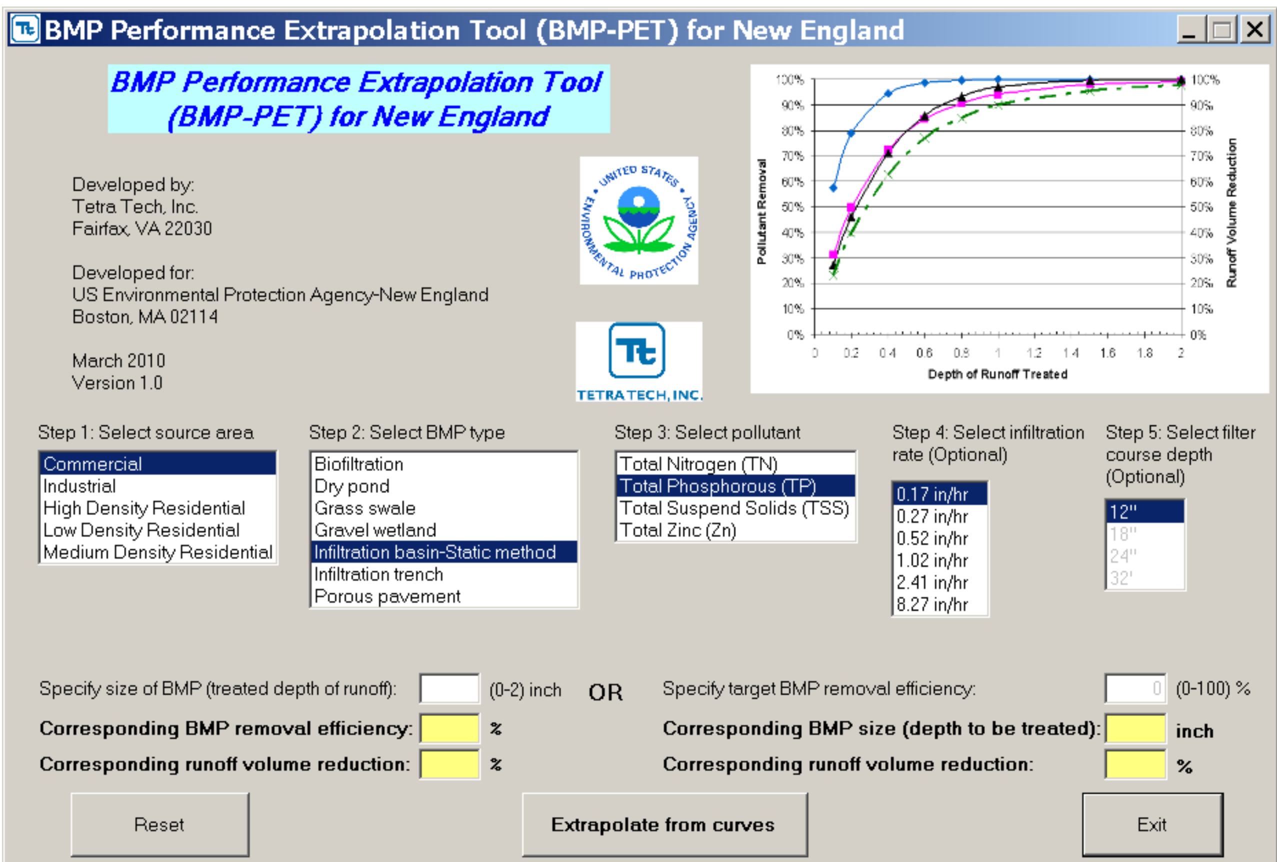
Operating Instructions for EPA Region 1's

BMP Performance Extrapolation Tool for New England



How to Make your *BMP-PET for New England* Work for YOU!

I. Understanding your BMP-PET

Your Regional BMP-PET is here for you!

The ***BMP Performance Extrapolation Tool for New England*** provides an easier, faster way to estimate BMP stormwater treatment performance for your site-specific conditions, your choice of BMP-type, and pollutant(s) of concern. Depending on what information or requirements you have,

- You can use the tool to estimate a selected BMP's **pollutant load removal efficiency** for a given BMP size (in terms of treated depth of runoff from impervious area),
  OR
- You can use the tool to estimate the **size of a selected BMP needed** to achieve a given target removal efficiency.

