Protocol for Total Suspended Solids Removal Based on Field Testing
Amendments to TARP Protocol
Dated August 5, 2009, Revised December 15, 2009

The New Jersey Stormwater Management Rules at N.J.A.C. 7:8-5.5 require "major development" projects to remove 80% of the total suspended solids (TSS) from the projects' post-developed runoff. To help achieve this requirement, Table 2 at N.J.A.C. 7:8-5.5(c) provides a list or approved TSS removal rates for constructed stormwater best management practices (BMPs). However, the Rules presently specify at N.J.A.C. 7:8-5.7(d) that approved TSS removal rates for manufactured treatment devices (MTDs) must be verified by the New Jersey Corporation for Advanced Technology (NJCAT) and then certified by the New Jersey Department of Environmental Protection.

Final performance certification or acknowledgement of such devices is to be based upon the results of field testing of a selected MTD performed in accordance with the following requirements. These requirements have been based, in general, upon the Technology Acceptance Reciprocity Partnership (TARP) Protocol for Stormwater Best Management Practice Demonstrations. However, to meet the specific requirements of the Stormwater Management Rules, the NJDEP has modified and/or expanded portions of the TARP Protocol. Amended portions are indicated as revisions, while new portions are indicated as additions to the existing TARP Tier II Protocol.

Certification or acknowledgement of an MTD shall be given by NJDEP shall be based upon the results of a series of tests of the MTD performed in accordance with the requirements of this protocol and the following signed statements:

A signed statement from the verification entity listing the protocol requirements and indicating that all of the requirements of the protocol were met or exceeded. Such statement must detail how any deviations to the protocol exceeds the requirements and that no mathematical adjustments were done to account for the deviations unless prior written agreement from the NJDEP was obtained. The submission from the verification entity for NJDEP acknowledgement or certification shall only be accepted for review if the package includes all of the required signed statements indicating that all of the protocol requirements were met or exceeded.

A written and electronic report from the verification entity that includes verified TSS removal rates, recommended TSS removal rates, and all items required for submission outlined in **TARP Seciton 6. Submission Requirements for MTD Verification and Certification or Acknowledgement** for the subject MTD. The format of the design and maintenance document shall be similar to the non-proprietary BMPs currently in the New Jersey Stormwater Best Management Practices Manual.

A signed statement from the manufacturer listing the protocol requirements and indicating that all of the requirements were met or exceeded.

A signed statement from the testing entity, if different from the manufacturer, listing the protocol requirements and indicating that all of the requirements for testing were met or exceeded.

In reviewing both the TARP and NJDEP requirements, it is important to note that the New Jersey Stormwater Management Rules specifically require the removal of total suspended solids (TSS) from stormwater runoff. This requirement was mandated through NJPDES Municipal Stormwater Phase rules in compliance with the requirements by the USEPA Stormwater Phase II Final Rule. In addition, the removal rates for constructed BMPs contained in Table 2 at N.J.A.C. 7:8-5.5(c) are specifically for TSS. Therefore, in

compliance with the requirements of both the USEPA and New Jersey Rules and for consistency with the removal rates for constructed BMPs published in the New Jersey Rules, the final certification or acknowledgement requirements for MTDs presented below specifically require the measurement of TSS during field testing.

It should be noted that these NJDEP requirement differ from the standard requirements of the TARP Protocol. As such, the data may or may not be accepted as reciprocal data by other TARP States. Guidance regarding the acceptance of the data under this revised protocol must be obtained for each State, as applicable.

TARP Section 1 – Introduction

No NJDEP Revisions or Additions.

TARP Section 2.1 – Preparation

No NJDEP Revisions or Additions.

TARP Section 2.2 – Stormwater BMP Screening for Validation

Addition 1: Site Characterization Sampling: Storm event sampling shall be performed for both site characterization and device performance. Site characterization sampling should be performed prior to final test site selection and approval. The hydrologic condition of the site must remain essentially unchanged between site characterization and device performance testing.

A minimum of 3 storm events shall be tested to characterize a site. As such, the site characterization sampling location shall be chosen so that the size and hydrologic characteristics of the sampled runoff's drainage area is as representative as possible of the expected drainage area to the device to be tested. See TARP Section 3.3 – Stormwater Data Collection Guidance as revised below for individual storm event requirements.

Site characterization sampling shall include TSS sampling, particle size sampling, and continuous flow measurements of the site runoff expected to enter the device. Samples of the influent to the device shall be taken and analyzed for TSS in accordance with Standard Method APHA 2540D. In addition to TSS, samples may also be collected and analyzed for Suspended Solids Concentration (SSC) in accordance with ASTM Method D3977-97. Such data may then be utilized to obtain average influent and effluent SSC concentrations and load rates in the same manner as that for TSS. If developed, such sample data, analytic results, and computations should also be provided as part of the submittal for interim certification or acknowledgement. This information will provide a more robust database comparing TSS and SSC removal rates that may inform future changes by the NJDEP to these testing requirements.

