New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device

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Contents

1. Overview

This document is the laboratory testing procedures required for a stormwater filtration manufactured treatment device (MTD) seeking verification in the State of New Jersey, as required by the Stormwater Management Rules, N.J.A.C. 7:8. This document shall be adhered to by manufacturers, New Jersey Corporation for Advanced Technology (NJCAT) and entities performing or overseeing the testing of a filtration MTD to meet that verification requirement.

Significant Digits

For purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded "to the nearest unit" in the last right-hand digit used in expressing the specification limit, in accordance with the rounding method of ASTM Practice E29, for Using Significant Digits in Test Data to Determine Conformance with Specifications. For example, 20.0 mg/L limit shall mean that the concentration shall be accurate to the tenth place and the final value shall be reported with three significant digits (i.e., a measured value of 20.065 mg/L shall be reported as 20.1 mg/L). 200. mg/L limit shall mean that the concentration shall be accurate to the ones place and the final value shall be reported with three significant digits (i.e., a measured value of 198.506 mg/L shall be reported as 199. mg/L).

2. Definitions

Commercially Available

Means available for purchase, with operational components at full size, identical dimensions, and configurations, and comprised of materials specified for commercial use, except for the housing or other structural components that do not affect hydraulic performance, which are specifically used to facilitate laboratory testing.

Detention Time

The period of time during TSS Removal Efficiency Testing that is calculated by dividing the operational wet volume of the filtration MTD by the flow rate during the test run.

Effective Filtration Treatment Area (EFTA)

The surface area of the filtration media perpendicular to the flow path and depth of media within a filtration MTD.

Effective Sedimentation Treatment Area (ESTA)

The entire area within the MTD where sedimentation occurs, including any pretreatment chambers or areas where sediment is known to collect outside of the primary sediment capture and storage location.

Maintenance Sediment Storage Depth and Volume

The maintenance sediment storage depth and volume of a Filtration MTD represents the amount of sediment that can accumulate in the MTD prior to maintenance, as recommended by the manufacturer and confirmed via scour testing.

Maximum Treatment Flow Rate (MTFR)

The highest flow rate that can be conveyed through a Filtration MTD to achieve performance-based claims for total suspended solids (TSS) removal described in this protocol.

Off-line

An MTD configuration in which flow rates up to the MTFR are routed into the treatment chamber of the

MTD and all flows in excess of the MTFR are diverted around the treatment chamber of the MTD via an upstream bypass or diversion.

On-line

An MTD configuration in which flow rates in excess of the MTFR are permitted to flow through the treatment chamber of the MTD.

Sediment Mass Loading Capacity

The maximum mass of test sediment that can be captured by the filtration MTD prior to either an unacceptable loss of hydraulic capacity at design driving head, unacceptable head loss at MTFR, or an unacceptable reduction in pollutant removal efficiency at MTFR, occurring as a result of filter media breakthrough or occlusion.

Significant Digit

Any of the figures 0 through 9 that is used with its place value to denote a numerical quantity to some desired approximation, excepting all leading zeros and some trailing zeros in numbers not represented with a decimal point.

Suspended Sediment Concentration (SSC)

The concentration of sediments in a water column as defined by analytical testing in accordance with ASTM D3977. For the purposes of this laboratory testing protocol, SSC is considered as a surrogate for TSS.

Test Sediment

Material that is hard, firm, and inorganic with a specific gravity of 2.65, which is uniformly distributed and complies with the composition and particle size distribution criteria detailed in Table 1, Section 4.

Wet Volume (WV)

The maximum water volume in the MTD during a filtration run. It may increase as sediment loading on the filters increases.

3. Laboratory Testing Criteria

A. Laboratory Qualifications

All analytical methods used for TSS (measured as suspended sediment concentration (SSC)) samples collection and analyses required by the protocol (i.e., ASTM D4959, ASTM D3977, ASTM D6913, ASTM Method D7928, and USGS I3765-85) must be conducted by a laboratory certified by a NELAP or ISO/IEC 17025 (General Requirements for the Competence of Testing and Calibration Laboratories) recognized accreditation body to conduct the specific test method. If a laboratory is not specifically certified for ASTM D3977, they must demonstrate proficiency as described in Section 3 B. Filtration MTD testing can be performed by an independent or in-house NJCAT approved laboratory.