- Coming soon is a new version of the tool, BMP-PET 2, which will include the capability to determine BMP capacities needed for drainage areas with both impervious and pervious surfaces.

If you choose one of the two **infiltration BMPS** for low-impact development (LID),

- You will also see performance results in terms of stormwater **runoff volume reduction**.

This March 2010 version of the tool has a menu of 4 pollutants:

- The choices for **Total *Phosphorus (TP)***, ***Total Suspended Solids (TSS)***, and **Total Zinc *(Zn)*** are *operational now*.

- The choice for ***Total Nitrogen (TN)*** is a placeholder, and will be operational as soon as EPA Region 1 completes current research project with UNH Stormwater Center for regionally-specific BMP performance data.

Background and Where to Get More Information

The BMP-PET is an interface tool that provides users with results of BMP performance modeling conducted by Tetra Tech, Inc for EPA Region 1. The BMP performance modeling project was conducted to develop credible long-term cumulative performance estimates for several types of BMPs that would be suitable for demonstrating compliance with stormwater permit requirements. The project used the EPA supported Storm Water Management Model (SWMM) to simulate hourly values of runoff volume and quality and the Prince George's County Best Management Practice Decision Support System, known as BMPDSS, to simulate continuous BMP performance for a regionally representative 11-year hourly precipitation record (1994-2004). The models were calibrated using flow and quality data collected at the University of New Hampshire's Storm Water Center (UNHSWC) for several BMP types.

Long-term cumulative performance estimates were developed for each BMP type for numerous hydraulic capacities expressed in terms of depth of runoff from impervious surfaces ranging from a small BMP size of 0.1 inch depth of runoff up to a large BMP capacity of 2.0 inches of runoff depth. Each BMP type was modeled to represent the design specifications (other than capacity) provided in *the Structural BMP Specifications for the Massachusetts Stormwater Handbook (MassDEP 2008a)*. Details of the design standards used in the modeling project can be found at the following link:

http://www.mass.gov/dep/water/laws/v2c2.pdf

The BMP performance results were plotted to develop cumulative performance curves to allow for the estimation of BMP performance for hydraulic capacities other than those explicitly simulated in the project. The modeling approach, calibration process and all of the modeling performance results including the curves and charts that have been incorporated into the BMP-PET are presented in the project's final report, *Stormwater Best Management Practices (BMP) Performance Analysis, 2008.* This report can be accessed at the following link:

http://www.epa.gov/region01/npdes/stormwater/assets/pdfs/BMP-Performance-Analysis-Report.pdf

II. Care, Feeding, and Exercising your BMP-PET

Your BMP-PET is very friendly!

Feed this little beastie the best site-specific information you have available, and BMP-PET will estimate the performance results for you.

Click on selections from the following menus and buttons, all located on the single-page interface:

Step 1: Select source area

Source area land use choices include: *Commercial, Industrial, and Residential High, Medium, or Low*. Together, the land-use categories represent a wide range of pollutant loading rates with low-density residential representing the lowest loading rates and commercial representing the highest rates. Table 3-2 from the final report (see below) provides the individual pollutant loading rates simulated for each land-use category. You may select the source area based on the land-use, or, if you have information on the loading rate for the area of interest, you can select the source area land use that best represents the desired loading rate.

Step 2: Select BMP Type

The BMP-PET includes performance estimates for the following seven types of storm water BMPs, separated below into two general categories:

Infiltration BMPs (direct stormwater runoff into the ground)	*Surface infiltration*
	Infiltration trench
Non-Infiltration BMPs (with under-drains and impermeable liners)	*Bio-filtration*
	Extended dry detention pond
	Water quality wet swale (detention system)
	Gravel wetland system
	Porous pavement

While these 7 BMP types do not represent the full range of storm water controls available, the performance estimates may be used for BMPs that have not been explicitly modeled if the desired BMP has functionality that is similar to one of the simulated BMP types. Please note that only the surface infiltration and the infiltration trench BMP types were simulated to direct storm water runoff into the ground (i.e., infiltration). All of the other simulated BMPs represent practices that have either under-drains or impermeable liners and therefore, are not hydraulically connected to the sub-surface soils (i.e., no infiltration). Following are some simple guidelines for selecting the BMP type and/or determining whether the results of any of the BMP types provided are appropriate for another BMP of interest.