The analysis of stormwater shall be conducted by an independent laboratory, and the field sampling shall be overseen by an independent party.

If the manufacturer is using its site and an independent observer, the observer shall meet the following requirements:

i) The observer shall have no personal conflict of interest regarding the test results.

ii) The observer shall have experience in a hydraulics, sampling and sedimentation lab, be familiar with the test and lab methods specified in this standard and have professional expertise in an appropriate discipline.
iii) The observer shall approve the experimental set-up and field testing protocol and observe the test for a minimum of 25% of the qualifying storm events for performance testing and all of the site characterization testing.
iv) The qualifications of the observer are subject to approval by the verification entity.

All samples shall be analyzed by an independent laboratory that either has New Jersey Environmental Laboratory Certification using the standards published at N.J.A.C. 7:18, "Regulations Governing the Certification of Laboratories and Environmental Measurements" or New Jersey National Environmental Laboratory Accreditation using the 2003 NELAC Standard and incorporated by reference at N.J.A.C. 7:18-1.5(d).

Either flow-weighted composite samples or discrete samples shall be collected and analyzed to determine a flow-weighted average TSS concentration, a flow-weighted particle size distribution (PSD), and a flow-weighted median particle size for each storm event sampled for site characterization.

In order to qualify as an approved test site:

1. The arithmetic average TSS concentration of the weighted average TSS concentration for each sampled storm must be not exceed 100 mg/l. In addition, the weighted average TSS concentration for an individual storm event included in the arithmetic average must not exceed 300 mg/l.

2. The arithmetic average particle size of the weighted median particle size for each sampled storm must not exceed 100 microns. In addition, the weighted median particle size for an individual storm event included in the arithmetic average must not exceed 200 microns.

While a minimum of 3 storm events must be sampled for site characterization, the arithmetic average TSS concentration and PSD described above must be based upon all sampled storms.

TARP Section 2.3 - Technology Specifications

Addition 1 – Maximum Conveyance and Treatment Flow Rates: The MTD selected for field testing must have Maximum Treatment Flow Rate (MTFR) that is no less than 75% and no greater than 125% of the computed peak runoff rate from the test site's drainage area to the MTD for the New Jersey Stormwater Quality Design Storm. This peak runoff rate is to be computed based upon pertinent drainage area characteristics in accordance with procedures contained in Chapter 5 – Computing Stormwater Runoff Rates and Volumes of the *New Jersey Stormwater Best Management Practices Manual*. If a device with such an MTFR is not manufactured, consideration should be given to adjusting the size of the drainage area to achieve the required Stormwater Quality Storm peak. If such diversions are not practical, the verification entity, with written agreement from NJDEP, may allow adjustments on a case-by-case basis.

The maximum conveyance flow rate (MCFR) of a MTD is the highest flow rate that can be conveyed through all of the MTD's treatment components without overflow, bypass, or surcharging. For filters, the maximum conveyance flow rate (MCFR) may not bypass the filter media. In filter MTDs that discharge intermittently at a constant flow rate through the use of float valves or similar mechanisms, the MCFR shall equal the maximum flow rate that can pass through the MTD without bypassing the filter media with the float valves in the fully open position.

The maximum treatment flow rate (MTFR) of a hydrodynamic MTD is the highest flow rate that can be conveyed through all of the MTD's treatment components without excessive scouring of accumulated sediment. The maximum treatment flow rate (MTFR) of a filter MTD is the highest flow rate that can pass through the MTD's filter media without excessive clogging (and subsequent loss of filter media flow capacity). The MTFR must also achieve the TSS removal rate and sediment and other maintenance intervals claimed by the manufacturer. As such, an MTD's MTFR will be equal to or less than the MTD's MCFR.

Once specified by the manufacturer and approved by the verification agency (see below), a device's MTFR will be used to determine the range of storm events that need to be included in the field testing as well as the device's minimum maintenance interval and maximum drainage area. The MTFR of the tested device will also serve as the basis for determining the MTFR of smaller and larger versions of the tested device. Finally, a device's MTFR will also be specified in the certification or acknowledgement and, as such, will be a key parameter in the selection of the device size required to meet the requirements of the New Jersey Stormwater Management Rules.