Information regarding laboratory testing qualifications can be found at: https://dep.nj.gov/stormwater/stormwater-manufactured-treatment-devices/mtd-guidance/ in the document entitled "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology: For use in accordance with the Stormwater Management Rules, N.J.A.C. 7:8," dated August 4, 2021.

B. Laboratory Proficiency

Prior to the start of testing, an analytical laboratory shall demonstrate proficiency in executing ASTM D3977 as follows:

1. In order to ensure analytical laboratories, not certified for ASTM D3977, are proficient in analyzing samples in accordance with ASTM D3977, spiked samples shall be analyzed by the laboratory prior to the start of testing.

2. Spiked SSC samples shall be prepared using the same test sediment prepared for SSC testing. Spiked SSC samples shall be prepared at two known concentrations of 20.0 +/- 5.0 mg/L and 50.0 +/- 5.0 mg/L. A minimum of three duplicate spiked samples shall be prepared and submitted for analysis at each of those two known concentrations.

3. SSC recovery results for spiked samples shall be within +/- 15% of the two known concentrations to be in compliance. The spiked sample recovery results for each of the two known concentrations shall be reported separately. An averaging of the results for each known concentration is allowed. However, an averaging of the results for all spiked samples across all known concentrations is not allowed.

4. Results of this proficiency testing must be included in the report submitted to NJCAT for verification.

C. Third-Party Observer (In-House Laboratory Testing)

Qualifications of the NJCAT approved third-party observer shall include:

- Minimum education requirements: B.E., B.S., or B.A. degree in an engineering-based or science-based curriculum.
- Professional experience: Performed tasks such as hydraulic testing, water quality monitoring and analytical measurements. Demonstrated knowledge and practice of experimental design and setup, sampling methods, handling sample security (i.e., chain of custody), task documentation and data management.
- Relevant experiences: The observer shall have experience in consulting or academia (reporting, general laboratory practices).

Specific tasks to be performed by the observer shall include:

i. Observe and document the preparation and collection of TSS removal and scour test sediment samples sent out for particle size distribution (PSD) analysis.

ii. Observe and document the collection of sediment concentration samples, i.e., background and scour, as suggested above. Ensure all samples meet the protocol minimum volume requirement of 500. mL.

iii. Document test setup, including a diagram and key dimensions, such as at a minimum, pipe sizes, slopes, and condition, hopper location and height, flow meter location, and sediment scour preloading depth and time.

iv. Observe/document influent sediment feed samples, lot numbers, initial and post run feed hopper sediment mass, sample collection and timing. Maintain control over sediment when not under observation, for example, by the use of security seals.

v. Verify times of sediment calibration samples, sediment feed start, feed stop, and flow start/stop and record these values in the log.

vi. Observe and document mass of sediment captured in the inlet pipe.

vii. Document/observe specifics of hydraulic testing (driving head).

viii. Check sample labeling, management, and security for transportation/shipping.

ix. Ensure calibration of testing devices, such as flow meters, scales, etc. have been performed to the manufacturer's requirement.

x. Review and confirm calculations, and adherence to the testing protocol.

xi. Maintain logbook and documentation of notes, measurements, etc., from items i through x.

D. Analysis of TSS Samples

Analysis of all Total Suspended Solids (TSS) samples shall be done in accordance with ASTM D3977 "Standard Test Methods for Determining Sediment Concentrations in Water Samples." TSS is defined as any particulate test sediment that is transported to the filtration MTD during flow conditions.

E. Temperature

The temperature of the water for all testing shall not exceed 80.0 degrees Fahrenheit.

F. Background TSS Levels

Background TSS is defined as the TSS present in the source water used for testing. The maximum allowable background concentration for each individual sample is 20.0 mg/L. The use of flocculants is not an acceptable means to reduce background TSS levels.