Surface Infiltration represents a practice that provides temporary surface storage of runoff (e.g., ponding) for subsequent infiltration into the ground. Appropriate practices for use of the surface infiltration performance estimates include infiltration basins, infiltration swales, rain gardens and bio-retention systems that rely on infiltration and provide the majority of storage capacity through surface-ponding.

Infiltration Trench is a practice that provides temporary storage of runoff using the void spaces within the soil/sand/gravel mixture that is used to backfill the trench for subsequent infiltration into the surrounding sub-soils. Performance results for the infiltration trench can be used for all subsurface infiltration practices including systems that include pipes and/or chambers that provide temporary storage. Also, the results for this BMP type can be used for bio-retention systems that rely on infiltration when the majority of the temporary storage capacity is provide in the void spaces of the soil filter media and porous pavements that allow infiltration to occur.

Bio-filtration is a practice that provides temporary storage of runoff for filtering though an engineered soil media. The storage capacity is typically made of void spaces in the filter media and temporary ponding at the surface of the practice. Once the runoff has passed through the filter media it is collected by an under-drain pipe for discharge. Depending on the design of the filter media manufactured or packaged bio-filter systems such as tree box filters may be suitable for using the bio-filtration performance results.

Extended Dry Detention Pond performance results should only be used for practices that have been designed in accordance with the design specifications for extended dry detention ponds provided in *the Structural BMP Specifications for the Massachusetts Stormwater Handbook (MassDEP 2008a)*.

Water Quality Wet Swale performance results should only be used for practices that have been designed in accordance with the design specifications for a water quality wet swale provided in *the Structural BMP Specifications for the Massachusetts Stormwater Handbook (MassDEP 2008a)*.

Gravel Wetland performance results should be used for practices that have been designed in accordance or share similar features with the design specifications for gravel wetland systems provided in *the Structural BMP Specifications for the Massachusetts Stormwater Handbook (MassDEP 2008a)*.

Porous Pavement performance results represent systems with an impermeable under-liner and an under-drain. *If porous pavement systems do not have an impermeable under-liner so that filtered runoff can infiltrate into sub-soils then the performance results for an infiltration trench may be used for these systems.*

Step 3: Select pollutant

Pollutant choices currently active in the BMP-PET include: ***Total Phosphorous (TP); Total Suspended solids (TSS); Total Zinc (Zn)***. These are common pollutants in stormwater runoff. BMPs have vastly different rates of removal for these different pollutants, depending on BMP design characteristics.

Step 4: Select Infiltration rate (For Infiltration BMPs Only)

The infiltration rate menu applies *only* to the two infiltration BMP types: ***Infiltration basin*** and ***Infiltration trench***. Performance estimates for the infiltration practices require selection of an infiltration rate from the menu. Performance estimates have been generated for 6 different infiltration rates: 0.17, 0.27, 0.52, 1.02, 2.41, and 8.27 in/hr. BMP-PET will automatically use the lowest value of 0.17 in/hr unless another rate is specified.

Step 5: Select filter course depth (For Porous Pavement BMP only)

The filter course depth menu applies *only* to the ***Porous pavement*** BMP. Performance estimates have been generated for 4 different filter course depths: 12, 16, 18, and 22 inches. BMP-PET will automatically use the lowest value of 12 inches unless another depth is specified.

Step 6: Specify your BMP size OR target removal efficiency

In one of the two white boxes beneath the menus arrayed in the tool, enter either:

- The ***size of BMP*** in terms of inches of runoff treated (0-2) inches in the left box

  OR

- The ***target BMP removal efficiency*** in terms of percent (0-100) % in the right box

Step 7: Press the middle button to ***Extrapolate from curves***

Your results will appear in the yellow boxes!

Exercise this little beast vigorously for optimal results! - Run each BMP selected for each of the pollutants, check out the different performance among BMP types for the same site, run this puppy through its paces, and play!

Remember to:

- Push the ***Reset*** button (bottom left corner) between each run.
- Push the ***Exit*** button (right left corner) when you are finished.

III. Examples of Why and How to use your BMP-PET

The results of this friendly tool can be used by:

- **MS4 communities** to track changes in impervious cover (reduction in impervious cover is estimated to be equivalent to reduction in stormwater volume) in their watersheds as they install infiltration BMPs and implement their SWIPs, or to calculate stormwater volume and effective impervious cover reduction for work already done.