The MCFR and MTFR of a device must be determined through laboratory testing in accordance with the NJDEP's Protocols for Manufactured Hydrodynamic and Filtration Devices for TSS Removal Based on Laboratory Analysis. If a device's MTCR and MTFR have previously been determined during certification or acknowledgement lab testing and approved by the verification entity, these flow rates shall also be used during final field testing (as described herein) without further testing. Please see these Laboratory Analysis Requirements for additional details regarding MCFR and MTFR determination, including 1) required pre-approval of the flow and water level conditions to be used to establish MCFR and MTFR and 2) the need to develop a flow equation that can be used to compute the MCFR and MTFR of larger and smaller versions of the tested device.

Addition 2 - Grates and Trash Racks: During field testing for device performance, runoff to a device that utilizes filtration and/or sedimentation to remove TSS may first be conveyed through a grate or trash rack to help remove trash, debris, and other large material that may block the device's filter. The openings of such racks or grates must have an area of no less than seven (7) square inches or is be no less than 0.5 inches across the smallest dimension. If such a grate or trash rack is utilized during field testing, details of the grate/rack shall be submitted to the verification agency for review and approval prior to field testing as part of the submitted Technology Specifications described in TARP Section 2.3 - Technology Specifications as revised above. In addition, final NJDEP certification or acknowledgement of a device that was field tested with a grate/rack will require that such a grate/rack always be included wherever the device is installed.

TARP Section 2.5 – Test QA Plan Scope

No NJDEP Revisions or Additions.

TARP Section 3.1 – Standardized Test Methods and Procedures

Revision 1: TSS shall be analyzed in accordance with Standard Method APHA 2540D.

Revision 2: Particle size distributions (PSDs) shall be determined through an appropriate method or combination of methods. Such methods may include, but is not limited to, the following:

1. Sieve Analysis
2. Coulter Counter
3. Hydrometer

4. Laser Diffraction

The selected methods to be used for PSD determination shall be included in the submitted Technology Specifications described in TARP Section 2.3 - Technology Specifications as revised above.

TARP Section 3.2 – Data Quality Assurance Project Plan

Addition 1: The prepared Quality Assurance Project Plan (QAPP) must be submitted to the verification entity for review and approval prior to the start of field testing.

TARP Section 3.3 – Stormwater Data Collection Guidance

Addition 1: With the exception of one storm sampled for device performance:

1. The maximum 15-minute rainfall intensity for any storm sampled for either site characterization or MTD performance shall be 5 inches per hour (i.e., 1.25 inches in 15 minutes).

2. The maximum total rainfall for any storm sampled for either site characterization or MTD performance shall be 3 inches.

3. As noted above, one storm sampled for MTD performance may exceed requirements 1 and 2 above.

Addition 2: The water level in the tested device shall be continuously recorded throughout the overall field testing program, including during non-sampled storms and non-rainfall days. The range of water levels to be recorded shall extend from below the normal, low flow or dry weather level in the device to a level that exceeds the water level at the device's MTCR. Upon completion of the field testing, the recorded water levels shall be plotted along with the rainfall also recorded over the field testing program (see Revision 5 below). This plot shall be submitted as part of the overall Stormwater BMP Demonstration Report as described in TARP Section 6 – Report Contents for Verification/Certification as revised below. This submittal shall also include a discussion of any anomalous, irregular, or missing rainfall or water level data.

Addition 3: All accumulated sediment must be removed from the tested device when the amount exceeds 50% of the device's Maximum Sediment Storage Depth and Volume as defined in the NJDEP's Protocols for Interim Hydrodynamic and Filtration Devices for TSS Removal Based on Laboratory Analysis. In addition, all filters must be recommissioned or replaced as appropriate when the flow rate through the filters is known to be less than 90% of the device's Maximum Treatment Flow Rate (MTFR) as defined above when the water level in the device upstream of the filters is at the level normally associated with the device's MTFR.

Addition 4: All maintenance performed on the tested device at any time during the overall field testing program, including any maintenance performed in accordance with Addition 3 above, shall be reported as part of the overall Stormwater BMP Demonstration Report as described in TARP Section 6 – Report Contents for Verification/Certification as revised below. This reporting shall include a description of each maintenance task performed, the reason(s) for the maintenance, the quantities of any sediment removed, and a discussion of any anomalous, irregular, or missing maintenance data.

Addition 5: In order to determine the tested device's required maintenance interval, the minimum duration of the overall field testing program shall be one year beginning at the time of the device's installation, commissioning or the beginning of the removal rate testing, whichever is greater.

Revision 1: In order to qualify for either site characterization or device performance sampling, a storm event must have a minimum total rainfall depth of 0.1 inches.

Revision 2: The inter-event dry period between successive storm events shall begin when runoff from the first storm ceases.