G. MTD Size and Availability

A full-scale commercially available filtration MTD shall be tested in the laboratory in the same configuration and with the same components as typically used in actual installations. (See Section 6 for information regarding the scaling of filtration MTDs.). A single full-scale commercially available cartridge or filtration module may be tested in the laboratory so long as the ratio of effective sedimentation treatment area (ESTA) to effective filtration treatment area (EFTA) is equal to or less than the ratio utilized in commercially available units, and the ratio of wet volume (WV) to effective filtration treatment area (EFTA) is also equal to or less than the ratio in commercially available units. The test configuration will determine the critical application parameters of the filtration MTD, which shall include the following:

1. Ratio of effective sedimentation treatment area to effective filtration treatment area.
2. The ratio of wet volume to effective filtration treatment area.
3. Flow rate per unit surface area of filtration media (gpm/ft^2) at the MTFR, which is defined as the highest flow rate that can be conveyed through the MTD while both achieving a performance claim based on the TSS removal efficiency testing procedures described in Section 4 of this protocol and allowing for sufficient operational longevity, i.e., sufficient sediment mass loading capacity so as not to cause an excessive maintenance frequency (< one year).
4. Flow rate (gpm) per cartridge or module at MTFR, for all tested cartridge types.
5. Driving head.

6. Depth of media.
7. Media description.

4. Total Suspended Solids Removal Efficiency and Sediment Mass Loading Capacity Testing

The objectives of laboratory testing of a filtration MTD are to establish a baseline for treatment performance (Removal Efficiency) and anticipated life cycle of the filtration MTD (Sediment Mass Loading Capacity). To ensure accurate results MTDs shall be tested in a new or restored condition, which includes maintaining the filtration MTD's sump, media, etc. to a level similar to the new condition. Removal Efficiency is based on the ability of the filtration MTD to reduce the influent TSS concentration. Removal Efficiency shall be established by effluent sampling as described below. The testing will be conducted at the MTFR (minimum of 10 test runs) until the maximum design driving head is reached. Then the influent flow rate shall be reduced to 90% of MTFR and testing shall resume until maximum design driving head is reached. Sediment removal efficiency for a filtration MTD must be > 80% on a cumulative mass basis after 10 test runs for the technology to be verified.

Sediment Mass Loading Capacity testing is conducted as a continuation of the TSS removal efficiency testing. It is used to determine the maximum mass of test sediment that can be captured by the filtration MTD as described in 4.H.12. Testing shall be conducted in accordance with the following requirements (A through H).

From the data collected from the controlled laboratory testing, the following graphs shall be produced to show the life cycle performance of the filtration MTD:

- Driving head vs. Sediment mass loading.
- Removal efficiency vs. Sediment mass loading.

A. Influent Flow Rate

The influent flow rate shall be at the MTFR during all test runs until the maximum design driving head is reached as a result of media occlusion. If the average flow rate tested is below the target MTFR, this average will become the MTFR for verification. Upon reaching the maximum design driving head, the influent flow rate shall be reduced to 90% of the MTFR. For filtration MTDs that do not operate under a design driving head, the influent flow rate shall remain at the MTFR. Note: The average flow rate is the average of the flow rates tested during removal efficiency testing.

B. Test Sediment

Test sediment particle size distribution (PSD) must be consistent with Column 2 in Table 1: Test Sediment Particle Size Distribution. PSD of the actual test (feed) sediment shall be determined using ASTM D6913 (Standard Test Methods for Particle -Size Distribution (Gradation) of Soils Using Sieve Analysis) and ASTM D7928 (Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis.) Three samples of the test sediment shall be obtained for PSD analysis and the results reported accordingly. A finer PSD than that of the specified PSD is acceptable but will likely lower the MTD performance. The average of the three samples shall be used to assess compliance with the target PSD.

Table 1: Test Sediment Particle Size Distribution[1]	
Particle Size (Microns)	**Target Minimum % Less Than[2]**
1,000	100
500	95
250	90
150	75
100	60
75	50
50	45
20	35
8	20
5	10
2	5

1. The material shall be hard, firm, and inorganic with a specific gravity of 2.65. The various particle sizes shall be uniformly distributed throughout the material prior to use.
2. A measured value may be lower than a target minimum % less than value by up to two percentage points, (e.g., at least 3% of the particles must be less than 2 microns in size [target is 5%]), provided the measured d_{50} value does not exceed 75 microns.