- **Watershed stakeholders** required to estimate BMP pollutant removals in order to qualify for state non-point source program (Clean Water Act 319) funds for the development of watershed based management plans.

- **State and local regulators** required to determine if new development permit proposals will satisfy anti-degradation provisions in state water quality standards – will the BMPs be adequate to protect lakes and streams from excessive stormwater discharges e.g. ensure post-development annual stormwater flow volume and pollutant load are comparable to pre-development conditions ?

Example calculations using the BMP-PET:

1. If you want to estimate the actual pollutant load reduction in lbs/yr from a site as a result of a particular BMP installation:

- Estimate appropriate BMP size, depth of runoff in inches (Effective Volume of BMP/Drainage Area).
- Estimate corresponding percent load reduction from BMP-PET
- Estimate the pre-BMP load by multiplying the area of the site by the appropriate factor in Table 3-2_excerpted below from the 2008 report, *Stormwater Best Management Practices (BMP) Performance Analysis* report page 17 to get the estimated annual pre-BMP pollutant load from the site
- Multiply this pre-BMP load by the percent load reduction (expressed as a fraction) obtained from the estimation tool to get the pollutant load reduction in lbs/yr.

Table 3-2. Summary of typical pollutant loading export rates from different land uses

Land cover/Source category	Pollutant loading export rates (lbs/ac-yr)			
	TSS	**TP**	**TN**	**Zn**
Commercial	1,000	1.5	9.8	2.1
Industrial	670	1.3	4.7	0.4
High-Density Residential	420	1.0	6.2	0.7
Medium-Density Residential	250	0.3	3.9	0.1
Low-Density Residential	65	0.04	0.4	0.04

Source: Shaver et al. 2007

2. If you want to estimate the effective impervious cover reduction from a site using an infiltration BMP in New England :

- Estimate appropriate BMP size, depth of runoff in inches (Effective Volume of BMP/Drainage Area).
- Estimate corresponding percent runoff volume reduction from BMP-PET
- Multiply the impervious area of the site being treated by the percent runoff volume reduction (expressed as a fraction) obtained from the estimation tool to get the effective impervious cover reduction.

3. If you want to estimate the stormwater runoff volume reduction from a site using an infiltration BMP in New England :

- Based on rainfall conditions for Boston, MA and most areas in New England (1998-2002)[1], an impervious acre generates 1.16 million gallons of runoff per year (MG/yr).
- Multiply this pre-BMP runoff volume 1.16 million gallons per year (MG/yr per acre treated) by the percent runoff volume reduction (expressed as a fraction) obtained from the estimation tool to get the runoff volume reduction per year in MG/yr per impervious acre treated.

4. If you want to estimate the stormwater runoff volume reduction needed from a site using an infiltration BMP to maintain predevelopment annual runoff volumes in New England:

- Based on rainfall conditions for Boston, MA and most areas in New England (1998-2002), an impervious acre generates 1.16 million gallons of runoff per year (MG/yr). Assuming your desired target stormwater runoff volume is that of predevelopment conditions, if that same acre was wooded with a hydrologic soil group C (HSG C) the estimated annual runoff volume would be 0.29 MG/yr. The difference between the existing runoff total and target runoff volume (0.87 MG/yr), expressed as percentage of total [(1.16 – 0.29) /1.16], results in a necessary 75% reduction in annual runoff volume.

- For a one-acre site needing 75% reduction in annual runoff volume to achieve predevelopment runoff volume conditions, select an infiltration BMP and appropriate infiltration rate, e.g. 0.17 in/hr and an infiltration trench, and iteratively select runoff depths (left side of screen) to determine what size BMP would achieve a 75% annual runoff volume reduction. BMP-PET identifies an infiltration trench with a storage capacity of 0.8 inches of runoff depth from the impervious area (0.8 in/12 in/ft*43,560 SF = 2,904 CF) to achieve a 75 % reduction in annual runoff volume.

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[1] Among 12 selected weather stations throughout New England, the overall average annual precipitation is 42.29 inches, as indicated in Table 2-1 (Tetra Tech 2008). The average annual precipitations of 33.89 inches at Burlington VT, is the only location with notably different (lower) rainfall than the other 11 stations, so use of the regional model for areas in western VT would yield conservative BMP design estimates.