Note to Readers:
This document is intended to be used in conjunction with model stormwater bylaw language regarding TMDLs. It provides specific guidance for applicants and stormwater authorities to implement the bylaw in areas subject to a pathogen (bacteria) TMDL. Other model guidance documents may be available for other pollutants subject to TMDLs. Items highlighted in yellow will need to be replaced with town-specific information. August 14. 2013.

TOWN NAME HERE Stormwater Management Bylaw
Total Maximum Daily Load (TMDL) Provision

Guidance for Permit Applicants Regarding Best Management Practices for Reducing Pathogen Pollution in Stormwater

Pathogen Reduction Requirement
In order to comply with applicable Pathogen (Bacteria) TMDL(s), [TOWN NAME HERE] requires that permit applicants under the TOWN NAME HERE Stormwater Bylaw treat the first inch of runoff from all impervious areas, referred to as the "one in water quality volume," using Best Management Practices (BMPs) that are consistent with TMDL load allocations and waste load allocations. This requirement applies to all geographic areas of TOWN NAME HERE.

All references below to the "MassDEP Stormwater Handbook" or "the Stormwater Handbook" or "the Handbook" refer to the 2008 edition of the Massachusetts Stormwater Handbook as published by the Massachusetts Department of Environmental Protection, or to the equivalent section of subsequent editions of that publication.

Demonstrating Compliance with Pathogen Reduction Requirement
Demonstrating compliance with the TOWN NAME HERE pathogen reduction requirement is a four step process. As described in greater detail below, all applicants must:

1) demonstrate that they have evaluated and implemented environmentally sensitive site design and low impact development techniques to minimize the volume of runoff being created and reduce or eliminate the volume being conveyed to discharge via closed drainage systems;

2) infiltrate or evaporate any remaining portion of the one inch water quality volume which is not fully addressed through step 1;

3) to the extent that site-specific constraints make it infeasible to address the one inch water quality volume in full as outlined in steps 1 & 2 above, utilize other "Pathogen-Effective" BMPs described below to treat any remaining portion of the one inch water quality volume; and

4) demonstrate that they have incorporated specific pollution prevention measures into their required stormwater operation and maintenance plans**.**

Step 1: Environmentally Sensitive Site Design and Low Impact Development BMPs
Thoughtful site design which minimizes impervious cover and "disconnects" impervious surfaces (i.e. directs runoff onto appropriately sized pervious areas rather than into hard piped conveyance systems) can dramatically reduce or even eliminate the volume of runoff that would

otherwise need to be addressed with more expensive structural BMPs. Such techniques are often described collectively as “low impact development” or “LID.” *Examples* include:

- Minimizing street and driveway widths, reducing street lengths with cluster design, shared driveways, reduced front yard setbacks, single sidewalks, vegetated cul-de-sacs, and structured parking.
- Replacement of impervious surfaces with porous alternatives.
- Preservation of existing vegetation, and avoidance of soil compaction.
- Designing impervious areas to drain onto adjacent lawns, parking lot islands, rain gardens and other porous surfaces, rather than directly into catch basins.
- Green roofs.

The MassDEP Stormwater Handbook (see Volume 3, Chapter 1, beginning on page 42) lays out criteria and procedures for computing credits for specific site design and low impact development BMPs. These credits may be used to reduce or eliminate the runoff volume to be treated in Steps 2 and 3.

Step 2: Infiltrate or Evaporate the Remaining Water Quality Volume
That portion of the first inch of runoff which has not been addressed using better site design and low impact development credits should be captured and disposed of through the use of infiltration BMPs, rainwater reuse or other measures that result in evaporation or consumptive use on site.

Note: Different sources may use similar sounding names to refer to different BMPs. Throughout this document we have used the same terminology to describe each BMP as found in th**e** MassDEP Stormwater Handbook. In some cases, names given to a BMP in other reference sources are given in parenthesis, along with any specific design requirements for TOWN NAME HERE.

Before discharging runoff from paved areas (excluding roofs) to infiltration practices, pretreatment must achieve 44% reduction of Total Suspended Solids (TSS), or 80% when using field-dynamic sizing.