C. Background Sampling

a. Background TSS samples shall be obtained at a pre-determined location upstream from the introduction of the test sediment.

b. Background samples shall be taken in correspondence with the odd numbered effluent samples (first, third, fifth, etc.). Each sample shall be a minimum of 500. mL.

c. The time each sample is collected shall be recorded. The background data shall be used in adjusting the effluent samples for background concentration.

d. Each individual background concentration shall not exceed 20.0 mg/L.

D. Test Sediment Feed

The test sediment feed shall include a method to introduce the test sediment within the following parameters:

a. The test sediment feed rate and total mass of test sediment introduced during each test run shall be a precisely known quantity. The dry sediment feed location must be 3.0 feet or less upstream from the test unit. Inlet and outlet pipes must be of equal diameter with a minimum slope of 1%.

b. A test run comprises the time interval during which the addition of a known quantity of Test Sediment is added to the filtration MTD at a predetermined target concentration. The test run shall be a minimum of 30 minutes.

c. A minimum of ten (10) test runs at the MTFR shall be conducted at an influent TSS concentration of 200. mg/L. Additional test run(s) may be conducted to determine the sediment mass load capacity using an influent TSS concentration of 200. mg/L or 400. mg/L. (See 4.H.12 for when mass load

capacity testing is completed.)

d. The test sediment feed rate shall be introduced at a rate within 10% of the targeted value of 200. mg/L (180. – 220. mg/L) or 400. mg/L (360. – 440. mg/L) influent concentration.

e. Test sediment shall be injected using an auger, vibratory hopper or other suitable means of sediment addition that provides a consistent, calibrated concentration of solids. Three test sediment feed samples shall be collected from the injection point to include one sample at the start of dosing, one sample in the middle of the test run, and one sample just prior to the conclusion of the dosing. Each sample shall be collected in a clean container over an interval timed to the nearest second and shall be a minimum 0.10 liter or collection interval shall not exceed one minute, whichever comes first. In general, the sample collection time should be as short as possible. Samples shall be weighed to the nearest 0.1g and the concentration coefficient of variance (COV, defined by standard deviation divided by mean) shall not exceed 0.10. Note that the mass extracted for calibration samples should be subtracted from the total mass introduced to the system when calculating removal efficiency.

E. Flow Measurements

a. A flow meter or equivalent device must be located upstream of the MTD.

b. The flow meter must be installed directly in/on the inlet pipe at a location where fully developed flow is attained and placed a sufficient distance away from any velocity or turbulence increasing devices (valves, pumps, elbows, flanges, etc.) as required/dictated by the flow meter manufacturer. These requirements must be provided to NJCAT.

c. All flow meters used in this protocol must be calibrated as required by the instrument manufacturer. Copies of flow meter calibrations shall be included with the final report. The flow meter data logger must record flows at a minimum of once per minute and the average flow rate reported.

d. During all test runs, the allowable variation shall be ±10% for the targeted flow rate. The COV of the flow data shall be ≤ 0.03.

F. Head Measurements

Either a data logging depth gauge or standpipe shall be used during all test runs. If using a data logging depth gauge, the water level shall be recorded at a minimum frequency of at least once every minute for the entire run including startup and drain down of the MTD. If using a standpipe, the water level shall be recorded at a minimum of five minute intervals, as well as the start and end of each test run, and when samples are collected. The minimum tolerance of the depth gauge or standpipe shall be within +/- 0.125 inches.

G. Effluent Sampling Test Methods

Effluent samples shall be collected via grab or isokinetic sampling. Grab sampling is acceptable without flow rate limitations. Isokinetic sampling is limited to flows greater than 0.50 cfs. If grab sampling is used, 750 mL bottles or larger should be used to ensure collection of a 500. mL sample in a single sweeping motion.

H. Testing Procedure

1. After initiating and stabilizing the flow rate at the MTFR as well as the sediment feed, effluent sampling shall not begin until the filtration MTD has been in operation for a minimum of three detention times. For systems with no wet sump, as long as all influent is dosed to the target sediment concentration, the requirement of three detention times is eliminated.