Revision 3: The minimum number of storms to be sampled for device performance shall be a minimum of 20, although 25 or more are recommended. Sampled storms do not need to consecutive. The peak runoff rate from at least three of these storms shall exceed 75% of the device's MTFR. The minimum total rainfall for all storms sampled for device performance shall be 15 inches. The sampling and performance results for all sampled storms must be reported and included in all performance, maintenance interval, and cost computations.

Revision 4: The minimum number of samples to be collected for either site characterization or device performance during a sampled storm shall be 10 for storms lasting 1 hour or more. The minimum number of samples for a sampled storm lasting less than 1 hour shall be 6. Samples shall be taken over time so that a minimum of 70% of a sampled storm's total runoff volume is included in the sampling.

Revision 5: Rainfall during sampled storm events shall be recorded continuously throughout the event with maximum time interval of 5 minutes for runoff collection based on time and a maximum rainfall interval of 0.01 inches for runoff collection based on volume. In addition, rainfall shall also be recorded continuously throughout the overall field sampling program. Rainfall from non-sampled storm events may either be recorded by the same rain gage used for sampled storms or obtained from a nearby rain gage provided that such gage has a minimum recording interval of 1 hour. If such a gage is used to record non-sampled storms, the name, location, recording interval, and operator of the gage shall be submitted to the verification entity for review and approval prior to field testing as part of the submitted Technology Specifications described in TARP Section 2.3 - Technology Specifications as revised above.

Revision 6: Device influent and effluent sampling shall be performed at locations upstream and downstream of any device diversions and/or bypasses so that the entire sampled storm runoff (including diverted or bypassed runoff) can be included in the sampling.

TARP Section 3.4 – Statistical Testing of Data

No NJDEP Revisions or Additions.

TARP Section 4 – Health and Safety Plans

No NJDEP Revisions or Additions.

TARP Section 5 – Cost Information

No NJDEP Revisions or Additions.

TARP Section 6 – Report Contents for Verification/Certification or Acknowledgement

Addition 1:
In addition to the information listed above and the requirements for report contents in the TARP protocol, verification/certification reports must also include the following information:

Description of Technology
Describe how the device works, including its physical, chemical, and/or biological treatment functions. The description must include the main treatment processes in the device and any ancillary processes required for the unit to function in accordance with the performance claim with respect to the pollutants of concern. The report should also indicate what other types of BMPs, based on their treatment processes, can or cannot be used in series with the device to provide enhanced removal rates.

A comparison to the design of the standard BMP as shown in the New Jersey Stormwater Best Management Practiced Manual should be provided where applicable. (For example, a wet pond's pollutant treatment is mainly based on the residence time of the permanent pool, the volume, and the drawdown time of the water quality design storm above the permanent pool. A pool/drawdown MTD should at a minimum provide these comparisons.)

Installation requirements
Provide installation criteria such as soil characteristics, slope, and limitations on tailwater, and depth to seasonal high water table that are important to ensure the performance of the device.

Maintenance Plans
Maintenance plans must contain specific preventative and corrective maintenance information. All maintenance documents must be written in non-technical language. In order to ensure incorporation of appropriate maintenance, a detailed maintenance plan for each MTD must be provided that incorporates the following:

- Minimum required maintenance frequency for each component in order to achieve the annual TSS removal rate.
- Description of what conditions trigger the need for maintenance and how neglect of specified maintenance activities (e.g., sediment removal, filter media replacement, oil removal) causes BMP underperformance;
- Location of Access Points and type of inspection needed – whether above ground or underground;
- Training needed to Perform Maintenance. This may include training videos to be made available to maintenance staff.
- Equipment needed for maintenance and discussion of obtaining replacement parts. This must indicate what portions of the device are only available through the vendor.

Units
All dimensions must be consistent with standard units utilized in stormwater management design: **Length/distance**: inches, feet; **Area**: square feet, acres; **Volume**: cubic feet; **Velocity**: feet per second; and **Flowrate**: cubic feet per second.

TARP Appendix A

This flowchart is no longer applicable.

TARP Appendix B New Jersey

Addition 1: Standard Method APHA 2540D

TARP Appendix C

No NJDEP Revisions or Additions.

TARP Appendix D

The New Jersey State Standards have been superseded by the "Process for Certification of Manufactured Treatment Devices As Of May 15,2009 through the Effective Date of the Stormwater Management Rules at N.J.A.C. 7:8," dated May 15, 2009 available through www.njstormwater.org.

TARP Appendix E – Stormwater BMP Demonstration Summary

No NJDEP Revisions or Additions.

TARP Appendix F – QAPP Groups and Elements

No NJDEP Revisions or Additions.

TARP Appendix G – Web Sites for Developing Stormwater Test QA Plans

No NJDEP Revisions or Additions.

TARP Appendix H – Bibliography

Addition 1: USDA NRCS Soil Survey Manual, 1997.