The various types of infiltration BMPs, along with procedures for designing and sizing these BMPs, are outlined in the MassDEP Stormwater Handbook (*Volume 2, Chapter 2*). These infiltration BMPs include:

- Infiltration basins (Handbook page 86).
- Infiltration trenches (Handbook page 94).
- Infiltrating dry water quality swales (also referred to as infiltration swales; size swale to infiltrate the WQ volume; Handbook page 78).
- Subsurface infiltration structures (Handbook page 103).
- Dry wells (Handbook page 84).
- Leaching catch basins (only when each leaching catch basin is paired with a traditional off-line, deep-sump catch basin; Handbook page 100).
- Porous asphalt, porous concrete and porous pavers (Handbook page 118).
- Rain gardens and infiltrating bioretention cells (Handbook page 23).

The above practices must be sized separately for each catchment area, using the one inch water quality volume (or the remainder thereof after LID credits). Because the objective is water quality treatment rather than groundwater recharge, capturing and recharging an increased

depth of rainfall from only a portion of the site (i.e. recharging 2" of rainfall from 50% of the impervious area rather than 1" from 100% of the impervious) is not acceptable for compliance with the water quality treatment requirement.

Step 3: Treat Remaining Water Quality Volume Using other Pathogen-Effective BMPs
Infiltration and evaporation are the only stormwater management BMPs which have demonstrated the ability to consistently meet the pathogen reduction targets of the TMDL(s) applicable to TOWN NAME HERE. Where site constraints make it infeasible to infiltrate all of one inch water quality volume remaining after LID credits, applicants shall use one of the "Pathogen Effective" BMPs described below to treat the remaining water quality volume that is not fully addressed in Step 2.

The Pathogen Effective BMPs listed below are presumed to meet the pathogen TMDL requirements of the TOWN NAME HERE Stormwater Bylaw only when infiltration is not feasible and when the BMPs are sized to treat the remainder of the one inch water quality volume in accordance with the guidelines in the MassDEP Stormwater Handbook regarding applicability, design, sizing, pretreatment, construction and maintenance**.** Any specific design requirements for Town Name Here are noted in parenthesis.

Pathogen Effective BMPs include the following specific practices:

Filtration Practices

- Filtering bioretention cells (when furnished with an underdrain; Handbook page 23).
- Filtering dry water quality swales (the WQ volume is retained, filtered and discharged via an underdrain; also sometimes referred to as bioretention swales or biofilter swales; not to be confused with drainage channels or grassed channels; Handbook page 78).
- Sand and organic filters, including tree filter boxes (underdrains should not discharge to a catch basin sump; alternate configurations are sometimes known as tree pits, tree channels, green gutters, or stormwater planters; Handbook page 57).
- Porous pavements (although normally used as an infiltration practice, porous pavements can also be utilized as a filtration practice when provided with an appropriate reservoir/filter course and underdrain; Handbook page 118).

Constructed Stormwater Wetlands and Wet Basins

- Shallow marsh wetlands (Handbook page 38).
- Pocket wetlands (Handbook page 41).
- Basin/wetland systems (Handbook page 39).
- Extended detention wetlands (Handbook page 40).
- Gravel wetlands (may arguably be considered a filtration practice; Handbook page 47).
- Wet basins (with appropriate permanent pool volume and length to width ratio; Handbook page 63).
- Wet water quality swales (not to be confused with drainage channels or grassed channels; Handbook page 79).

Alternative Best Management Practices
If an applicant would like to use a BMP not discussed above which it believes is effective at reducing pathogen pollution, the applicant should submit appropriate technical documentation demonstrating the effectiveness of the proposed BMP for consideration by the NAME OF STORMWATER AUTHORITY HERE. Performance information should include third-party testing.

Pathogen-Ineffective Best Management Practices

Many conventional BMPs are ineffective at removing pathogens and dissolved pollutants, and may substantially exacerbate pathogen concentrations in stormwater runoff. While some of these BMPs may play and important role as pre-treatment or volume-control BMPs, they are not considered effective at removing pathogens on their own, nor should they be used as the terminal BMP in a treatment train.