2. The mass of sediment collected from the influent pipe is subtracted from the total mass of test sediment added during dosing to yield the Net mass. Average Influent Concentration is the Net mass divided by the volume of water that flowed through the filtration MTD during dosing, as follows:

$$\textbf{Average Influent Concentration} = \frac{\textbf{Net mass}}{\textbf{Total volume of water flowing through the MTD during addition of test sediment}}$$

   The volume of water that flows through the filtration MTD shall be calculated by multiplying the average flow rate by the time of sediment injection only.

3. If the test sediment feed is interrupted for measurement, the next effluent sample shall be collected following a minimum of three detention times.

4. The minimum sample size collected shall be 500. mL.

5. A minimum of five evenly spaced effluent samples shall be collected downstream of the filtration MTD during each test run. Any internally bypassed water shall be included in the sample.

6. For filtration MTDs that have backwash or post-operation drawdown flows, the effluent shall be volumetrically quantified and sampled. Two evenly volume-spaced samples shall be collected of the backwash or drawdown effluent to determine the TSS concentration and included in the removal efficiency calculations (see below in item 8).

7. All effluent samples shall be analyzed to determine TSS concentration in accordance with ASTM D3977 "Standard Test Methods for Determining Sediment Concentrations in Water Samples."

8. Individual run removal efficiency shall be calculated as follows:

$$Removal\ Efficiency\ (\%) = \frac{\left(\begin{array}{c}Average\ Influent\\ TSS\ Concentration\ X\\ Total\ Volume\\ of\ Test\ Water\end{array}\right) - \left(\begin{array}{c}Adjusted\ Effluent\\ TSS\ Concentration\ X\\ Total\ Volume\\ of\ Effluent\ Water\end{array}\right) - \left(\begin{array}{c}Average\\ Drawdown\ Flow\\ TSS\ Concentration\ X\\ Total\ Volume\\ of\ Drawdown\ Water\end{array}\right)}{\begin{array}{c}Average\ Influent\ TSS\ Concentration\ X\\ Total\ Volume\ of\ Test\ Water\end{array}} \times 100$$

   Note: Since some filters "ripen", increasing removal efficiency during the initial loading runs, the TSS removal efficiency requirement of >80% is to be calculated based on the first 10 qualifying runs on a cumulative mass basis.

9. *Sediment Mass Load Capacity Testing* is a continuation of TSS removal efficiency testing. The influent concentration may be increased to 400. mg/L to accelerate testing. However, once increased it cannot be decreased back to 200. mg/L.

10. The influent sediment concentration must be within 10% of 200. mg/L or 400. mg/L, depending

on the testing. The 10% requirement is calculated on a per test run basis. This could result in a test run(s) being disqualified from removal efficiency testing, but the sediment introduced should still be calculated into the overall sediment mass load capacity.

11. During sediment mass load capacity testing, a continuous test run can be employed. However, the test sediment feed rate should be measured in accordance with the procedures in Section 4.D a minimum of every hour to ensure compliance with the influent sediment concentration. The one (1) hour time interval between test sediment feed rate sampling shall begin upon conclusion of the three (3) times detention period. The coefficient of variation (COV) for test sediment feed samples shall not exceed 0.10 and the flow rate needs to be ±10% of the MTFR with a COV of ≤ 0.03.

12. Sediment mass load capacity testing is considered complete when 90% of the MTFR is reached, or when the MTD exceeds its maximum design driving head at 90% MTFR, or when an unacceptable reduction in pollutant removal efficiency at MTFR occurs, as demonstrated by the TSS removal efficiency (on a cumulative mass basis) dropping below 80%. The mass loading capacity is determined by the mass captured in the runs prior to the run where the TSS removal efficiency drops below 80%. However, for some filtration systems, these criteria for ending testing are not achieved following extensive sediment loading on the filter system. The testing can be terminated when the manufacturer feels that the system has demonstrated sufficient capacity to ensure that the filter system installation will not require overly frequent maintenance.

5. Scour Testing for On-line Approval

In the event that a manufacturer would like to pursue verification for an on-line system, a scour test is required to ensure that previously captured sediment will not be released or discharged.