These pathogen-ineffective BMPs include:

- Catch basins. Treated effluent from a Pathogen-Effective BMPs should never be routed through a catch basin sump.
- Oil and grit separators,and proprietary separators (including particle separators and hydrodynamic separators).
- Sediment forebays.
- Rock lined swales, drainage channels, and grassed swales designed for conveyance rather than water quality. These conveyance practices should not be confused with dry and wet water quality swales, which are designed to retain and treat the water quality volume through media filtration, infiltration or permanent ponding as further described in the MassDEP Stormwater Handbook.
- Dry detention basins, and extended dry detention basins (though in some cases these BMPs may be reconfigured as wetland detention basins which are Pathogen-Effective).

Redevelopment Projects

If an applicant for a redevelopment project wishes to assert that site conditions do not allow the one inch water quality volume to be fully addressed using one or more of the BMPs outlined in Steps 1-3 above, the applicant must submit a narrative justification explaining what specific BMPs were considered and why they could not be implemented. The justification must be prepared at a sufficient level of detail to enable the NAME OF PERMITTING AUTHORITY to make a determination as to the credibility of the assertion and should, at a minimum, address the following points:

- Describe what site design and low impact development BMPs are utilized to reduce the quantity of runoff generated. If there are catchment areas for which no such BMPs are utilized, or for which only a portion of the catchment is managed using such BMPs, describe which site design and low impact development BMPs were considered and why they were deemed infeasible.

- Describe what infiltration and/or consumptive-use BMPs are used to treat the remainder of the one inch water quality volume. If there are catchment areas where no such BMPs are proposed, or where such BMPs treat less than the required water quality volume, describe for each such catchment area why each of the infiltration/consumptive-use BMPs listed above could not be implemented, addressing site constraints such as tight soils, shallow groundwater, contaminated soils or bedrock. Discuss what measures were considered that would at least partially meet the infiltration requirements. For each such catchment area, identify the remaining portion of the one inch water quality volume to be treated using Pathogen-Effective BMPs.

- If there are catchments where none of the Pathogen-Effective BMPs listed above are proposed, or where the full remaining water quality volume is not treated with Pathogen-Effective BMPs, describe what portion of the water quality volume is not fully treated,

why site conditions don't permit each of the Pathogen-Effective BMPs listed above to be implemented, and what measures were considered that would at least partially meet the pathogen requirements.

Step 4: Pathogen Effective Pollution Prevention Measures
In addition to the structural and non-structural (LID) BMPs outlined above, all applicants must address pollution prevention practices targeting pathogens in their required Operation and Maintenance Plan. Pollution prevention practices vary widely depending on the use of a site. Some pollution prevention practices which are effective at reducing pathogens include:

- Regular street sweeping, particularly when more efficient vacuum sweeping equipment is used.
- Frequently patrolling paved and unpaved areas to remove litter, garbage and pet waste.
- Minimizing the use of water or pressure washers to clean paved surfaces.
- Ensuring that dumpsters are kept under cover (i.e. not exposed to rainfall or, if outdoors, located away from directly connected paved areas and/or kept tightly sealed).
- Educating site users (employees, customers, residents) about appropriate pest waste management through signage, educational literature, installation of mutt-mitt stations or other measures.
- Educating site users (employees, customers, residents) not to dump anything into catch basins (i.e. pet waste, wash water, etc.) through signage, storm drain markers and informational literature or training activities.
- Discouraging unnatural concentrations of waterfowl, vermin and other wildlife through proper management of garbage, and educating site users not to feed wildlife.
- Inspecting all storm drain outfalls at least annually for indicators of potential illicit connections of sewer or septic flow to the storm drain system. Indicators include outfalls with odors, heavy algae growth, white or gray sediments, or flow during periods of dry weather. Follow up tests should be performed promptly on any suspicious outfalls.

Background on Bacteria TMDL(s)
Projects subject to TOWN NAME's Stormwater Bylaw and projects in TOWN NAME which are subject to the jurisdiction of the Massachusetts Wetlands Protection Act Regulations are required to implement BMPs that are consistent with any applicable Total Maximum Daily Loads (TMDLs).