A. Scour Testing Procedure

Filtration Cartridges

The scour test shall be performed utilizing a full-scale, commercially available filtration MTD. Alternatively, as indicated in Section 3.G, a single full-scale commercially available cartridge or filtration module may be tested in the laboratory so long as the ratio of effective sedimentation treatment area (ESTA) to effective filtration treatment area (EFTA) is equal to or less than the ratio utilized in commercially available units, and the ratio of wet volume (WV) to effective filtration treatment area (EFTA) is also equal to or less than the ratio in commercially available units. The pre-load shall be consistent with the particle size distribution (PSD) described in Table 1.

The use of either virgin or mature (loaded during prior removal efficiency/loading capacity testing) filter cartridges is allowable when conducting scour testing. Should a mature filter(s) be used, the preload mass may be quantified or estimated; however, the mass cannot be included in the 50% sediment preload mass required for scour testing.

The sedimentation chamber(s) shall be preloaded to 50% of the manufacturer's recommended maximum sediment storage volume. Sediment distribution in the filtration system chambers following TSS removal efficiency and capacity loading testing may be quantified by mass and the mass distribution used as a basis for scour testing. These mass distribution results shall be documented in the performance test report. Sediment distribution measurements are optional; however, they may be helpful in planning scour testing. The preload volume of sediment may be distributed among the filtration system's different chambers in proportion to available sediment storage volumes and in accordance with maintenance recommendations **or** may be distributed in proportion to the sediment deposition measurements made following performance testing.

If applicable, a false floor may be installed in the sedimentation chamber of the filtration MTD at a level below the 50% maximum sediment storage volume and then covered with sufficient test sediment to achieve 50% of the maximum sediment storage volume. In doing so, the level of the false floor shall be at least four inches below the 50% maximum sediment storage volume. Following preloading of sediment and prior to commencing the scour test, the test sediment layer shall be leveled. Commencement of the scour test shall start within 96 hours of pre-loading the filtration MTD. When applicable, the filtration MTD shall be filled with clear water to its normal, dry weather operating depth. Clear water is defined as water with a background TSS concentration of less than 20.0 mg/L.

Following preloading and the addition of clear water, the scour test shall commence by conveying clear water through the MTD at increasing flow rates. The flow rate shall be increased to the target flow rate within three minutes of commencement of the test. The flow rate shall then remain constant at the target flow rate for the remainder of the test duration. The flow rate shall be recorded continuously so that the effluent samples can be compared to corresponding flow rate values. Fifteen (15) effluent samples are to be taken at times of 1, 3 and 5 minutes after the commencement of conveying clear water through the MTD, and then every two minutes thereafter for an additional 12 samples (i.e., 7. 9, 11…29 minutes). All 15 samples are to be used to determine average effluent concentration.

A minimum of eight background samples of the clear water shall be collected at evenly spaced intervals throughout the duration of the scour test. All samples (background and effluent) shall be analyzed for TSS in accordance with ASTM D3977 "Standard Test Methods for Determining Sediment Concentrations in Water Samples." The maximum allowable background concentration in the clear water shall not exceed 20.0 mg/L.

Horizontal Bed Filters

Three testing protocol options are outlined below. All options require that the protocol requirements for filtration cartridge testing be followed, e.g., number of background and effluent samples, sampling frequency, test duration be met.

- Load the bed surface with 50% of the maximum sediment loading used to determine the maximum sediment loading capacity (**not** 50% of the sediment captured in the bed). This sediment can be added to the bed in up to five equal increments, uniformly distributed across the bed surface. Clean water, at the MTFR, should then be passed through the sediment loaded bed for up to 30 minutes following each sediment loading, to condition the system. Once the targeted amount of sediment has been loaded on the bed, wait 12-24 hours before conducting the scour test.

- Load the bed by flowing a 400. mg/L influent concentration sediment at the MTFR for a duration (bed loading need not be completed in a continuous run) that would equate to achieving 50% of the maximum sediment loading used to determine the maximum sediment loading capacity (**not** 50% of the sediment captured in the bed). In this option, no effluent sediment concentrations would be required to be measured. However, the total sediment added would be required to be determined from the mass injected from the sediment feeder. Also, the sediment injection rate (calibration samples) would be required to be measured once every 30-minutes to ensure consistency of feed rate (COV $\leq$0.10). The sediment loading could be continuous from the start of loading to the conclusion or could be done in segments. Once the targeted amount of sediment has been loaded on the bed, wait 12-24 hours before conducting the scour test.

- Scour testing can be conducted on a horizontal bed filter immediately following mass sediment loading capacity testing on the fully loaded filter (100% sediment mass loading capacity). The loading capacity test is complete as soon as the system exceeds the driving head or when the removal efficiency performance on a cumulative mass basis drops below 80% and the filter shall not be run at all between

the completion of the loading test and commencement of the scour test. The scour testing can only be conducted once, even though the sediment remaining on the filter is >50% sediment capture.

B. Sampling Procedures

Effluent samples shall be collected via grab or isokinetic sampling as described in Section 4.G and be a minimum of 500. mL.

C. Scour Testing Results

All effluent sample results from a scour test shall be adjusted for background concentration [adjusted effluent concentration = recorded effluent concentration– background concentration]. All background sample results shall be graphed with respect to time of collection so that the proper background TSS concentration at the time of effluent sample collection can be used for determining the adjusted effluent concentration. All adjusted effluent concentrations from a scour test shall be included in the calculation of the average effluent TSS concentration. As stated above, there shall be a minimum of 15 effluent sample results used to determine the average effluent TSS concentration.

If the average effluent TSS concentration measured during scour testing is no more than 20.0 mg/L, the MTD qualifies for on-line installation as long as the maximum conveyance rate of the drainage system does not exceed the maximum conveyance flow rate used for scour testing. However, if the average effluent TSS concentration is greater than 20.0 mg/L or the conveyance flow rate of the drainage system exceeds the tested flow rate, the MTD does not qualify for on-line installation and shall be installed off-line.

6. Scaling of Filtration MTDs

The TSS removal rate determined for the tested full scale, commercially available filtration MTD, or single full-scale commercially available cartridge or filtration module, may be applied to other model sizes of that filtration MTD provided that appropriate scaling principles are applied. Scaling the tested filtration MTD or single full-scale commercially available cartridge or filtration module, to determine other model sizes and performance without completing additional testing is acceptable provided that:

a. Depth of media, composition of media, and gradation of media remain constant.

b. The ratio of the MTFR to effective filtration treatment area (filter surface area) is the same or less than the tested filtration MTD; and

c. The ratio of effective sedimentation treatment area to effective filtration treatment area is the same or greater than the tested filtration MTD; and

d. The ratio of wet volume to effective filtration treatment area is the same or greater than the tested filtration MTD.

7. Units of Measure

All dimensions shall be consistent with standard units utilized in stormwater management design.

- **Area**: square feet
- **Concentration**: milligrams/liter

- **Flow Rate**: cubic feet per second, gallons per minute
- **Hydraulic Loading Rate**: gallons per minute per square foot of filter surface area
- **Length/Distance**: inches, feet
- **Velocity**: feet per second
- **Volume**: cubic feet, milliliter, liter, gallons

Appendix - Requirements for Filtration MTDs

A. TSS Removal Efficiency

TSS removal efficiency is based on the ability of the filtration MTD to reduce the influent TSS concentration before filter cartridge, module or bed replacement. Hence, the filtration MTD TSS removal efficiency will be the cumulative mass removal efficiency at the conclusion of the removal efficiency test runs.

B. Maximum Allowable Inflow Drainage Area

The maximum impervious inflow drainage area per filter cartridge, module or bed shall be computed by the below equation. This equation is based upon the requirement that the minimum interval between required filter maintenance shall be one year. For information on the Verification requirements for Maintenance and details on the submittal process refer to the "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology: For use in accordance with the Stormwater Management Rules, N.J.A.C. 7:8," which is available at https://dep.nj.gov/stormwater/stormwater-manufactured-treatment-devices/mtd-guidance/.

Maximum Inflow Drainage Area (acres)

$$= \frac{\text{Mass Captured Before} < 80\% \text{ Removal Eff. (lbs)}}{\text{600 lbs per Acre of Drainage Area Annually}}$$

or

$$= \frac{\text{Mass Captured Before 10\% MTFR Loss (lbs)}}{\text{600 lbs per Acre of Drainage Area Annually}}$$