A TMDL is a plan for reducing the levels of a specific water pollutant that is causing a waterbody to violate state surface water quality standards. TMDLs are required by the Federal Clean Water Act and are developed and/or approved by state and federal authorities. Under a TMDL, the amount of a pollutant that may be discharged by storm drains or discharge pipes is known as a "waste load allocation," while the amount that may be discharged from other nonpoint sources is known as a "load allocation."

The Municipal Separate Storm Sewer System (MS4) general permit issued to TOWN NAME by the US Environmental Protection Agency, along with requirements of the Wetlands Protection Act Regulations issued by the Massachusetts Department of Environmental Protection, make TOWN NAME responsible for complying with TMDLs and ensuring that private development and redevelopment projects also comply.

Over time, new TMDLs may be developed, old TMDLs may be modified, and scientific information on the effectiveness of various stormwater BMPs may be subject to change. NAME

OF STORMWATER AUTHORITY has prepared this pathogen TMDL guidance document to assist permit applicants in complying with TMDL requirements. This document will be updated periodically as needed to reflect changing information.

The following pathogen and bacteria TMDLs have been approved by MassDEP for TOWN NAME. Taken together these TMDLs cover all areas of TOWN NAME.

- TMDL of Bacteria for Neponset River Basin (CN 121.0) and TMDL Addendum
- Final Pathogen TMDL for the Charles River Watershed, January 2007 (CN 0156.0)

Both of these TMDLs use a concentration-based approach for setting load- and waste-load allocations, and both use fecal coliform as the indicator organism. The load and waste load allocations for stormwater runoff are:

> "Not to exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms."

The Addendum to the Neponset Bacteria TMDL uses E. coli and enterococcus as indicator organisms. While the specific load allocations and waste load allocations have slightly different thresholds depending on the indicator organism used, the procedures for demonstrating compliance with the TOWN NAME pathogen requirements are the same.

As recommended by the TMDLs, TOWN NAME uses a BMP-based approach to evaluating compliance with Pathogen TMDL requirements. Rather than requiring applicants to collect water quality samples to demonstrate ongoing compliance with TMDLs, TOWN NAME requires applicants to implement and properly maintain structural and non-structural BMPs that are effective in reducing bacterial pollution.

MassDEP has developed Watershed Based Plans to guide efforts to address point and nonpoint sources of pollution. The Technical Memoranda for the Neponset and Charles River Watershed Based Plan(s) establish event mean concentrations (EMCs) for fecal coliform in stormwater runoff for various land uses. The table below summarizes EMCs for Fecal Coliform for the various land uses found in TOWN NAME HERE and the level of pollutant reduction required to comply with the TMDL load allocation and waste load allocations. The requirements and procedures outlined above have been designed to ensure that stormwater discharges in TOWN NAME HERE are consistent with TMDL requirements.

Land Use Category	**EMC Fecal Coliform[1] (#/100ml)**	**% Reduction to meet TMDL LA and WLA**
Agricultural/pasture	5,000	96%
High Density Residential	16,901	99%
Medium Density Residential	12,360	98%
Low Density Residential	2,950	93%
Industrial	1,467	86%
Commercial	9,306	98%
[1]MassDEP Technical Memoranda Neponset and Charles Watershed-Based Plan(s)		

Additional Resources

A wide variety of resources are available to help identify and implement appropriate stormwater BMPs. The following references may be particularly useful and were relied upon in large part for the development of this guidance document. All are readily available online.

- The MassDEP Stormwater Handbook (Volume 2 Chapter 2) identifies some of the BMPs that are effective at removing pathogens from stormwater runoff. The Handbook defines each of the BMPs referenced above, and describes critical pre-treatment, siting, planning, and design considerations.

- The MassDEP and US EPA prepared a document titled "Mitigation Measures to Address Pathogen Pollution in Surface Waters: a TMDL Implementation Guidance Manual for Massachusetts." This document provides information on a variety of pathogen BMPs.

- The MassDEP has developed the "Massachusetts Nonpoint Source Pollution Management Manual" which provides useful fact sheets on numerous BMPs, many of which are helpful in efforts to control pathogens in stormwater.

- The Metropolitan Area Planning Commission has prepared the "Low Impact Development Toolkit" which provides useful advice on a variety of low cost techniques to reduce stormwater runoff volumes, and treat polluted runoff.